EXPIRES: 6/30/19

Utility Calculations for

Mary's Annexation
for
CMTWH, LLC

Devco Job #16-447
October 2017

Table of Contents

Utilities Narrative – Mary's Annexation

Sanitary Sewer Facilities

The properties within the proposed annexation boundary are located within the Dunawi Basin of the public sanitary sewer system. Based upon the information from the Corvallis Wastewater Utilities Master Plan, a pipe extension is necessary to connect to the City's sanitary sewer system.

Sanitary sewer demand calculations are located in the Appendix of this report, and a summary of the projected sanitary sewer demands is listed below.

- Sanitary sewer design flows for the proposed annexation, maximum development scenario (Various zoning designations), is as follows:
    - Area Information:
        - Total Annexation Site Area = 118.63 Ac
        - Maximum Dwelling Units Calculated = 2,273 DU
    - Number of People = (2,273 Units) (2.14 People/Unit) = 4,865 People
    - Design Flows = 193 gpcd * 4,865 people + 4000 gal/Ac/day * 118.63 Ac
    - Design Flows = 1,413,465 gal/day = 981.57 gpm = 2.187 cfs

There is currently an existing 15-inch mainline located within Dunawi Creek on site. Sanitary sewer improvements will connect to this 15-inch mainline to serve the proposed annexation area. The existing 15-inch sanitary sewer line will have the capacity to convey the proposed demands for the area.

Public Waterline

The properties within the proposed annexation boundary are located within the First Level water service area. The First Level water service area serves elevations 210' – 287'. The Corvallis Water System Distribution Facilities Plan identifies improvements required for the main distribution system in the vicinity of the annexation. In order to meet the maximum development potential scenario, the improvements include extending an 18" waterline through the site, with an 18" distribution loop on the north end and an 18" loop connection to West Hills Road to the south. The reasonable development scenario use for the site will likely require a smaller size pipe running through the site. The pipe size shall be determined during the design phase.

As shown in the Waterline Calculations in the appendix, a summary of the projected water demands for the proposed annexation, maximum development scenario, is below.

- Area Information:
    - Total Annexation Site Area = 118.63 Ac
    - Zones include MUR, RS-12, and C-OS
- Peak Hour Demand Total = 3,243 gpm (use 3,250 gpm)
- Fire flow demand for Commercial = 4,000 gpm
- Maximum Peak Water Demand = Peak Hour Demand + Fire Flow
- 3,250 gpm + 4,000 gpm = 7,250 gpm

There is currently a 20-inch waterline located in West Hills Road and another 20-inch waterline in 53rd Street next to the proposed annexation site. Future waterline improvements needed to serve the proposed annexation area will require extending an 18" waterline through the site and connecting a distribution 12-inch waterlines to serve the proposed zones. Existing fire flows from the Corvallis Fire Department show that the current water system infrastructure is adequate to serve both domestic and fire flows.

Storm Drainage

The properties within the proposed annexation boundary are located within the Dunawi Creek Drainage Basin of the public storm drainage system. The City's Stormwater Master Plan (SWMP) does not identify any significant improvements within the proposed annexation area.

Stormwater currently drains along the natural contours of the site and eventually into Dunawi Creek. Future storm drainage improvements will follow this pattern and drain to Dunawi Creek after being detained and treated to meet City of Corvallis standards. Stormwater Facilities located along the riparian corridor on site are designed to allow stormwater runoff from proposed site improvements to recharge nearby streams and channels at pre-developed rates.

A summary of the stormwater calculations for the proposed annexation is below.

- Annexation Area Basin:
  - The 10-year peak stormwater runoff is
    - Existing = 21.96 cfs
    - Proposed Developed = 79.07 cfs
  - An increase of 260% in stormwater runoff due to the proposed zone change for the 10-year, 24-hour storm event.

Under the requirements of the City's Stormwater Design Standards, the rate of stormwater discharge from the site will match or be less than the existing rate of discharge up to the 10-year, 24-hour rainfall event with the use of stormwater detention facilities. The detention facilities on site shall be sized to detain stormwater runoff and discharge at a rate allowed per the City of Corvallis Standards. This is due to the requirement of the development to provide detention facilities and flow control structures to limit stormwater runoff to historic pre-developed runoff rates.

