

**Good Counsel Meadows
Mankato, MN**

HYDRAULIC DESIGN SUMMARY REPORT

For

Southwest Minnesota Housing Partnership

August 2025

Prepared by:
Widseth Consulting Engineers, Rochester, Minnesota

Project # 2025-10591

I hereby certify that this plan, specification or report 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.


Andre T. Ringle

08/27/2025
Lic. No. 60708

Table of Contents

Section

- 1.0 Project Summary and Proposed Site Improvements**
- 2.0 Water Quality Volume**
- 3.0 PRE-Improvement, & POST-Improvement Discharge Rates**
- 4.0 Risk Assessment**

Appendix

- 1 NOAA Atlas 14 Precipitation Frequency Table**
- 2 Hydrologic Soils Group Map**
- 3 Pre-Development Drainage Map & Hydraulic Model
for the 2-year, 10-year, & 100-year storm events**
- 4 Post-Development Drainage Map & Hydraulic Model
for the 2-year, 10-year, & 100-year storm events**

DRAINAGE REPORT

Project Name:

Good Counsel Meadows – Mankato, MN

Widseth Project #

2025-10591

SECTION 1.0 – Project Summary and Proposed Site Improvements

We have completed our analysis and design recommendation for the stormwater management system associated with the above referenced project. This design was guided by the MPCA NPDES permit and MnDOT.

Hydrologic & Hydraulic Modeling

The HydroCAD™ Ver. 10.0 modeling software was utilized to develop the hydrologic contributions serving the proposed project site. This software is adept at modeling urban drainage settings and can provide storage routing calculations under dynamic outlet conditions.

In accordance with MnDOT Technical Memorandum No. 13_08_B_04, NOAA Atlas 14 precipitation frequency data was utilized. Basin characteristics developed using the survey, along with NOAA Atlas 14 rainfall data, peak flows were generated utilizing SCS procedures. Where storage routing calculations were completed, SCS Unit Hydrograph procedures were utilized. See Appendix 1 for NOAA Atlas 14 precipitation frequency table.

PRE-Improvement Condition

The existing site consists of a grassed meadow east of the existing road, 4th St North.

The existing soils on the project site are classified as HSG C according to web soil survey. Soils in the forested drainage area uphill of the pond are classified as HSG B. See Appendix 2 for Soils Map.

POST-Improvement Condition

Proposed site improvements include the construction of eight single-family houses with an alley running behind the houses and three single family houses on the north side of the property that will have direct access onto 4th St N.

The stormwater runoff from the site will flow to a proposed stormwater pond in the SE corner of the property and outflow through storm sewer to the storm sewer in 4th St N. The stormwater from the three houses to the north will continue to flow into 4th St and not into the proposed stormwater pond. The water quality volume in the proposed stormwater pond accounts for the three houses on the north side of the property.

SECTION 2.0 – Water Quality Volume

Impervious Area:

Proposed impervious surface:	1.09	acres
Existing impervious surface:	0.00	acres
New impervious surface:	1.09	acres

Water Quality Volume:

Proposed Water Quality Volume – Live Storage @ 857.50:	0.26	acre-feet
Required Water Quality Volume:	0.09	acres-feet
Excess Water Quality Volume:	0.17	acres-feet

The impervious area for the three single-family homes to the north is included in the calculation for required water quality volume despite not being routed to the proposed stormwater pond.

SECTION 3.0 – PRE & POST-Improvement Discharge Rates:

Discharge Rates:

See Tables 1 & 2 for the PRE-Improvement & POST-Improvement Conditions for discharge rates for the 2, 10, and 100-year storm events.

Table 1 – PRE-Improvement Discharge Rates

Area	HydroCAD Node	2-Year Storm (cfs)	10-Year Storm (cfs)	100-Year Storm (cfs)
4 th Street Surface	1R	0.78	13.84	34.27
4 th Street Storm Sewer	2R	0.00	0.00	0.00
Total	Total	0.78	13.84	34.27

Table 2 – POST-Improvement Discharge Rates

Area	HydroCAD Node	2-Year Storm (cfs)	10-Year Storm (cfs)	100-Year Storm (cfs)
4 th Street Surface	1R	0.00	0.00	0.00
4 th Street Storm Sewer	2R	0.22	3.88	9.89
Total	Total	0.22	3.88	9.89

SECTION 5.0 – Risk Assessment

The lowest proposed first floor elevation of the houses is 861.70. The 100-year HWL in the proposed stormwater pond is 859.34, which is over two feet below the lowest FFE. Additionally, there is an overflow for the pond with the controlling elevation set at 860.40. The modeling suggests there to be minimal risk of flooding even in extreme events.

Minor Adjustments

Minor adjustments in placement of structures and conveyance piping orientation will not invalidate this design/analysis. A variety of design and performance data can be found in the attached summary results information. Additional calculations and results will be stored in the project design file. Any exceptions to system contribution, sizing, invert elevations or locations should be revisited before final plans, specifications, & engineering.

Appendix

- 1 NOAA Atlas 14 Precipitation Frequency Table
- 2 Hydrologic Soils Group Map
- 3 Pre-Development Drainage Map & Hydrology Calculations for the 2, 10, & 100-year storm events (HydroCAD)
- 4 Post-Development Drainage Map & Hydrology Calculations for the 2, 10, & 100-year storm events (HydroCAD)

APPENDIX 1

NOAA Atlas 14 Precipitation Frequency Table



NOAA Atlas 14, Volume 8, Version 2
Location name: Mankato, Minnesota, USA*
Latitude: 44.1661°, Longitude: -94.0054°
Elevation: 778 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.376 (0.297-0.489)	0.448 (0.353-0.582)	0.569 (0.447-0.741)	0.673 (0.525-0.879)	0.821 (0.619-1.10)	0.938 (0.690-1.27)	1.06 (0.751-1.45)	1.18 (0.805-1.66)	1.36 (0.884-1.93)	1.49 (0.944-2.14)
10-min	0.551 (0.434-0.715)	0.656 (0.517-0.853)	0.833 (0.655-1.08)	0.985 (0.769-1.29)	1.20 (0.907-1.61)	1.37 (1.01-1.86)	1.55 (1.10-2.13)	1.74 (1.18-2.43)	1.99 (1.30-2.83)	2.18 (1.38-3.14)
15-min	0.671 (0.530-0.873)	0.800 (0.631-1.04)	1.02 (0.798-1.32)	1.20 (0.938-1.57)	1.46 (1.11-1.96)	1.68 (1.23-2.26)	1.89 (1.34-2.60)	2.12 (1.44-2.96)	2.42 (1.58-3.45)	2.66 (1.69-3.82)
30-min	0.909 (0.718-1.18)	1.09 (0.857-1.41)	1.39 (1.09-1.81)	1.64 (1.28-2.15)	2.01 (1.52-2.69)	2.30 (1.69-3.11)	2.60 (1.84-3.57)	2.91 (1.98-4.07)	3.34 (2.18-4.76)	3.67 (2.32-5.27)
60-min	1.18 (0.928-1.53)	1.40 (1.10-1.81)	1.78 (1.39-2.31)	2.11 (1.65-2.76)	2.60 (1.97-3.51)	3.01 (2.22-4.08)	3.44 (2.44-4.74)	3.89 (2.64-5.45)	4.52 (2.95-6.46)	5.02 (3.18-7.21)
2-hr	1.44 (1.15-1.84)	1.70 (1.36-2.18)	2.16 (1.72-2.78)	2.58 (2.04-3.32)	3.20 (2.46-4.27)	3.72 (2.78-4.99)	4.27 (3.08-5.83)	4.86 (3.35-6.76)	5.70 (3.76-8.07)	6.38 (4.08-9.06)
3-hr	1.62 (1.30-2.05)	1.90 (1.53-2.41)	2.41 (1.93-3.06)	2.88 (2.29-3.67)	3.59 (2.79-4.77)	4.20 (3.17-5.61)	4.85 (3.52-6.59)	5.56 (3.86-7.69)	6.58 (4.38-9.26)	7.40 (4.76-10.4)
6-hr	1.90 (1.55-2.38)	2.23 (1.82-2.79)	2.83 (2.30-3.55)	3.39 (2.74-4.26)	4.26 (3.35-5.59)	5.00 (3.82-6.59)	5.80 (4.27-7.79)	6.68 (4.70-9.14)	7.94 (5.35-11.1)	8.98 (5.84-12.5)
12-hr	2.17 (1.79-2.66)	2.55 (2.10-3.14)	3.24 (2.67-4.00)	3.88 (3.18-4.81)	4.87 (3.88-6.29)	5.70 (4.41-7.41)	6.60 (4.92-8.74)	7.59 (5.39-10.2)	9.00 (6.12-12.4)	10.1 (6.68-14.0)
24-hr	2.47 (2.07-2.99)	2.87 (2.40-3.48)	3.60 (3.00-4.37)	4.28 (3.55-5.22)	5.33 (4.31-6.79)	6.22 (4.88-7.98)	7.19 (5.42-9.40)	8.25 (5.94-11.0)	9.77 (6.72-13.3)	11.0 (7.32-15.1)
2-day	2.87 (2.44-3.42)	3.24 (2.75-3.86)	3.94 (3.33-4.70)	4.61 (3.87-5.53)	5.67 (4.65-7.14)	6.59 (5.24-8.35)	7.61 (5.82-9.83)	8.73 (6.37-11.5)	10.4 (7.23-14.0)	11.7 (7.88-15.8)
3-day	3.14 (2.69-3.70)	3.52 (3.01-4.15)	4.23 (3.61-5.01)	4.91 (4.16-5.84)	5.99 (4.95-7.46)	6.92 (5.54-8.68)	7.94 (6.11-10.2)	9.07 (6.66-11.9)	10.7 (7.52-14.4)	12.1 (8.17-16.2)
4-day	3.35 (2.89-3.93)	3.75 (3.23-4.40)	4.50 (3.86-5.29)	5.20 (4.43-6.14)	6.29 (5.22-7.76)	7.22 (5.81-8.99)	8.24 (6.37-10.5)	9.36 (6.90-12.2)	11.0 (7.74-14.6)	12.3 (8.38-16.5)
7-day	3.88 (3.38-4.49)	4.35 (3.78-5.03)	5.18 (4.49-6.01)	5.93 (5.11-6.91)	7.06 (5.90-8.56)	8.00 (6.49-9.80)	9.01 (7.02-11.3)	10.1 (7.50-13.0)	11.6 (8.26-15.3)	12.9 (8.84-17.1)
10-day	4.39 (3.86-5.04)	4.92 (4.31-5.64)	5.82 (5.08-6.69)	6.61 (5.74-7.64)	7.77 (6.52-9.30)	8.72 (7.11-10.6)	9.72 (7.62-12.0)	10.8 (8.05-13.7)	12.3 (8.74-16.0)	13.4 (9.27-17.7)
20-day	6.03 (5.37-6.80)	6.70 (5.96-7.56)	7.80 (6.90-8.82)	8.72 (7.67-9.90)	9.99 (8.46-11.7)	11.0 (9.06-13.0)	12.0 (9.49-14.6)	13.0 (9.81-16.2)	14.4 (10.4-18.4)	15.4 (10.8-20.1)
30-day	7.45 (6.69-8.31)	8.26 (7.40-9.22)	9.56 (8.54-10.7)	10.6 (9.42-11.9)	12.0 (10.3-13.9)	13.1 (10.9-15.4)	14.2 (11.3-17.0)	15.2 (11.5-18.8)	16.6 (12.0-21.0)	17.5 (12.4-22.7)
45-day	9.24 (8.37-10.2)	10.3 (9.29-11.4)	11.9 (10.7-13.2)	13.2 (11.8-14.7)	14.9 (12.7-16.9)	16.1 (13.4-18.6)	17.2 (13.8-20.5)	18.3 (14.0-22.4)	19.7 (14.4-24.8)	20.7 (14.6-26.6)
60-day	10.8 (9.80-11.8)	12.0 (10.9-13.2)	13.9 (12.6-15.3)	15.4 (13.9-17.1)	17.4 (14.9-19.6)	18.8 (15.7-21.5)	20.0 (16.1-23.6)	21.2 (16.3-25.7)	22.7 (16.6-28.3)	23.6 (16.8-30.2)

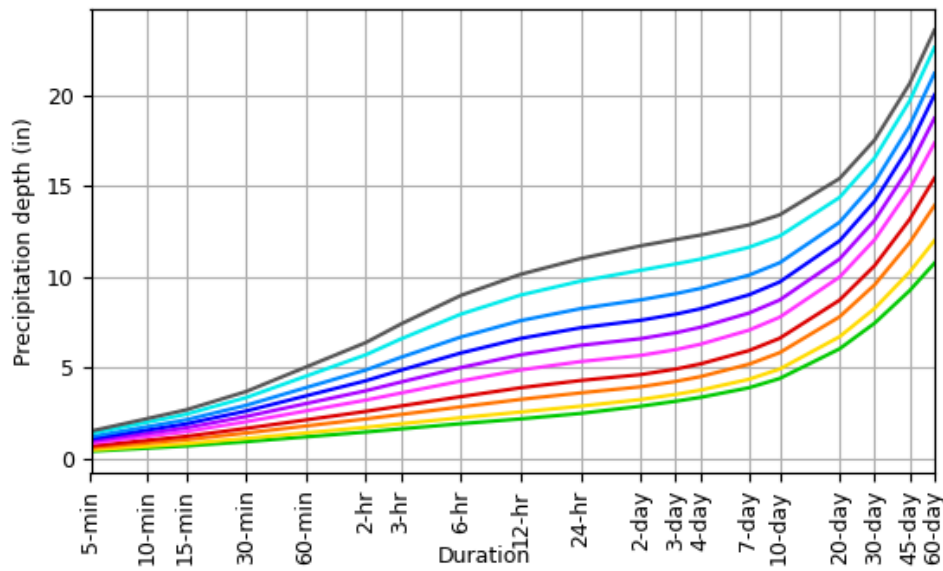
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

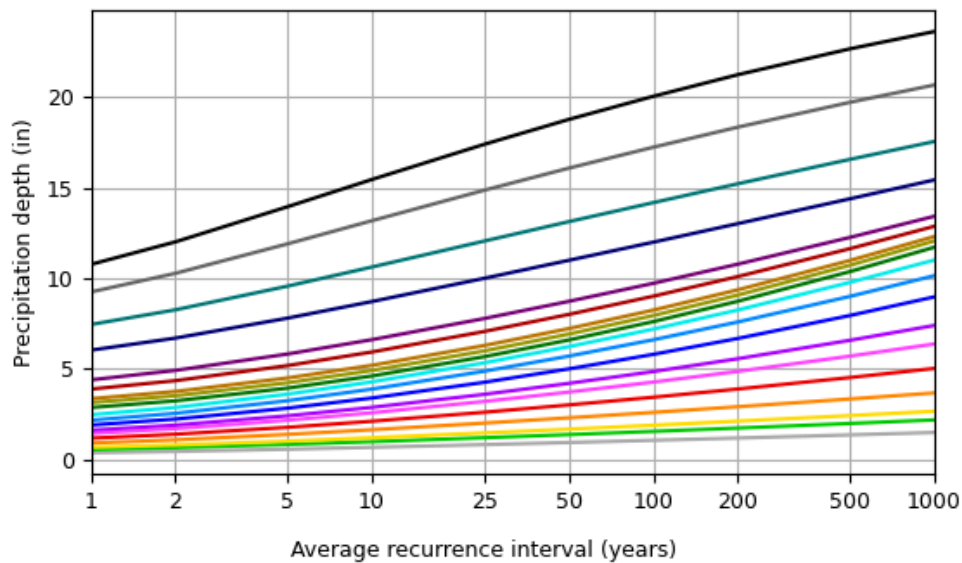
PF graphical

PDS-based depth-duration-frequency (DDF) curves

Latitude: 44.1661°, Longitude: -94.0054°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000

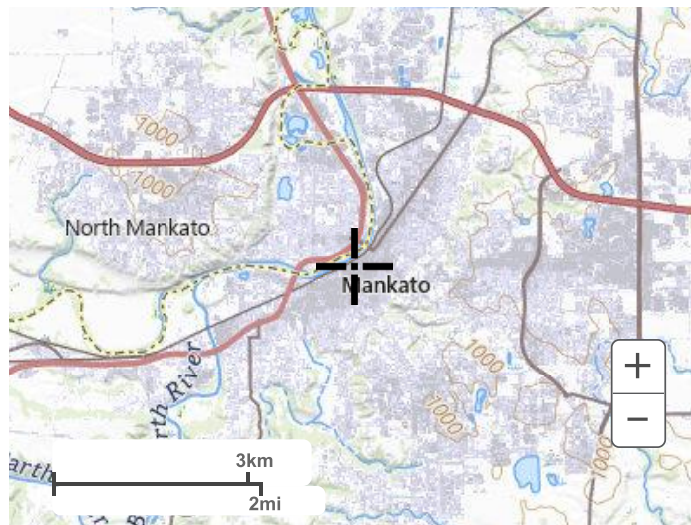


Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

[Back to Top](#)

Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



[Back to Top](#)

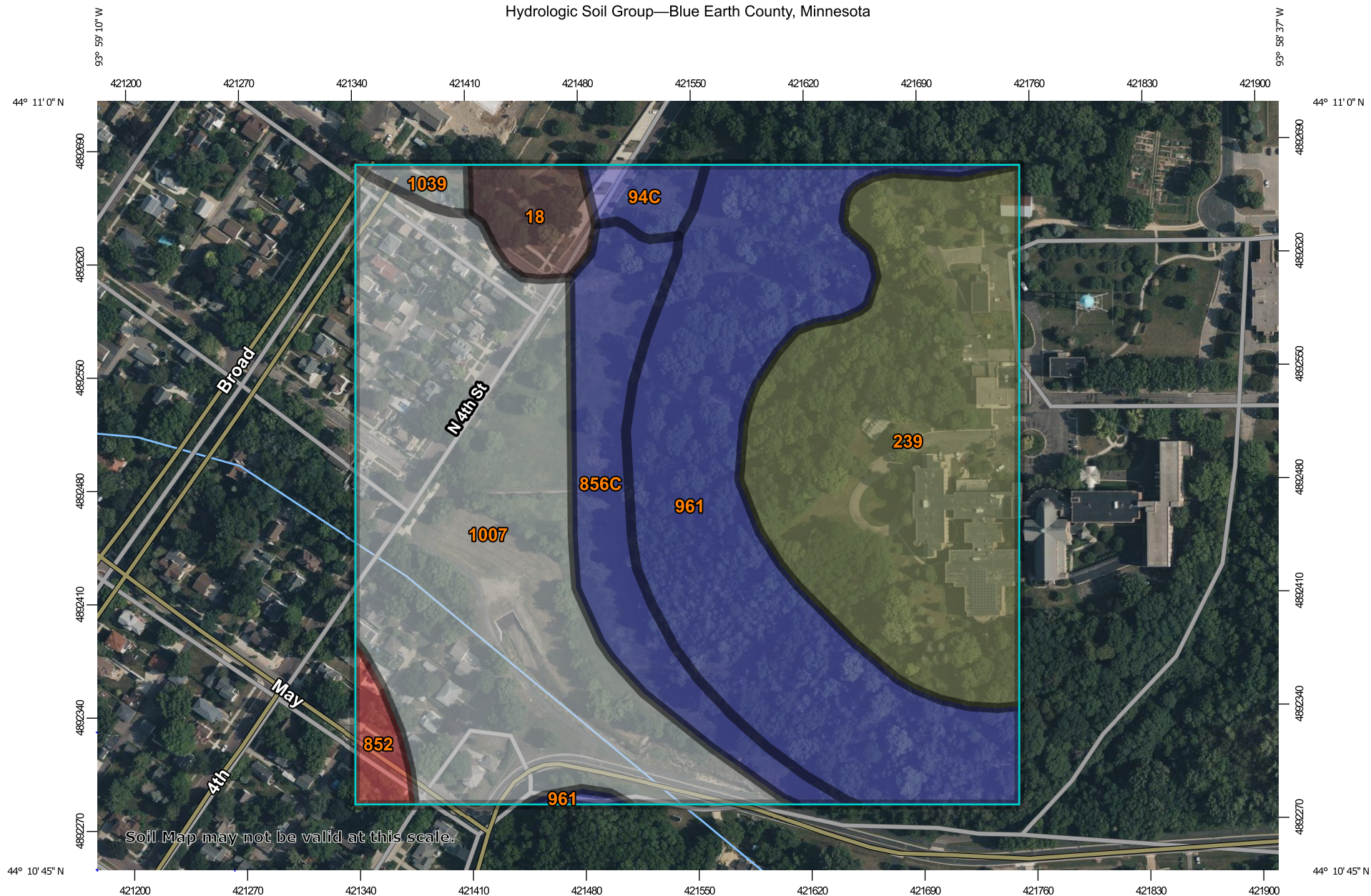
[US Department of Commerce](#)
[National Oceanic and Atmospheric Administration](#)
[National Weather Service](#)
[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

[Disclaimer](#)

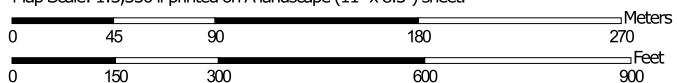
APPENDIX 2

Hydrologic Soils Group Map

Hydrologic Soil Group—Blue Earth County, Minnesota



Map Scale: 1:3,350 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

8/26/2025
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Blue Earth County, Minnesota
 Survey Area Data: Version 22, Sep 7, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 2, 2023—Aug 8, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
18	Comfrey clay loam	B/D	1.1	2.8%
94C	Terril loam, 6 to 15 percent slopes	B	0.7	1.7%
239	Le Sueur loam, 1 to 3 percent slopes	C/D	10.5	26.0%
852	Copaston-Urban land complex, 1 to 4 percent slopes	D	0.6	1.5%
856C	Terril-Urban land complex, 6 to 15 percent slopes	B	3.6	9.0%
961	Storden complex, very steep	B	10.4	25.9%
1007	Alluvial-Urban land complex		13.0	32.3%
1039	Urban land, 0 to 2 percent slopes		0.3	0.8%
Totals for Area of Interest			40.4	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

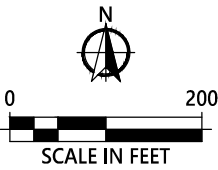
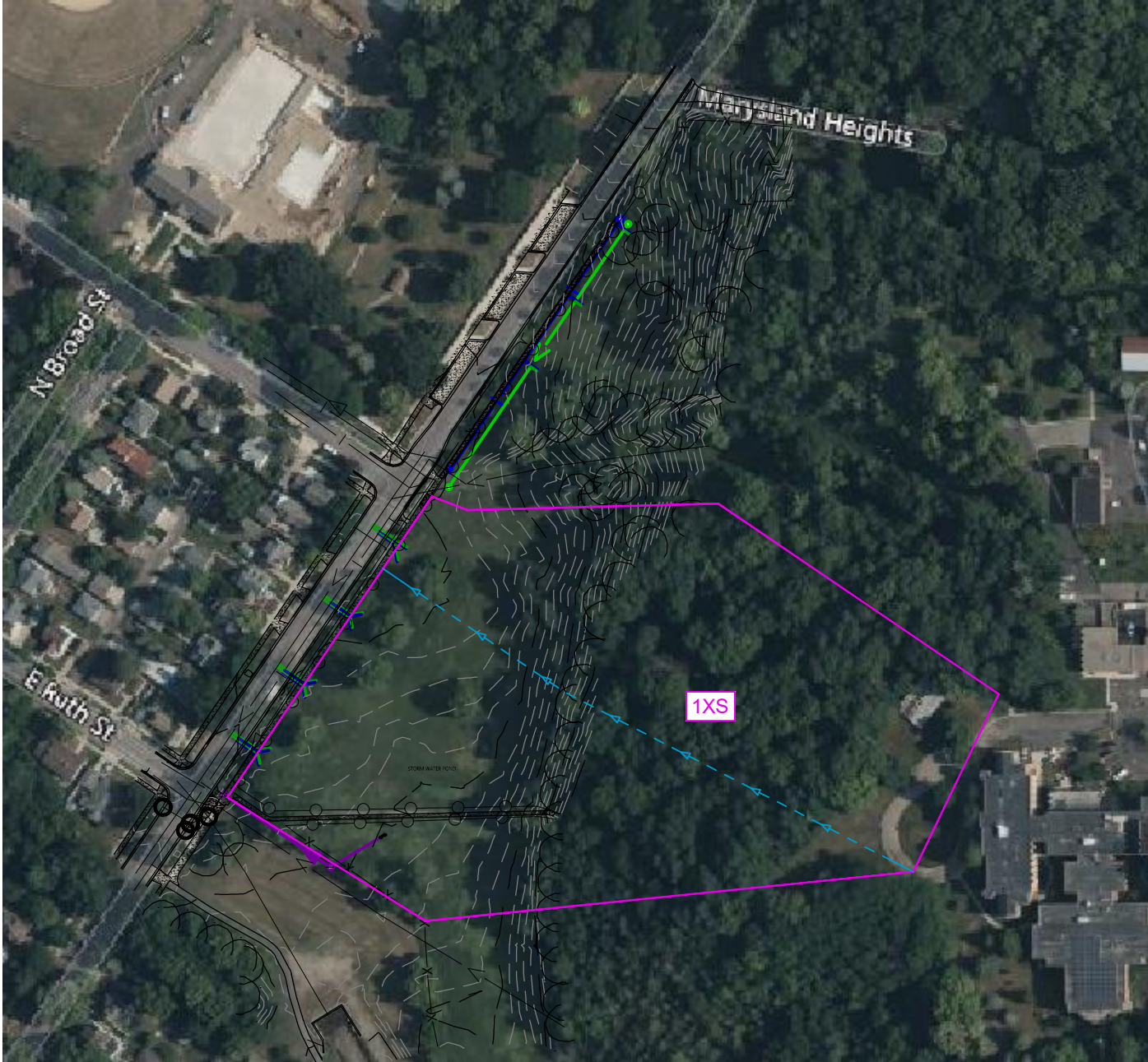
Tie-break Rule: Higher