Street Lights

At the time of a future development proposal, the developer or owner will coordinate with the City of Corvallis to address street lights and to ensure that these services are available to the proposed site.

Franchise Utilities

At the time of any development proposal, the developer or owner will coordinate with the appropriate franchise utility companies to ensure that these services are available to the site. Any franchise utilities that are extended onto the proposed site will be installed within a new 7-foot Public Utility Easement (PUE) adjacent to an existing right-of-way or within easements that extend to the individual structures.

Sanitary Sewer Calculations

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT: Mary's Annexation	PROJECT NO: 16-447	DESIGN: K.E.	DATE: 08/17

Proposed Contributing Flows to Existing 15" Sanitary Sewer Line under Dunawi Creek on Site

Background Information

- Area Information:
  - Per City of Corvallis WWMP, annual average sanitary usage is 193 gal/person/day + 4,000 gal/Ac/Day for I & I. (Based on Gross Area)
  - Gross Area
    - MUR = 17.98 Acres
    - RS-12 = 91.15 Acres
    - C-OS = 9.50 Acres
    - Total = 118.63 Acres
- Zone Information
  - Number of Dwelling Units
    - MUR = 25 DU/Ac
    - RS-12 = 20 DU/Ac
    - C-OS = 0 DU/Ac

Maximum Development Potential Scenario Flows

- Number of Dwelling Units
  - MUR =17.98 Ac x 25 Units/Ac = 449.5 Units = Use 450 Units
    - The highest development scenario occurs when MUR is listed as all residential.
  - RS-12 = 91.15 Ac x 20 Units/Ac = 1823 Units
  - C-OS = 9.50 Ac x 0 Units/Ac = 0 Units
  - Total Dwelling Units = 2,273 Units
- Number of People = (2,273 Units) (2.14 People/Unit) = 4,865 People
- Design Flows = 193 gpcd * 4,865 people + 4000 gal/Ac/day * 118.63 Ac
- Design Flows = 1,413,465 gal/day = 981.57 gpm = 2.187 cfs

  * The Maximum Development Potential sanitary sewer design demand flows for the contributing area above is 981.57 gpm or 2.187 cfs.

Reasonable Development Scenario Flows

- Proposed Units and Areas
  - Proposed Dwelling Units = 1,117 Units
- Number of People = (1,117 Units) (2.14 People/Unit) = 2,391 People
- Design Flows = 193 gpcd * 2,391 people + 4000 gal/Ac/day * 118.63 Ac
- Design Flows = 935,983 gal/day = 649.99 gpm = 1.448 cfs

  * The Proposed Reasonable Development Scenario sanitary sewer design demand flows for the contributing area above is 649.99 gpm or 1.448 cfs.

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT: Mary's Annexation	PROJECT NO: 16-447	DESIGN: K.E.	DATE: 08/17

Existing Contributing Flows to 15" Sanitary Sewer Line under the Drainage way on Site

- Area Information:
  - Per City of Corvallis WWMP, annual average sanitary usage is 193 gal/person/day + 4000 gal/Ac/Day for I & I. (Based on Gross Area)
  - Contributing Area to Sanitary Sewer in Dunawi Creek
    - MUC = 4.76 Acres
    - MUR = 15.54 Acres
    - Public Institutional = 34.78 Acres
    - RS-6 = 91.18 Acres
    - RS-9 = 13.50 Acres
    - RS-12 = 6.47 Acres
    - Total Area = 166.23 Acres
  - Number of Dwelling Units per zone is as follows:
    - MUC = 4.4 units/Ac
    - MUR = 25 units/Ac
    - Public Institutional = 4.4 units/Ac
    - RS-6 = 6 units/Ac
    - RS-9 = 9 units/Ac
    - RS-12 = 20 units/Ac
- Number of Dwelling Units
  - MUC = 4.76 Ac x 4.4 Units/Ac = 20.94 Units
  - MUR = 15.54 x 25 Units/Ac = 388.50 Units
  - Public Institutional = 34.78 Ac x 4.4 Units/Ac = 153.03 Units
  - RS-6 = 91.18 Ac x 6 Units/Ac = 547.08 Units
  - RS-9 = 13.50 Ac x 9 Units/Ac = 121.50 Units
  - RS-12 = 6.47 Ac x 20 Units/Ac = 129.40 Units
  - Total Dwelling Units = 1,360.45 Units = 1,361 Units
- Number of People = (1,361 Units) (2.14 People/Unit) = 2,913 People
- Design Flows = 193 gpcd * 2,913 people + 4000 gal/Ac/day * 166.23 Ac
- Design Flows = 1,227,129 gal/day = 852.17 gpm = 1.899 cfs