APPENDIX 3

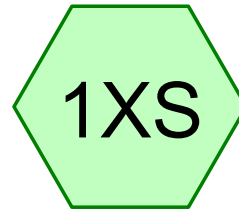
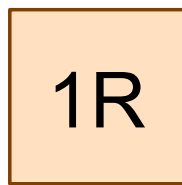
Pre-Development Drainage Area Map And HydroCAD Report

PRE-DEVELOPMENT DRAINAGE MAP

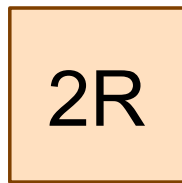
EXISTING SUBCATCHMENT BOUNDARY	
EXISTING FLOW PATH	
EXISTING IMPERVIOUS AREA	



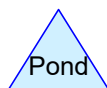
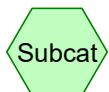
DRAWN BY: ATR CHECKED BY: ATR	I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ##### UNDER THE LAWS OF THE STATE OF MINNESOTA. ##### LIC. NO.: ##### DATE: #####	DATE	REV#	REVISIONS DESCRIPTION



4th Ave N Surface



4th Ave N Storm Sewer



Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Printed 8/26/2025

Page 2

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	Type II 24-hr		Default	24.00	1	1.70	2
2	10-YR	Type II 24-hr		Default	24.00	1	4.28	2
3	100-YR	Type II 24-hr		Default	24.00	1	7.19	2

Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Printed 8/26/2025

Page 3

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.560	74	>75% Grass cover, Good, HSG C (1XS)
4.866	70	Woods, Good, HSG C (1XS)
8.426	72	TOTAL AREA

Pre-Development

Prepared by Widseth Smith Nolting

Printed 8/26/2025

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Page 4

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
8.426	HSG C	1XS
0.000	HSG D	
0.000	Other	
8.426		TOTAL AREA

Pre-Development

Prepared by Widseth Smith Nolting

Printed 8/26/2025

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Page 5

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	3.560	0.000	0.000	3.560	>75% Grass cover, Good	1XS
0.000	0.000	4.866	0.000	0.000	4.866	Woods, Good	1XS
0.000	0.000	8.426	0.000	0.000	8.426	TOTAL AREA	

Pre-Development

Type II 24-hr 2-YR Rainfall=1.70"

Prepared by Widseth Smith Nolting

Printed 8/26/2025

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Page 6

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

Subcatchment1XS:

Runoff Area=367,036 sf 0.00% Impervious Runoff Depth>0.15"
Flow Length=775' Slope=0.1400 '/' Tc=23.1 min CN=72 Runoff=0.78 cfs 0.103 af

Reach 1R: 4th Ave N Surface

Inflow=0.78 cfs 0.103 af
Outflow=0.78 cfs 0.103 af

Reach 2R: 4th Ave N Storm Sewer

Total Runoff Area = 8.426 ac Runoff Volume = 0.103 af Average Runoff Depth = 0.15"
100.00% Pervious = 8.426 ac 0.00% Impervious = 0.000 ac

Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/26/2025

Page 7

Summary for Subcatchment 1XS:

Runoff = 0.78 cfs @ 12.25 hrs, Volume= 0.103 af, Depth> 0.15"
Routed to Reach 1R : 4th Ave N Surface

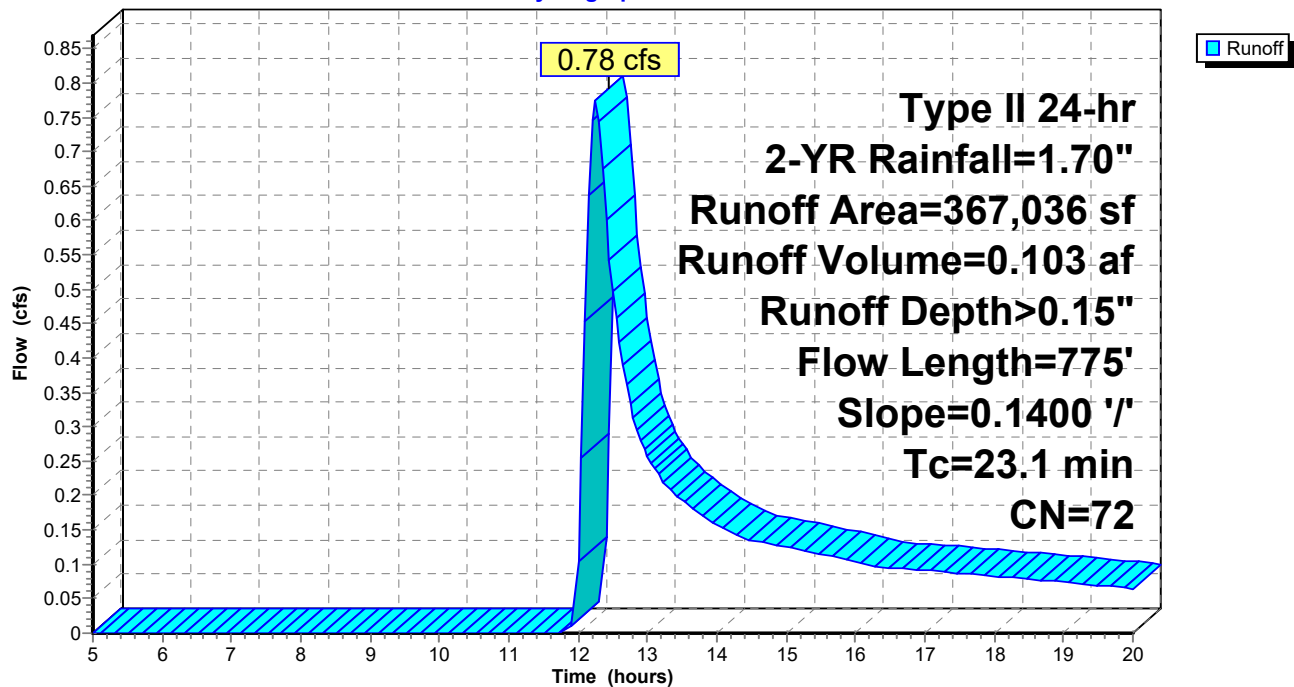
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=1.70"

Area (sf)	CN	Description
155,068	74	>75% Grass cover, Good, HSG C
211,968	70	Woods, Good, HSG C
367,036	72	Weighted Average
367,036		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.1	775	0.1400	0.56		Kerby Method, Deciduous forest N= 0.60

Subcatchment 1XS:

Hydrograph



Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/26/2025

Page 8

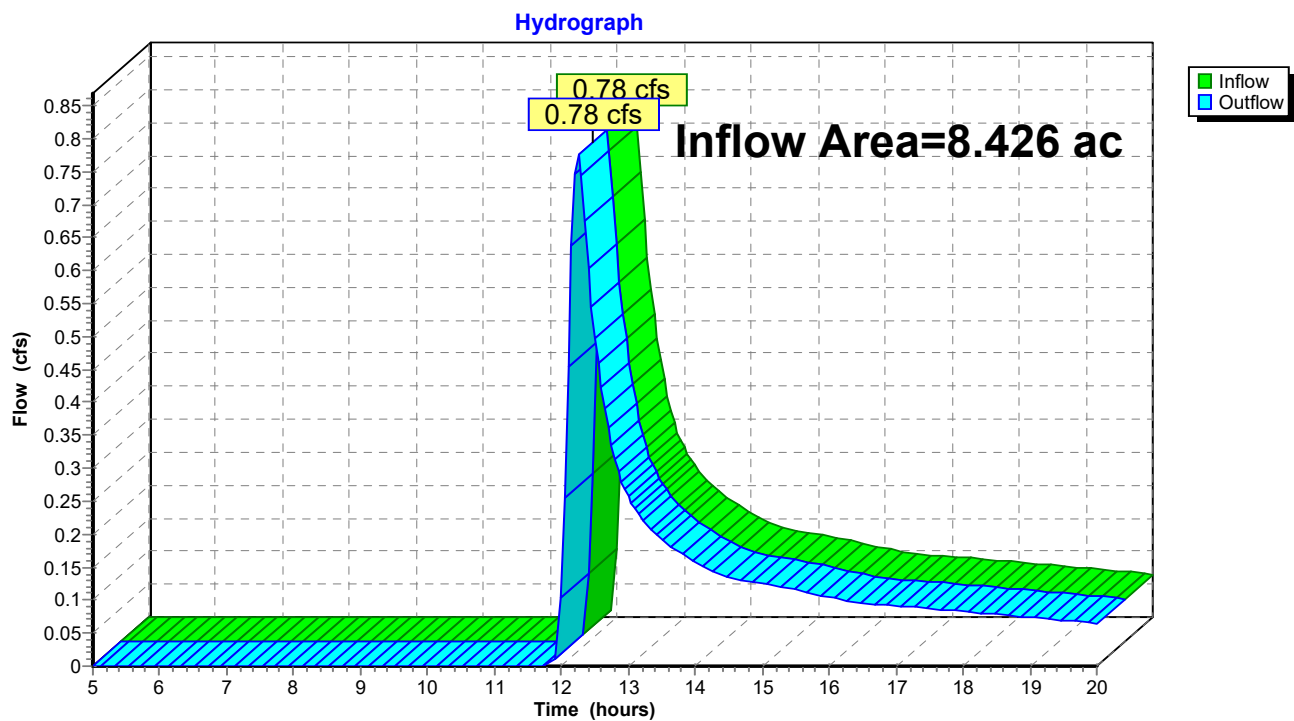
Summary for Reach 1R: 4th Ave N Surface

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.426 ac, 0.00% Impervious, Inflow Depth > 0.15" for 2-YR event
Inflow = 0.78 cfs @ 12.25 hrs, Volume= 0.103 af
Outflow = 0.78 cfs @ 12.25 hrs, Volume= 0.103 af, Atten= 0%, Lag= 0.0 min

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

Reach 1R: 4th Ave N Surface



Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/26/2025

Page 9

Summary for Reach 2R: 4th Ave N Storm Sewer

[40] Hint: Not Described (Outflow=Inflow)

Pre-Development

Prepared by Widsseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/26/2025

Page 10

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

Subcatchment1XS:

Runoff Area=367,036 sf 0.00% Impervious Runoff Depth>1.50"

Flow Length=775' Slope=0.1400 '/' Tc=23.1 min CN=72 Runoff=13.84 cfs 1.053 af

Reach 1R: 4th Ave N Surface

Inflow=13.84 cfs 1.053 af

Outflow=13.84 cfs 1.053 af

Reach 2R: 4th Ave N Storm Sewer

Total Runoff Area = 8.426 ac Runoff Volume = 1.053 af Average Runoff Depth = 1.50"

100.00% Pervious = 8.426 ac 0.00% Impervious = 0.000 ac

Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/26/2025

Page 11

Summary for Subcatchment 1XS:

Runoff = 13.84 cfs @ 12.17 hrs, Volume= 1.053 af, Depth> 1.50"
Routed to Reach 1R : 4th Ave N Surface