*The sanitary sewer design demand flows for the existing area in the sanitary pipe is 852.17 gpm or 1.899 cfs.

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT: Mary's Annexation	PROJECT NO: 16-447	DESIGN: K.E.	DATE: 08/17

Capacity of 15" Sanitary Sewer Line under the Drainage way on Site

Use Manning's Equation to determine pipe capacity:

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

n = Manning's Coefficient
n = 0.013
A = Area of Pipe Cross Section
$A = \pi r^2$
R = Hydraulic Radius
R = Area of Pipe Section / Wetted Perimeter
S = Slope
S = 0.005 ft/ft (per city as-built information)

$$Q = \frac{1.486}{0.013}(1.227\ sf)(0.313)^{\frac{2}{3}}\left(0.005\frac{ft}{ft}\right)^{\frac{1}{2}} = 4.572\ cfs$$

Conclusion

Maximum Development Potential Flows
2.187 cfs + 1.899 cfs = 4.086 cfs (Existing and Proposed flow rates)
4.572 cfs > 4.086 cfs
OK

Reasonable Development Scenario Flows
1.448 cfs + 1.899 cfs = 3.347 cfs (Existing and Proposed flow rates)
4.572 cfs > 3.347 cfs
OK

The capacity of the existing 15" pipe is able to convey the Maximum Development Potential and Proposed Reasonable Development sanitary sewer flows.

FILE: I:\CML3D Projects\16447\Reports\Annexation Utility Calculations - April 2017\Sanitary Sewer\16447_UTIL_EXHB_SSWR.dwg [SSWR] 4/18/2017 4:42 PM - Kyle

SCALE IN FEET

0 125 250 500

SCALE: 1" = 250'

DRAWING STATUS:	DATE:
☒ PRELIMINARY	04/18/17
☐ SUBMITTED	
☐ BID SET	
☐ PERMIT SET	
☐ CONST. SET	

No.	REVISION:	DATE:

PRELIMINARY

PROJECT: MARY'S ANNEXATION

PROJECT LOCATION: CORVALLIS, OR

CLIENT: CMTWH, LLC

DEVCO engineering Inc
Corvallis Oregon
(541) 757-0931
245 NW CONIFER, P.O. BOX 121
CORVALLIS, OR 97339
WWW.DEVCOENGINEERING.COM

SHEET TITLE: SANITARY SEWER
DRAWING: 4
DRAWN BY: DEVCO
JOB NO. 16447

ZONING LEGEND

- PUBLIC INSTITUTION
- MIXED USE COMMERCIAL
- MIXED USE RESIDENTIAL
- RS-6
- RS-9
- RS-12

SCALE: N.T.S.

PRELIMINARY

DRAWING STATUS:	DATE:
☒ PRELIMINARY	04/18/17
☐ SUBMITTED	
☐ BID SET	
☐ PERMIT SET	
☐ CONST. SET	

No.	REVISION:	DATE:

DEVCO engineering inc.
Corvallis, Oregon 541 757-1661
245 NW CONIFER, P.O. BOX 221
CORVALLIS, OR 97339
WWW.DEVCOENGINEERING.COM

PROJECT: MARY'S ANNEXATION
PROJECT LOCATION: CORVALLIS, OR
CLIENT: CMTWH, LLC

JOB NO. 16447
DRAWN BY: DEVCO
SHEET TITLE: EXISTING SSWR
DRAWING: 5

FILE: I:\CML3D Projects\16447\Reports\Annexation Utility Calculations - April 2017\Sanitary Sewer\16447_UTIL_EXHB_SSWR.dwg [EX-COND] 4/18/2017 4:43 PM - Kyle