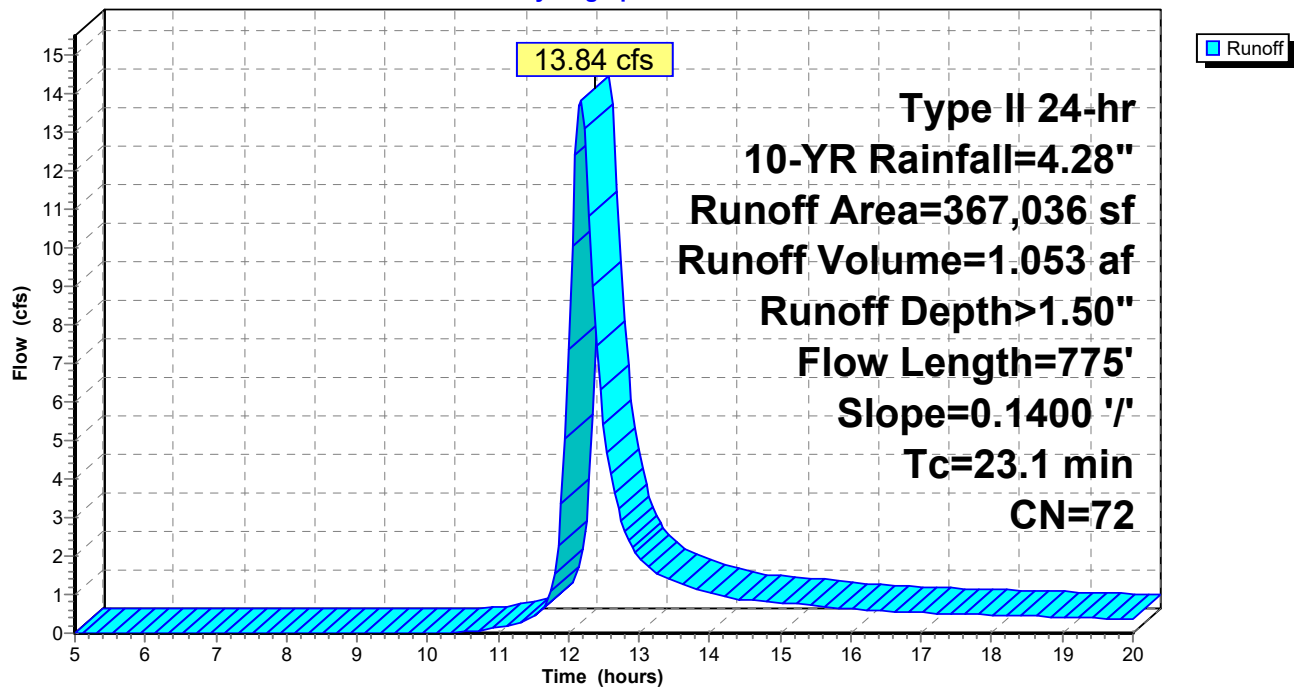
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.28"

Area (sf)	CN	Description
155,068	74	>75% Grass cover, Good, HSG C
211,968	70	Woods, Good, HSG C
367,036	72	Weighted Average
367,036		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.1	775	0.1400	0.56		Kerby Method, Deciduous forest N= 0.60

Subcatchment 1XS:

Hydrograph



Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/26/2025

Page 12

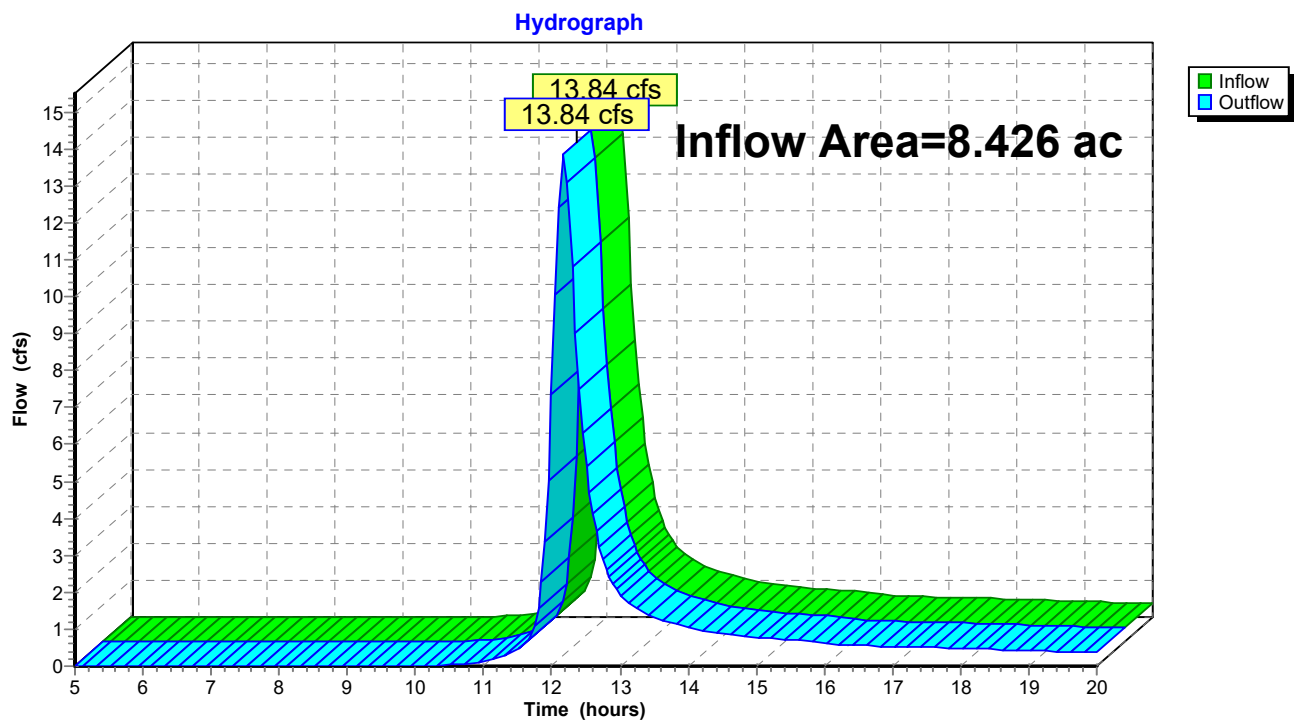
Summary for Reach 1R: 4th Ave N Surface

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.426 ac, 0.00% Impervious, Inflow Depth > 1.50" for 10-YR event
Inflow = 13.84 cfs @ 12.17 hrs, Volume= 1.053 af
Outflow = 13.84 cfs @ 12.17 hrs, Volume= 1.053 af, Atten= 0%, Lag= 0.0 min

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

Reach 1R: 4th Ave N Surface



Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/26/2025

Page 13

Summary for Reach 2R: 4th Ave N Storm Sewer

[40] Hint: Not Described (Outflow=Inflow)

Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/26/2025

Page 14

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

Subcatchment1XS:

Runoff Area=367,036 sf 0.00% Impervious Runoff Depth>3.67"
Flow Length=775' Slope=0.1400 '/' Tc=23.1 min CN=72 Runoff=34.27 cfs 2.577 af

Reach 1R: 4th Ave N Surface

Inflow=34.27 cfs 2.577 af
Outflow=34.27 cfs 2.577 af

Reach 2R: 4th Ave N Storm Sewer

Total Runoff Area = 8.426 ac Runoff Volume = 2.577 af Average Runoff Depth = 3.67"
100.00% Pervious = 8.426 ac 0.00% Impervious = 0.000 ac

Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/26/2025

Page 15

Summary for Subcatchment 1XS:

Runoff = 34.27 cfs @ 12.16 hrs, Volume= 2.577 af, Depth> 3.67"
Routed to Reach 1R : 4th Ave N Surface

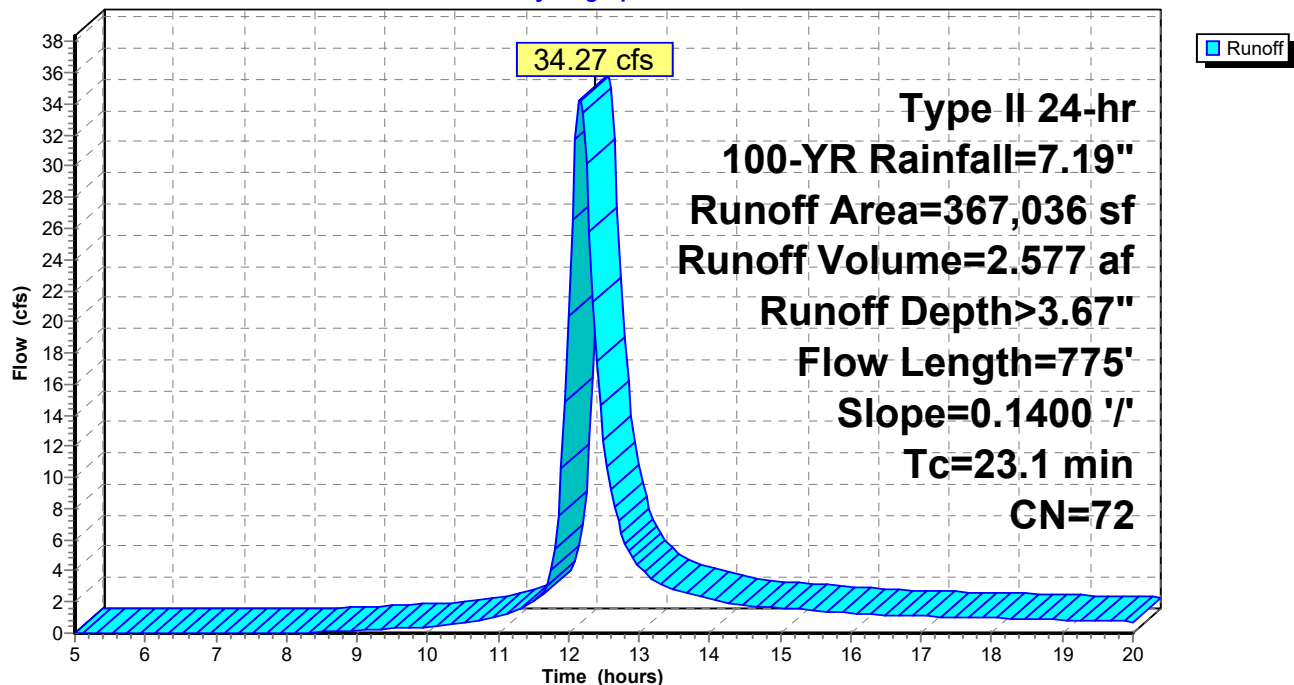
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=7.19"

Area (sf)	CN	Description
155,068	74	>75% Grass cover, Good, HSG C
211,968	70	Woods, Good, HSG C
367,036	72	Weighted Average
367,036		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.1	775	0.1400	0.56		Kerby Method, Deciduous forest N= 0.60

Subcatchment 1XS:

Hydrograph



Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/26/2025

Page 16

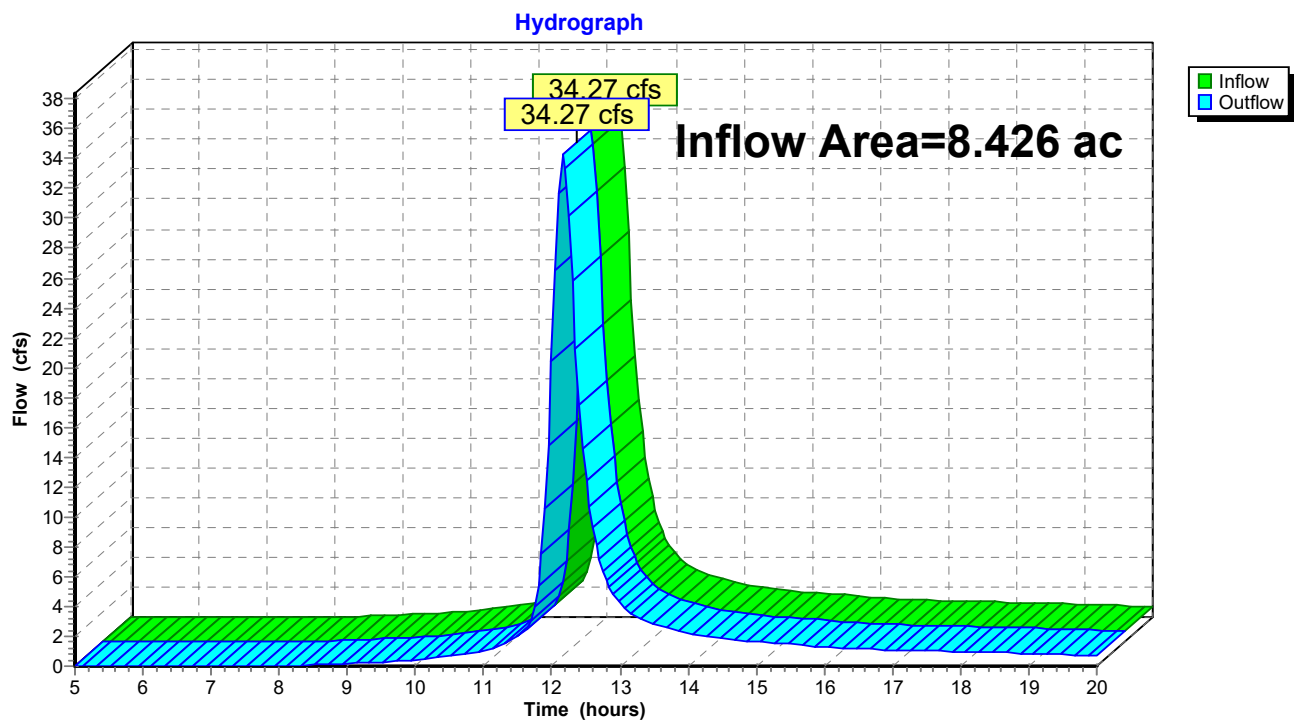
Summary for Reach 1R: 4th Ave N Surface

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.426 ac, 0.00% Impervious, Inflow Depth > 3.67" for 100-YR event
Inflow = 34.27 cfs @ 12.16 hrs, Volume= 2.577 af
Outflow = 34.27 cfs @ 12.16 hrs, Volume= 2.577 af, Atten= 0%, Lag= 0.0 min