Per capita, wet season, dry weather	193 gallons per capita per day--peak rate
Per acre, wet season, wet weather	4,000 gallons per acre per day--peak for 5-year, 24-hour event

*2.14 population per EDU assumed for Master Planning purposes

Zone	
AG-OS	-
CB	4.4
CBF	4.4
CS	4.4
GI	7.4
GI	8.7
II	8.7
LC	4.4
LI	4.4
OSU	
P-AO	4.4
PD(12U)	16
PD(CS)	4.4
PD(GI)	8.7
PD(LC)	4.4
PD(LI)	8.4
PD(P-AO)	4.4
PD(RS-12)	[illegible]
PD(RS-12)	[illegible]
PD(RS-12U)	[illegible]
PD(RS-12U)	[illegible]
PD(RS-20)	25.0
PD(RS-3.5)	4.0
PD(RS-5)	4
PD(RS-6)	4.0
PD(RS-9)	9.0
PD(RTC)	4.4
PD(SA)	4.35
RS-12	[illegible]
RS-12	[illegible]
RS-12U	12.0
RS-20	25
RS-3.5	4
RS-5	4
RS-6	4.0
RS-9	9
RTC	4.4
SA	4.35
SAU	4.35
SSD	4.4

Res-Low	4.0
Res-Medium	9.0
Res-MH	12-16
Commercial (SA)	4.4
Ind-Limited	8.7
Ind-Intensive	7.4

Waterline Calculations

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT:	Mary's Annexation	PROJECT NO:	16447	DESIGN:	K.E.	DATE:	08/17

Waterline Calculations

1) Calculate maximum water demand for the proposed annexation area that is being zoned as RS-12 and Mixed Use Residential (MUR).

   - Maximum water demand = Peak hour demand + Fire flows
   - Per City of Corvallis Water Distribution System Facilities Plan (WDSFP), the fire flow requirements are as follows:
     - MUR – Use Apartments or Dormitories. Requires 4,000 gpm
     - RS-12 – Use Apartments or Dormitories. Requires 4,000 gpm

1) Water Demand Calculations for the Annexation Area

a. Maximum Development Potential Scenario

- Area Information:
  - Per City of Corvallis WDSFP, annual average water consumption rates for various zones are as follows:
    - MUR– 76 gal/person/day (Use Residential land use designation)
    - RS-12 – 76 gal/person/day (Use Residential land use designation)
  - Areas:
    - MUR – 17.98 Acres
    - RS-12 – 91.15 Acres
    - C-OS – 9.50 Acres
    - Total – 118.63 Acres
- MUR = (17.98 Ac) (25 units/Ac) (2.3 people/unit) (76 gal/person/day) = 78,573 gal/day
  - Average Demand = 78,573 gal/day = 54.57 gpm (Divide by 1,440 min/day)
  - Peak Day Demand = (54.57 gpm)(4) = 218.28 gpm => Use 219 gpm
  - Peak Hour Demand = (54.57 gpm)(11.75) = 641.20 gpm => Use 642 gpm
- RS-12 = (91.15 Ac) (20 units/Ac) (2.3 people/unit) (76 gal/person/day) = 318,661 gal/day
  - Average Demand = 318,661 gal/day = 221.3 gpm (Divide by 1,440 min/day)
  - Peak Day Demand = (221.3 gpm)(4) = 885.2 gpm => Use 886 gpm
  - Peak Hour Demand = (221.3 gpm)(11.75) = 2,600.3 gpm => Use 2,601 gpm
- C-OS = (9.50 Ac) (0 units/Ac) = 0 units = 0 gal/day

  - Highest fire flow demand required = 4,000 gpm
  - Maximum Peak Water Demand = MUR Peak + RS-12 Peak + C-OS Peak + Fire Flow
  - 642 gpm + 2,601 gpm + 0 gpm + 4,000 gpm = 7,243 gpm = Use 7,250 gpm

  * The Maximum Development Potential Scenario water demand for the proposed Annexation Area is 7,250 gpm.

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT:	Mary's Annexation	PROJECT NO:	16447	DESIGN:	K.E.	DATE:	08/17

b. Reasonable Development Scenario

- Area Information:
  - Per City of Corvallis WDSFP, annual average water consumption rates for various zones are as follows:
    - MUR– 76 gal/person/day (Use Residential land use designation)
    - RS-12 – 76 gal/person/day (Use Residential land use designation)
  - On-site Dwelling Units:
    - Residential – 1,117 Units
- Total = (1,117 units) (2.3 people/unit) (76 gal/person/day) = 195,252 gal/day
  - Average Demand = 195,252 gal/day = 135.59 gpm (Divide by 1,440 min/day)
  - Peak Day Demand = (135.59 gpm)(4) = 542.36 gpm => Use 543 gpm
  - Peak Hour Demand = (135.59 gpm)(11.75) = 1,593.18 gpm => Use 1,594 gpm
  - Highest fire flow demand required = 4,000 gpm
  - Maximum Peak Water Demand = Total Peak + Fire Flow
  - 1,594 gpm + 4,000 gpm = 5,594 gpm = Use 5,600 gpm

* The Reasonable Development Scenario water demand for the proposed Annexation Area is 5,600 gpm.

Summary:

- Per City of Corvallis WDSFP, the minimum diameter distribution pipeline size for Commercial or Residential is 12". [Table 5-2, City of Corvallis WDSFP]

- Fire hydrant 2024 is located on the west side of 53rd Street, approximately 400 lineal feet north of the roundabout intersection at SW West Hills Rd and 53rd Street. This hydrant is attached to a 20" waterline and the available fire flow at 20 psi is 5,339 gpm, per City Fire data.

- Fire hydrant 1957 is located on the north side of SW West Hills Road, approximately 1,100 lineal feet east of the roundabout intersection at SW West Hills road and 53rd Street. This hydrant is attached to a 20" waterline and the available fire flow at 20 psi is "infinity", per City Fire data. Assuming a flow rate of 8 ft/s, the calculated flow rate is 7,833 gpm.

- Construct an 18" mainline loop through the site, connecting to the 20" lines in SW West Hills Road and 53rd Street, to provide system redundancy.

(N)18" WATERLINE

(N)12" WATERLINE

(N)18" WATERLINE

(N)18" WATERLINE

(N)18" WATERLINE

(N)18" WATERLINE

(N)18" WATERLINE

(N)18" WATERLINE

(E)20" WATERLINE

(E)20" WATERLINE

WEST HILLS ROAD

53RD STREET

A

B

C

D

E

F

G

H

WATR

EWATR

PRELIMINARY

DRAWING STATUS:
- [x] PRELIMINARY
- [ ] SUBMITTED
- [ ] BID SET
- [ ] PERMIT SET
- [ ] CONST. SET

DATE: 04/18/17

No.	REVISION:	DATE:

DEVCO engineering inc.
245 NW CONIFER, P.O. BOX 231
CORVALLIS, OR 97339
541 757-1661
WWW.DEVCOENGINEERING.COM

PROJECT: MARY'S ANNEXATION

PROJECT LOCATION: CORVALLIS, OR

CLIENT: CMTWH, LLC

SCALE: 1" = 250'

0 125 250 500

SCALE IN FEET

JOB NO. 16447

DRAWN BY: DEVCO

SHEET TITLE: WATER

DRAWING:

FILE: i:\CIVIL3D Projects\16447\Reports\Annexation Utility Calculations - April 2017\Water\16447_UTIL_EXHB_WATR.dwg [WATR] 4/18/2017 4:51 PM - Kyle

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

www.devcoengineering.com

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

(541) 757-8991
Fax: (541) 757-9885

PROJECT: MARY'S ANNEXATION	PROJECT NO: 16447	DESIGN: KE	DATE: 08/17

PIPE LENGTHS

AC	330'	EF	160'
CD	1300'	EG	300'
BD	1040'	GH	450'
CE	2850'		
DE	1090'		