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

Reach 1R: 4th Ave N Surface



Pre-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/26/2025

Page 17

Summary for Reach 2R: 4th Ave N Storm Sewer

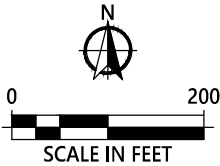
[40] Hint: Not Described (Outflow=Inflow)

APPENDIX 4

Post-Development Drainage Area Map And HydroCAD Report

POST-DEVELOPMENT DRAINAGE MAP

PROPOSED SUBCATCHMENT BOUNDARY	
PROPOSED FLOW PATH	
PROPOSED IMPERVIOUS AREA	

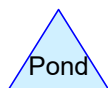
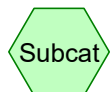
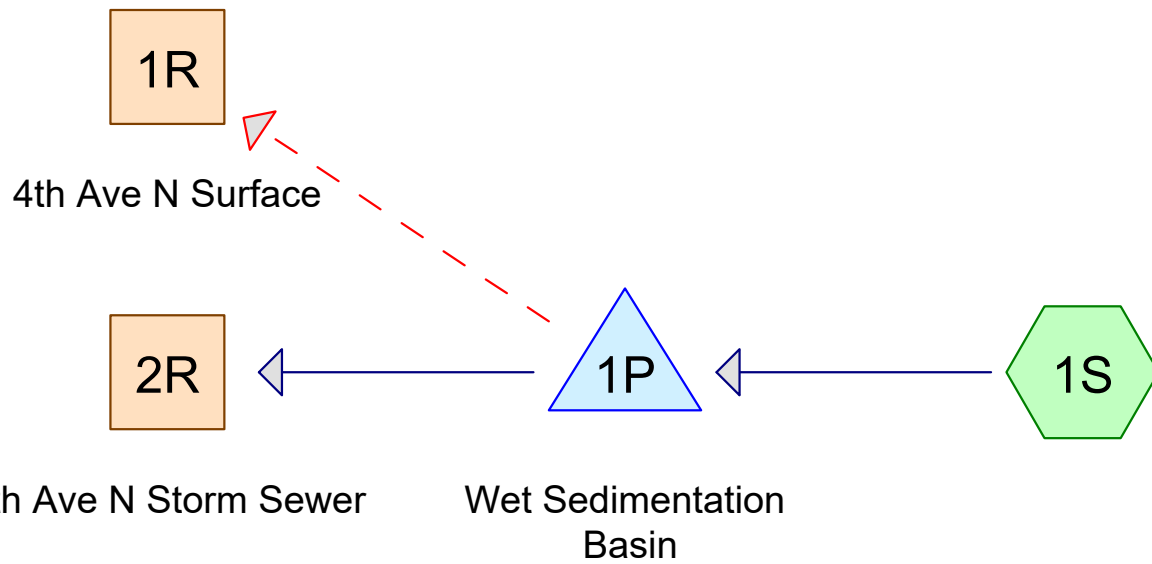


DRAWN BY:
ATR
CHECKED BY:
ATR

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ##### UNDER THE LAWS OF THE STATE OF MINNESOTA.

LIC. NO.: ##### DATE:

DATE	REV#	REVISIONS DESCRIPTION



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Printed 8/27/2025

Page 2

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YR	Type II 24-hr		Default	24.00	1	1.70	2
2	10-YR	Type II 24-hr		Default	24.00	1	4.28	2
3	100-YR	Type II 24-hr		Default	24.00	1	7.19	2

Post-Development

Prepared by Widseth Smith Nolting

Printed 8/27/2025

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Page 3

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.208	90	1/8 acre lots, 65% imp, HSG C (1S)
2.100	74	>75% Grass cover, Good, HSG C (1S)
0.252	98	Paved parking, HSG C (1S)
4.866	70	Woods, Good, HSG C (1S)
8.426	75	TOTAL AREA

Post-Development

Prepared by Widseth Smith Nolting

Printed 8/27/2025

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Page 4

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
8.426	HSG C	1S
0.000	HSG D	
0.000	Other	
8.426		TOTAL AREA

Post-Development

Prepared by Widseth Smith Nolting

Printed 8/27/2025

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Page 5

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.208	0.000	0.000	1.208	1/8 acre lots, 65% imp	1S
0.000	0.000	2.100	0.000	0.000	2.100	>75% Grass cover, Good	1S
0.000	0.000	0.252	0.000	0.000	0.252	Paved parking	1S
0.000	0.000	4.866	0.000	0.000	4.866	Woods, Good	1S
0.000	0.000	8.426	0.000	0.000	8.426	TOTAL AREA	

Post-Development

Prepared by Widseth Smith Nolting

Printed 8/27/2025

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Page 6

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1P	854.35	852.70	165.0	0.0100	0.013	0.0	15.0	0.0	

Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/27/2025

Page 7

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

Subcatchment1S:

Runoff Area=367,036 sf 12.31% Impervious Runoff Depth>0.21"

Flow Length=565' Slope=0.3300 '/' Tc=18.7 min CN=75 Runoff=1.62 cfs 0.147 af

Reach 1R: 4th Ave N Surface

Inflow=0.00 cfs 0.000 af

Outflow=0.00 cfs 0.000 af

Reach 2R: 4th Ave N Storm Sewer

Inflow=0.22 cfs 0.109 af

Outflow=0.22 cfs 0.109 af

Pond 1P: Wet SedimentationBasin

Peak Elev=856.96' Storage=39,155 cf Inflow=1.62 cfs 0.147 af

Primary=0.22 cfs 0.109 af Secondary=0.00 cfs 0.000 af Outflow=0.22 cfs 0.109 af

Total Runoff Area = 8.426 ac Runoff Volume = 0.147 af Average Runoff Depth = 0.21"
87.69% Pervious = 7.389 ac 12.31% Impervious = 1.037 ac

Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/27/2025

Page 8

Summary for Subcatchment 1S:

Runoff = 1.62 cfs @ 12.16 hrs, Volume= 0.147 af, Depth> 0.21"
Routed to Pond 1P : Wet Sedimentation Basin

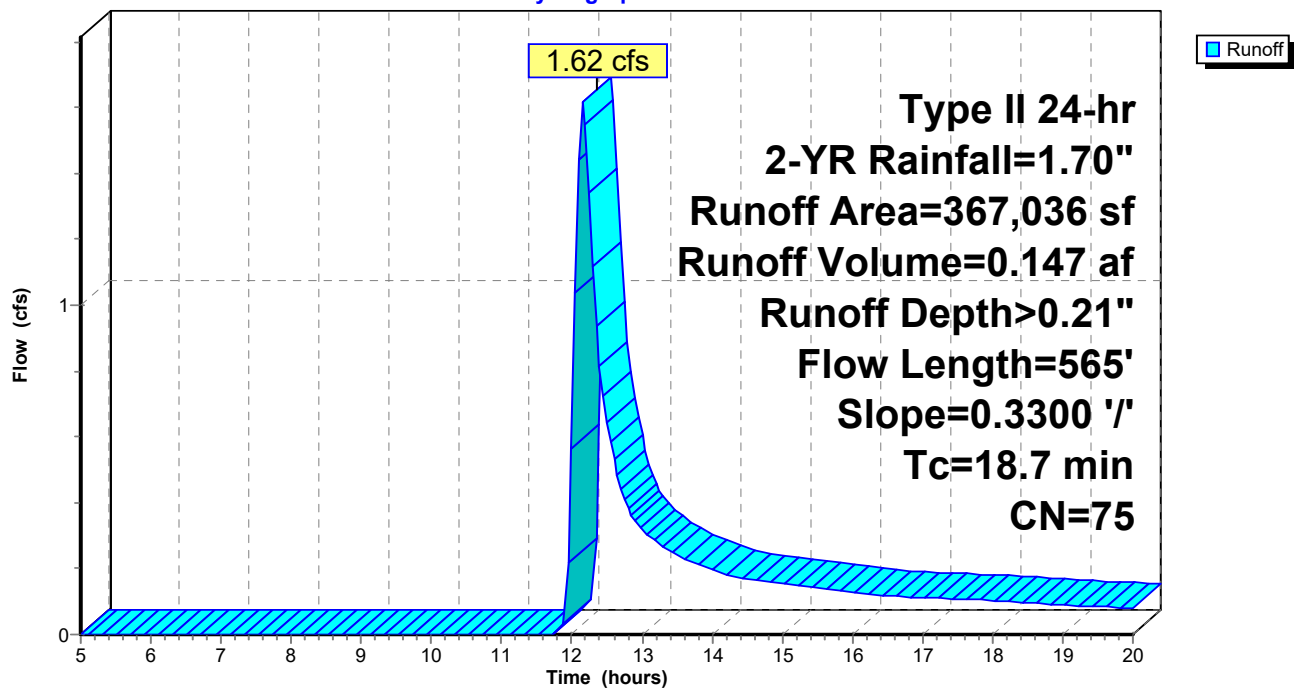
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=1.70"

Area (sf)	CN	Description
91,485	74	>75% Grass cover, Good, HSG C
211,968	70	Woods, Good, HSG C
52,625	90	1/8 acre lots, 65% imp, HSG C
10,958	98	Paved parking, HSG C
367,036	75	Weighted Average
321,872		87.69% Pervious Area
45,164		12.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	565	0.3300	0.50		Kerby Method, Deciduous forest with deep litter N= 0.80

Subcatchment 1S:

Hydrograph



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/27/2025

Page 9

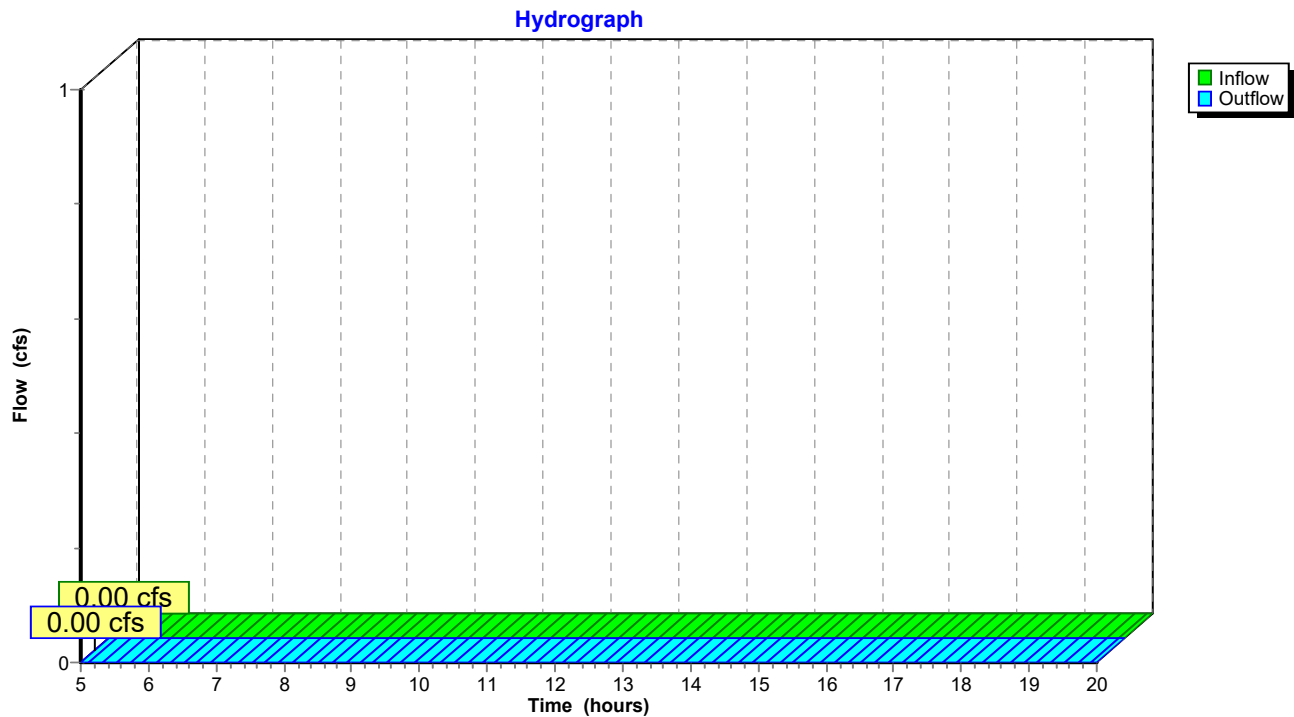
Summary for Reach 1R: 4th Ave N Surface

[40] Hint: Not Described (Outflow=Inflow)

Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

Reach 1R: 4th Ave N Surface



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/27/2025

Page 10

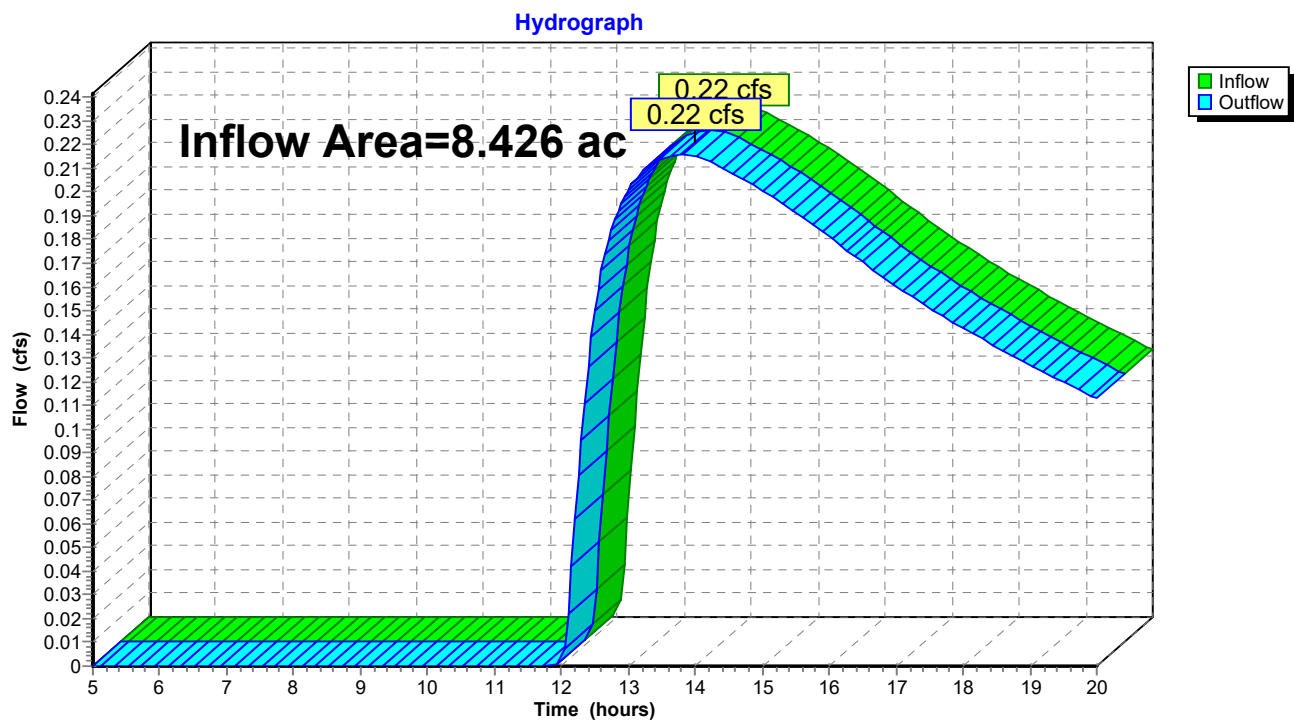
Summary for Reach 2R: 4th Ave N Storm Sewer

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.426 ac, 12.31% Impervious, Inflow Depth > 0.16" for 2-YR event
Inflow = 0.22 cfs @ 13.78 hrs, Volume= 0.109 af
Outflow = 0.22 cfs @ 13.78 hrs, Volume= 0.109 af, Atten= 0%, Lag= 0.0 min

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

Reach 2R: 4th Ave N Storm Sewer



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/27/2025

Page 11

Summary for Pond 1P: Wet Sedimentation Basin

Inflow Area = 8.426 ac, 12.31% Impervious, Inflow Depth > 0.21" for 2-YR event
Inflow = 1.62 cfs @ 12.16 hrs, Volume= 0.147 af
Outflow = 0.22 cfs @ 13.78 hrs, Volume= 0.109 af, Atten= 87%, Lag= 97.2 min
Primary = 0.22 cfs @ 13.78 hrs, Volume= 0.109 af
Routed to Reach 2R : 4th Ave N Storm Sewer
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 1R : 4th Ave N Surface

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 856.80' Surf.Area= 15,216 sf Storage= 36,590 cf
Peak Elev= 856.96' @ 13.78 hrs Surf.Area= 16,034 sf Storage= 39,155 cf (2,565 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

Center-of-Mass det. time= 92.5 min (946.4 - 853.9)

Volume	Invert	Avail.Storage	Storage Description
#1	852.80'	152,443 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
852.80	5,928	0	0
855.80	10,045	23,960	23,960
856.80	15,216	12,631	36,590
857.00	16,212	3,143	39,733
858.00	19,492	17,852	57,585
859.00	28,010	23,751	81,336
860.00	38,068	33,039	114,375
861.00	38,068	38,068	152,443

Device	Routing	Invert	Outlet Devices
#1	Primary	854.35'	15.0" Round RCP_Round 15" L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 854.35' / 852.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#2	Device 1	856.80'	1.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 2.0' Crest Height
#3	Device 1	858.80'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 2.0' Crest Height
#4	Secondary	860.66'	10.0' long x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.21 cfs @ 13.78 hrs HW=856.96' (Free Discharge)

↑ **1=RCP_Round 15"** (Passes 0.21 cfs of 7.39 cfs potential flow)

↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 0.21 cfs @ 1.34 fps)

↑ **3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=856.80' (Free Discharge)

↑ **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Post-Development

Prepared by Widseth Smith Nolting

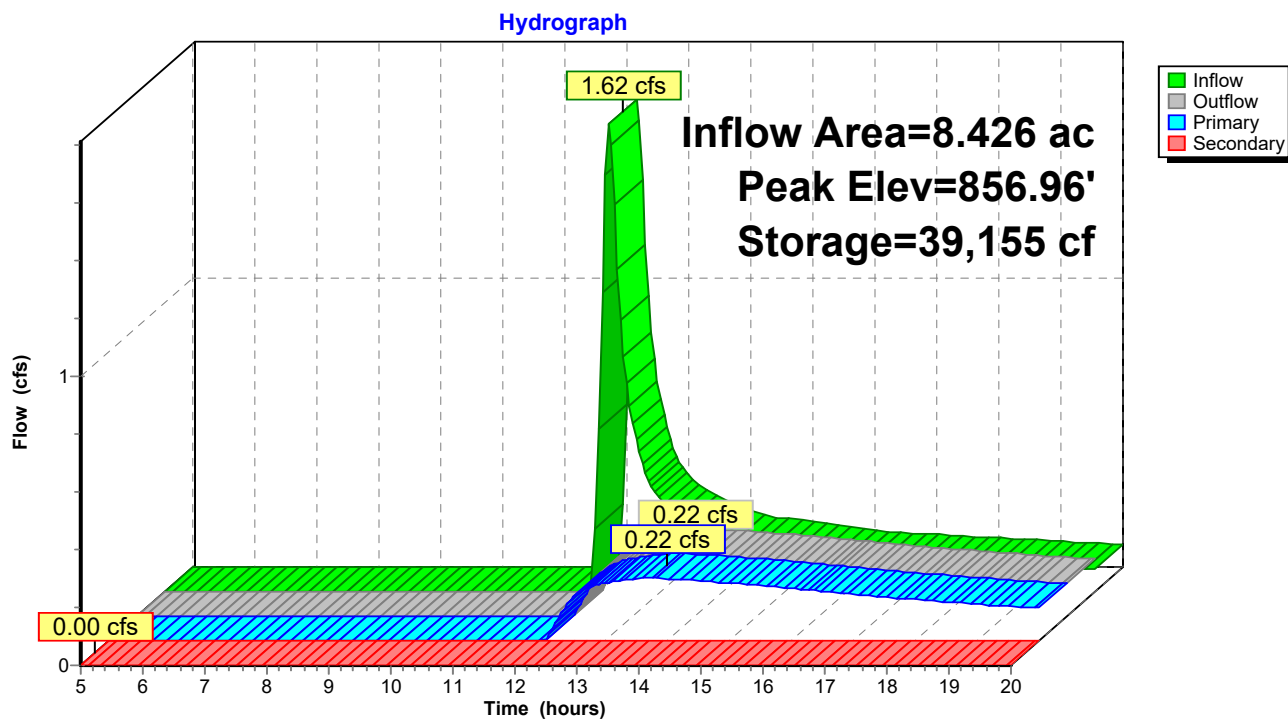
HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 2-YR Rainfall=1.70"

Printed 8/27/2025

Page 12

Pond 1P: Wet Sedimentation Basin



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/27/2025

Page 13

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

Subcatchment1S:

Runoff Area=367,036 sf 12.31% Impervious Runoff Depth>1.71"
Flow Length=565' Slope=0.3300 '/' Tc=18.7 min CN=75 Runoff=18.03 cfs 1.202 af

Reach 1R: 4th Ave N Surface

Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach 2R: 4th Ave N Storm Sewer

Inflow=3.88 cfs 1.089 af
Outflow=3.88 cfs 1.089 af

Pond 1P: Wet SedimentationBasin

Peak Elev=858.10' Storage=59,643 cf Inflow=18.03 cfs 1.202 af
Primary=3.88 cfs 1.089 af Secondary=0.00 cfs 0.000 af Outflow=3.88 cfs 1.089 af

Total Runoff Area = 8.426 ac Runoff Volume = 1.202 af Average Runoff Depth = 1.71"
87.69% Pervious = 7.389 ac 12.31% Impervious = 1.037 ac

Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/27/2025

Page 14

Summary for Subcatchment 1S:

Runoff = 18.03 cfs @ 12.12 hrs, Volume= 1.202 af, Depth> 1.71"
Routed to Pond 1P : Wet Sedimentation Basin

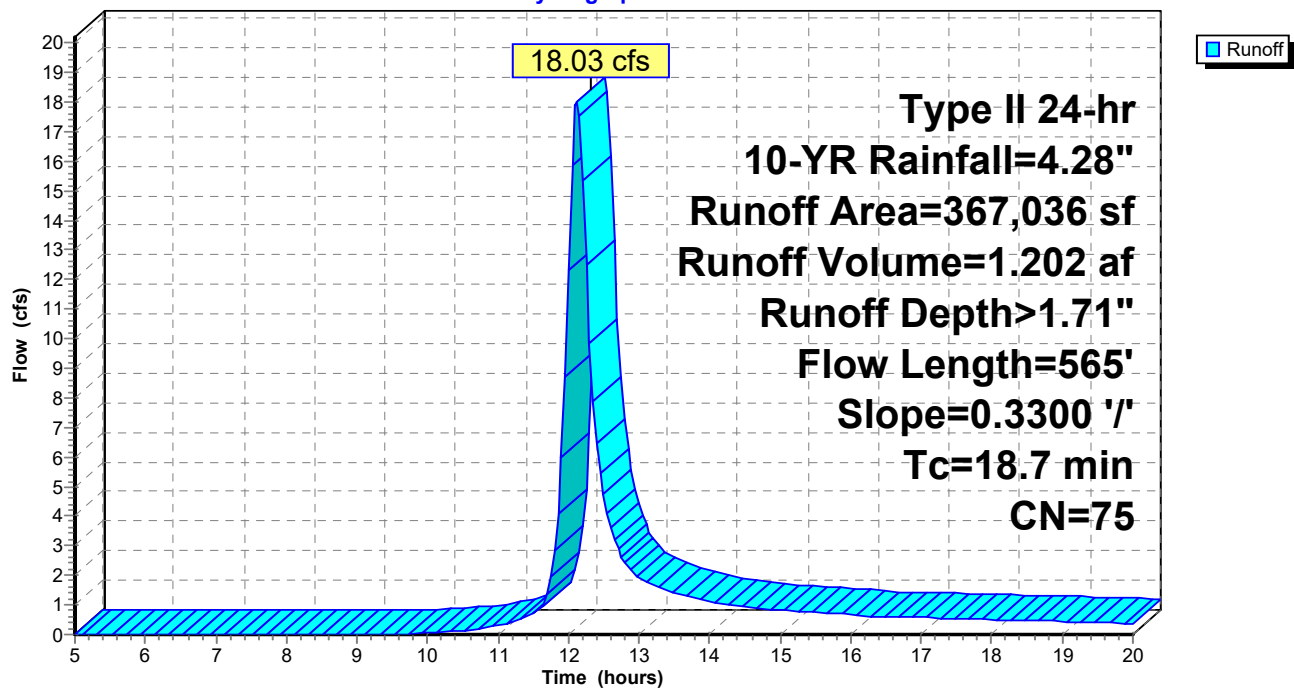
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.28"

Area (sf)	CN	Description
91,485	74	>75% Grass cover, Good, HSG C
211,968	70	Woods, Good, HSG C
52,625	90	1/8 acre lots, 65% imp, HSG C
10,958	98	Paved parking, HSG C
367,036	75	Weighted Average
321,872		87.69% Pervious Area
45,164		12.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	565	0.3300	0.50		Kerby Method, Deciduous forest with deep litter N= 0.80