ELEVATIONS: NEGLIGIBLE, ALL POINTS W/IN APPROXIMATELY 10' MOST RUNS

MAXIMUM WATER DEMAND: 7,250 GPM

INITIAL PRESSURE AT 20 PSI: POINT A = 5,339 GPM
POINT B = 7,833 GPM

* POINTS A & B ARE CONSIDERED INFINITE RESEVOIRS

REQUIRED: POINTS C-H MUST SATISFY MAXIMUM WATER DEMAND
RESIDUAL PRESSURE SHOULD BE 20 PSI

USE: $H_{OUT} = H_{STATIC} - h_e - h_f - h_{MINOR}$

H_{OUT} = RESIDUAL PRESSURE
H_{STATIC} = STATIC PRESSURE
h_e = ELEVATION LOSS (ASSUME 0')
h_f = PIPE FRICTION LOSS
h_{MINOR} = MINOR LOSS (ASSUME 0')

$$h_f = \frac{10.44 \cdot L \cdot Q^{1.85}}{C^{1.85} \, d^{4.8655}}$$

L = LENGTH OF PIPE (FEET)
C = 100 FOR D.I. (CONSTANT)
d = PIPE ⌀ (INCHES)

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

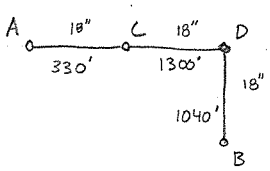
Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT: MARY'S ANNEXATION	PROJECT NO: 16447	DESIGN: KE	DATE: 08/17

AT POINT C



$H_C = H_A - h_{AC}$

$H_C = H_B - h_{BD} - h_{CD}$

$H_A = H_B = 52$ PSI STATIC PRESSURE

SET EQUAL

$$\cancel{H_A} - h_{AC} = \cancel{H_B} - h_{BD} - h_{CD}$$

$$\frac{\cancel{10.44}\,(330')(Q_{AC})^{1.85}}{\cancel{(100)^{1.85}}\,\cancel{(18)^{4.8655}}} = \frac{\cancel{10.44}\,(1300')(Q_{CD})^{1.85}}{\cancel{(100)^{1.85}}\,\cancel{(18)^{4.8655}}} + \frac{\cancel{10.44}\,(1040')(Q_{CD})^{1.85}}{\cancel{(100)^{1.85}}\,\cancel{(18)^{4.8655}}}$$

$$330\ Q_{AC}^{1.85} = (1300+1040)\,Q_{CD}^{1.85}$$

EQ 1

$$Q_{AC}^{1.85} = \left(\frac{2340}{330}\right) Q_{CD}^{1.85}$$

EQ 2

$$7250\ \text{GPM} = Q_{AC} + Q_{CD}$$

SOLVE SIMULTANEOUSLY

$Q_{AC} = 5380$ GPM

$Q_{CD} = 1870$ GPM

CHECK P_C IF $Q_C = 7250$ GPM

$$h_{AC} = \frac{10.44\,(330')(5380\ \text{GPM})^{1.85}}{100^{1.85}\quad 18^{4.8655}} = 4.28' = 2\ \text{PSI}$$

52 PSI − 2 PSI = 50 PSI OK

* PRESSURE AT POINT C WITH REQ'D FIRE FLOWS = 50 PSI

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

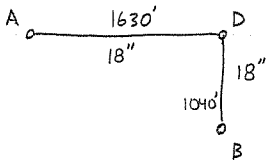
www.devcoengineering.com

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

(541) 757-8991
Fax: (541) 757-9885

PROJECT: MARY'S ANNEXATION	PROJECT NO: 16447	DESIGN: KE	DATE: 08/17

AT POINT D



$H_D = H_A - h_{AD}$

$H_D = H_B - h_{BD}$

$H_A = H_B = 52$ PSI STATIC

SET EQUAL $\quad H_A - h_{AD} = H_B - h_{BD}$

$$\frac{10.44\,(1630')\,Q_{AD}^{1.85}}{100^{1.85}\;18^{4.8655}} = \frac{10.44\,(1040')\,Q_{BD}^{1.85}}{100^{1.85}\;18^{4.8655}}$$