Subcatchment 1S:

Hydrograph



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/27/2025

Page 15

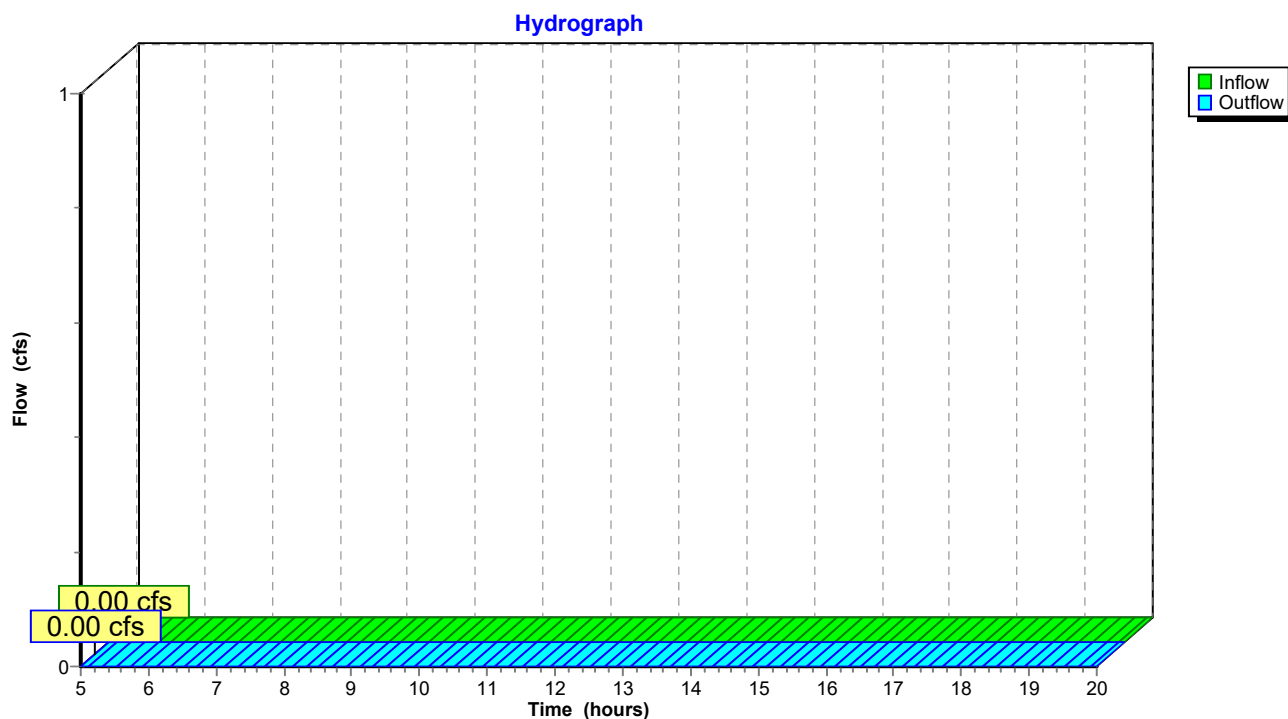
Summary for Reach 1R: 4th Ave N Surface

[40] Hint: Not Described (Outflow=Inflow)

Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

Reach 1R: 4th Ave N Surface



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/27/2025

Page 16

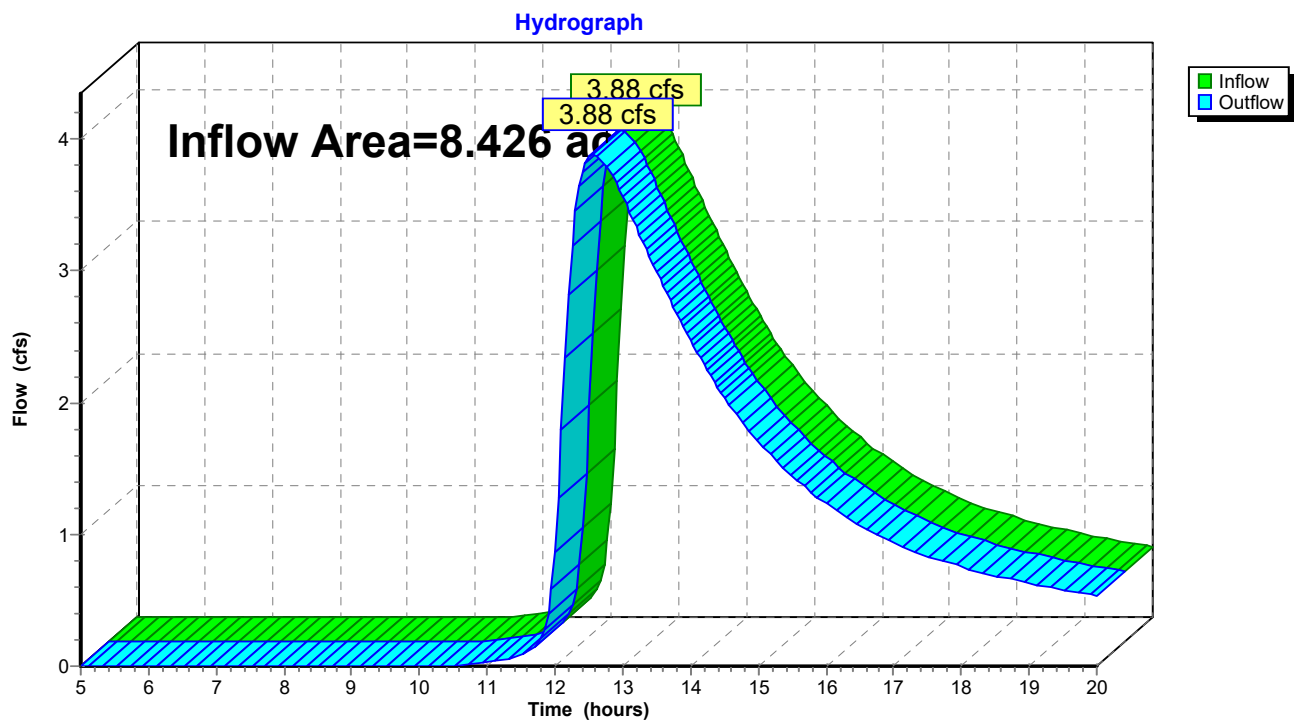
Summary for Reach 2R: 4th Ave N Storm Sewer

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.426 ac, 12.31% Impervious, Inflow Depth > 1.55" for 10-YR event
Inflow = 3.88 cfs @ 12.57 hrs, Volume= 1.089 af
Outflow = 3.88 cfs @ 12.57 hrs, Volume= 1.089 af, Atten= 0%, Lag= 0.0 min

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

Reach 2R: 4th Ave N Storm Sewer



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/27/2025

Page 17

Summary for Pond 1P: Wet Sedimentation Basin

Inflow Area = 8.426 ac, 12.31% Impervious, Inflow Depth > 1.71" for 10-YR event
Inflow = 18.03 cfs @ 12.12 hrs, Volume= 1.202 af
Outflow = 3.88 cfs @ 12.57 hrs, Volume= 1.089 af, Atten= 78%, Lag= 27.3 min
Primary = 3.88 cfs @ 12.57 hrs, Volume= 1.089 af
Routed to Reach 2R : 4th Ave N Storm Sewer
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 1R : 4th Ave N Surface

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

Starting Elev= 856.80' Surf.Area= 15,216 sf Storage= 36,590 cf

Peak Elev= 858.10' @ 12.57 hrs Surf.Area= 20,371 sf Storage= 59,643 cf (23,053 cf above start)

Plug-Flow detention time= 362.1 min calculated for 0.249 af (21% of inflow)

Center-of-Mass det. time= 73.2 min (877.6 - 804.4)

Volume	Invert	Avail.Storage	Storage Description
#1	852.80'	152,443 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
852.80	5,928	0	0
855.80	10,045	23,960	23,960
856.80	15,216	12,631	36,590
857.00	16,212	3,143	39,733
858.00	19,492	17,852	57,585
859.00	28,010	23,751	81,336
860.00	38,068	33,039	114,375
861.00	38,068	38,068	152,443

Device	Routing	Invert	Outlet Devices
#1	Primary	854.35'	15.0" Round RCP_Round 15" L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 854.35' / 852.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#2	Device 1	856.80'	1.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 2.0' Crest Height
#3	Device 1	858.80'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 2.0' Crest Height
#4	Secondary	860.66'	10.0' long x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=3.88 cfs @ 12.57 hrs HW=858.10' (Free Discharge)

↑ **1=RCP_Round 15"** (Passes 3.88 cfs of 8.68 cfs potential flow)

↑ **2=Sharp-Crested Rectangular Weir** (Weir Controls 3.88 cfs @ 4.03 fps)

↑ **3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=856.80' (Free Discharge)

↑ **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Post-Development

Prepared by Widseth Smith Nolting

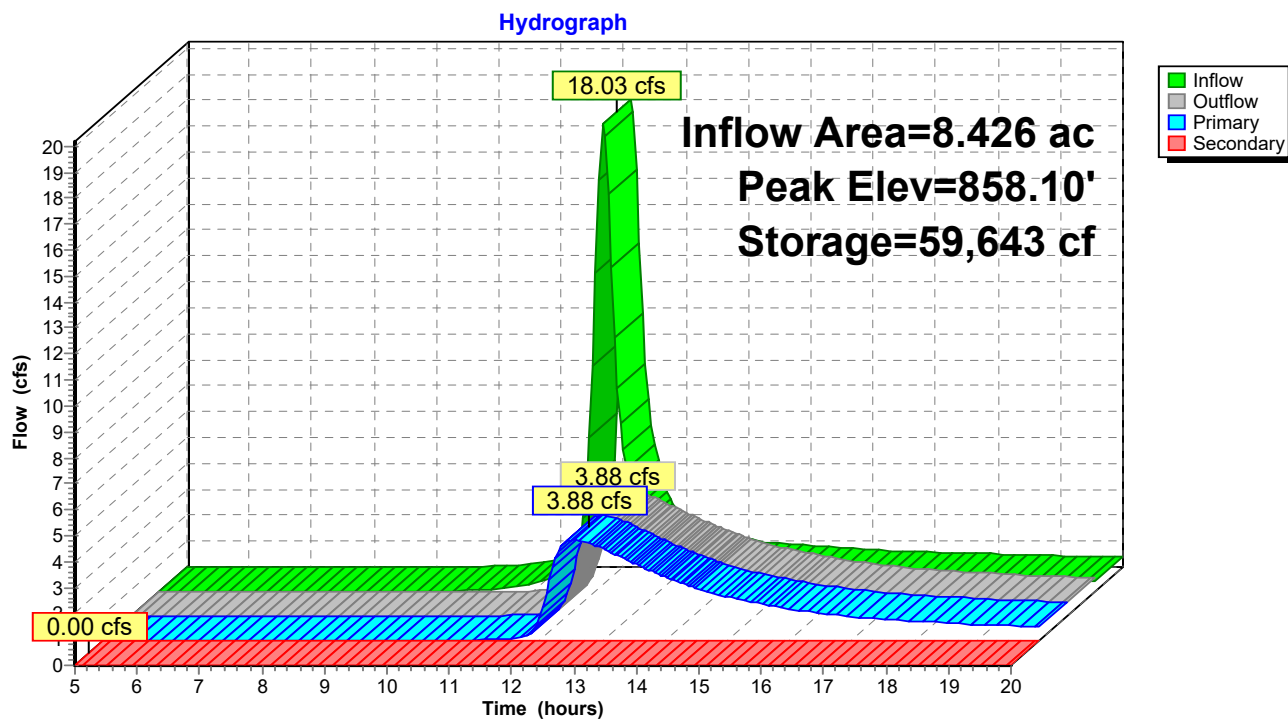
HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 10-YR Rainfall=4.28"

Printed 8/27/2025

Page 18

Pond 1P: Wet Sedimentation Basin



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/27/2025

Page 19

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

Subcatchment1S:

Runoff Area=367,036 sf 12.31% Impervious Runoff Depth>3.99"
Flow Length=565' Slope=0.3300 '/' Tc=18.7 min CN=75 Runoff=41.75 cfs 2.802 af

Reach 1R: 4th Ave N Surface

Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach 2R: 4th Ave N Storm Sewer

Inflow=9.88 cfs 2.622 af
Outflow=9.88 cfs 2.622 af

Pond 1P: Wet SedimentationBasin

Peak Elev=859.34' Storage=91,372 cf Inflow=41.75 cfs 2.802 af
Primary=9.88 cfs 2.622 af Secondary=0.00 cfs 0.000 af Outflow=9.88 cfs 2.622 af

Total Runoff Area = 8.426 ac Runoff Volume = 2.802 af Average Runoff Depth = 3.99"
87.69% Pervious = 7.389 ac 12.31% Impervious = 1.037 ac

Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/27/2025

Page 20

Summary for Subcatchment 1S:

Runoff = 41.75 cfs @ 12.11 hrs, Volume= 2.802 af, Depth> 3.99"
Routed to Pond 1P : Wet Sedimentation Basin

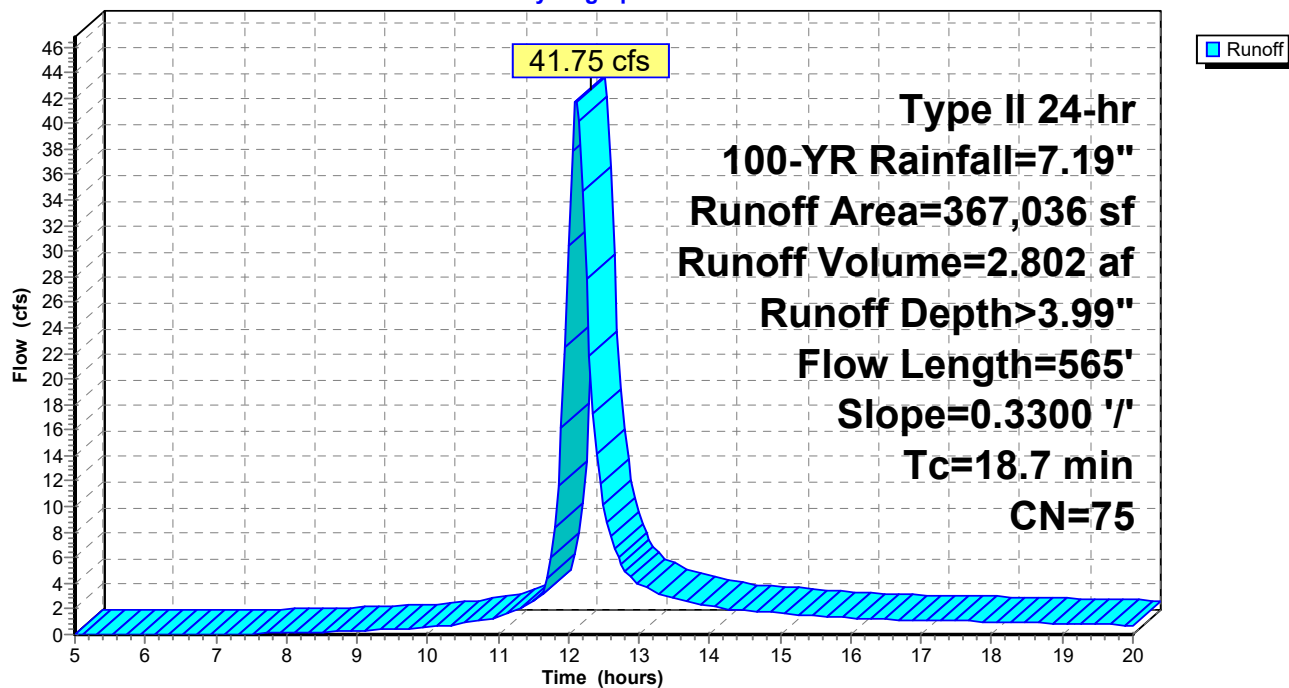
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=7.19"

Area (sf)	CN	Description
91,485	74	>75% Grass cover, Good, HSG C
211,968	70	Woods, Good, HSG C
52,625	90	1/8 acre lots, 65% imp, HSG C
10,958	98	Paved parking, HSG C
367,036	75	Weighted Average
321,872		87.69% Pervious Area
45,164		12.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	565	0.3300	0.50		Kerby Method, Deciduous forest with deep litter N= 0.80

Subcatchment 1S:

Hydrograph



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/27/2025

Page 21

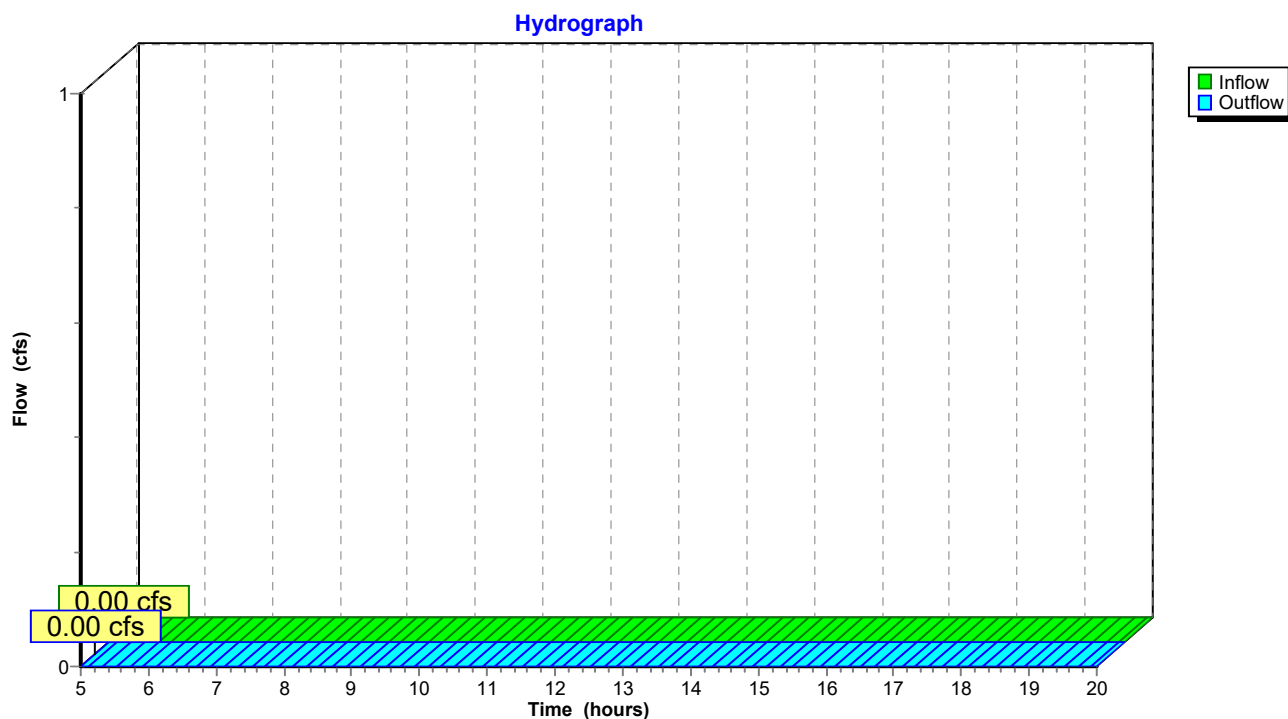
Summary for Reach 1R: 4th Ave N Surface

[40] Hint: Not Described (Outflow=Inflow)

Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

Reach 1R: 4th Ave N Surface



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/27/2025

Page 22

Summary for Reach 2R: 4th Ave N Storm Sewer

[40] Hint: Not Described (Outflow=Inflow)

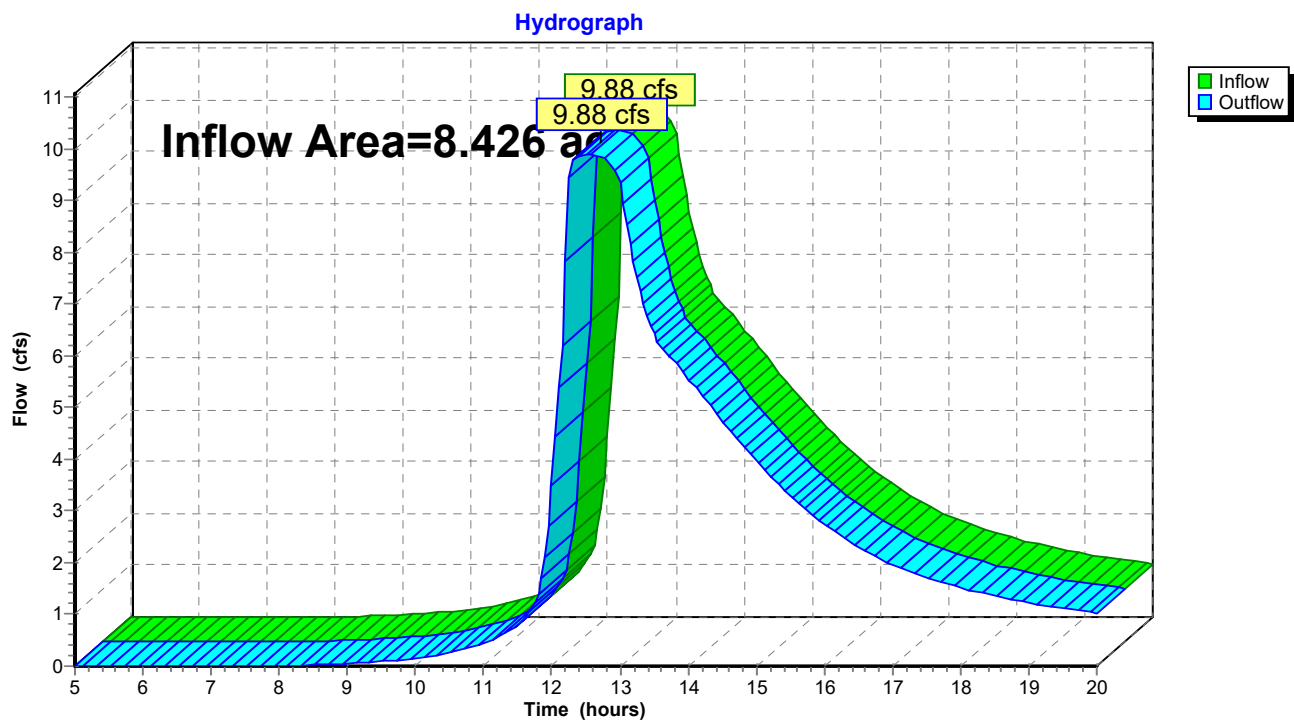
Inflow Area = 8.426 ac, 12.31% Impervious, Inflow Depth > 3.73" for 100-YR event

Inflow = 9.88 cfs @ 12.51 hrs, Volume= 2.622 af

Outflow = 9.88 cfs @ 12.51 hrs, Volume= 2.622 af, Atten= 0%, Lag= 0.0 min

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

Reach 2R: 4th Ave N Storm Sewer



Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/27/2025

Page 23

Summary for Pond 1P: Wet Sedimentation Basin

Inflow Area = 8.426 ac, 12.31% Impervious, Inflow Depth > 3.99" for 100-YR event
Inflow = 41.75 cfs @ 12.11 hrs, Volume= 2.802 af
Outflow = 9.88 cfs @ 12.51 hrs, Volume= 2.622 af, Atten= 76%, Lag= 23.9 min
Primary = 9.88 cfs @ 12.51 hrs, Volume= 2.622 af
Routed to Reach 2R : 4th Ave N Storm Sewer
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Routed to Reach 1R : 4th Ave N Surface

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 856.80' Surf.Area= 15,216 sf Storage= 36,590 cf
Peak Elev= 859.34' @ 12.51 hrs Surf.Area= 31,408 sf Storage= 91,372 cf (54,782 cf above start)

Plug-Flow detention time= 200.7 min calculated for 1.782 af (64% of inflow)
Center-of-Mass det. time= 73.8 min (860.2 - 786.5)

Volume	Invert	Avail.Storage	Storage Description
#1	852.80'	152,443 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
852.80	5,928	0	0
855.80	10,045	23,960	23,960
856.80	15,216	12,631	36,590
857.00	16,212	3,143	39,733
858.00	19,492	17,852	57,585
859.00	28,010	23,751	81,336
860.00	38,068	33,039	114,375
861.00	38,068	38,068	152,443

Device	Routing	Invert	Outlet Devices
#1	Primary	854.35'	15.0" Round RCP_Round 15" L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 854.35' / 852.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#2	Device 1	856.80'	1.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 2.0' Crest Height
#3	Device 1	858.80'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 2.0' Crest Height
#4	Secondary	860.66'	10.0' long x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=9.88 cfs @ 12.51 hrs HW=859.34' (Free Discharge)

↑ **1=RCP_Round 15"** (Barrel Controls 9.88 cfs @ 8.05 fps)

↑ **2=Sharp-Crested Rectangular Weir** (Passes < 7.63 cfs potential flow)

↑ **3=Sharp-Crested Rectangular Weir** (Passes < 5.18 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=856.80' (Free Discharge)

↑ **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Post-Development

Prepared by Widseth Smith Nolting

HydroCAD® 10.20-7a s/n 01722 © 2025 HydroCAD Software Solutions LLC

Type II 24-hr 100-YR Rainfall=7.19"

Printed 8/27/2025

Page 24

Pond 1P: Wet Sedimentation Basin