EQ 1 $\quad Q_{AD}^{1.85} = \frac{1040}{1630}\,Q_{BD}^{1.85}$

EQ 2 $\quad 7250\ GPM = Q_{AD} + Q_{BD}$

SOLVE SIMULTANEOUSLY

$Q_{AD} = 3{,}190$ GPM

$Q_{BD} = 4{,}060$ GPM

CHECK P_D IF $Q_D = 7{,}250$ GPM

$$h_{AD} = \frac{10.44\,(1630')(3190\ GPM)^{1.85}}{100^{1.85}\;18^{4.8655}} = 8.04' = 3.5\ PSI$$

$52 \cdot PSI - 3.5\ PSI = 48.5\ PSI$

* PRESSURE AT POINT D WITH REQUIRED FIRE FLOWS = 48.5 PSI

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

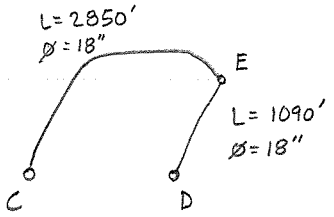
Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT: MARY'S ANNEXATION	PROJECT NO: 16447	DESIGN: KE	DATE: 08/17

AT POINT E



$H_E = H_C - h_{CE}$ $\quad H_C = 50\ PSI = 115.5'$

$H_E = H_D - h_{DE}$ $\quad H_D = 48.5\ PSI = 112.0'$

SET EQUAL $\quad H_C - h_{CE} = H_D - h_{DE}$

$$115.5 - \frac{10.44\,(2850')\,Q_{CE}^{1.85}}{100^{1.85}\ 18^{4.8655}} = 112.0 - \frac{10.44\,(1090')\,Q_{DE}^{1.85}}{100^{1.85}\ 18^{4.8655}}$$

EQ 1 $\quad Q_{CE} = \left[\left(3.5 + \frac{10.44\,(1090')\,Q_{DE}^{1.85}}{100^{1.85}\ 18^{4.8655}}\right) \div \left(\frac{10.44\,(2850')}{100^{1.85}\ 18^{4.8655}}\right)\right]^{1/1.85}$

EQ 2 $\quad 7{,}250\ GPM = Q_{CE} + Q_{DE}$

SOLVE SIMULTANEOUSLY $\quad Q_{CE} = 3010\ GPM$, $Q_{DE} = 4240\ GPM$

CHECK P IF $Q_E = 7{,}250$ GPM

$$H_E = H_C - h_{CE} = 115.5 - \frac{10.44\,(2850')\,(3010\ GPM)^{1.85}}{100^{1.85}\ 18^{4.8655}} = 102.9' = 44.5\ PSI$$

$$H_E = H_C - h_{DE} = 112.0 - \frac{10.44\,(1090')\,(4240\ GPM)^{1.85}}{100^{1.85}\ 18^{4.8655}} = 102.9' = 44.5\ PSI$$

* PRESSURE AT POINT E WITH REQ'D FIRE FLOWS = 44.5 PSI

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

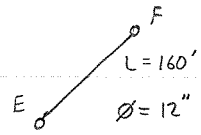
www.devcoengineering.com

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

(541) 757-8991
Fax: (541) 757-9885

PROJECT: MARY'S ANNEXATION	PROJECT NO: 16447	DESIGN: KE	DATE: 08/17

AT POINT F

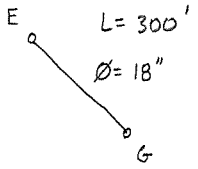


$H_F = H_E - h_{EF}$ $\qquad H_E = 44.5 \text{ PSI} = 102.9'$

$$H_F = 102.9' - \frac{10.44\,(160)(7250\text{ GPM})^{1.85}}{100^{1.85}\,12^{4.8655}} = 77.0' = 33.3 \text{ PSI}$$

* PRESSURE AT POINT F WITH REQ'D FIRE FLOWS = 33.3 PSI

AT POINT G

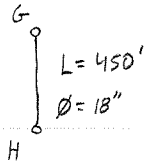


$H_G = H_E - h_{GE}$ $\qquad H_E = 44.5 \text{ PSI} = 102.9'$

$$H_G = 102.9' - \frac{10.44\,(300')(7250\text{ GPM})^{1.85}}{100^{1.85}\,18^{4.8655}} = 96.1' = 41.6 \text{ PSI}$$

* PRESSURE AT POINT G WITH REQ'D FIRE FLOWS = 41.6 PSI

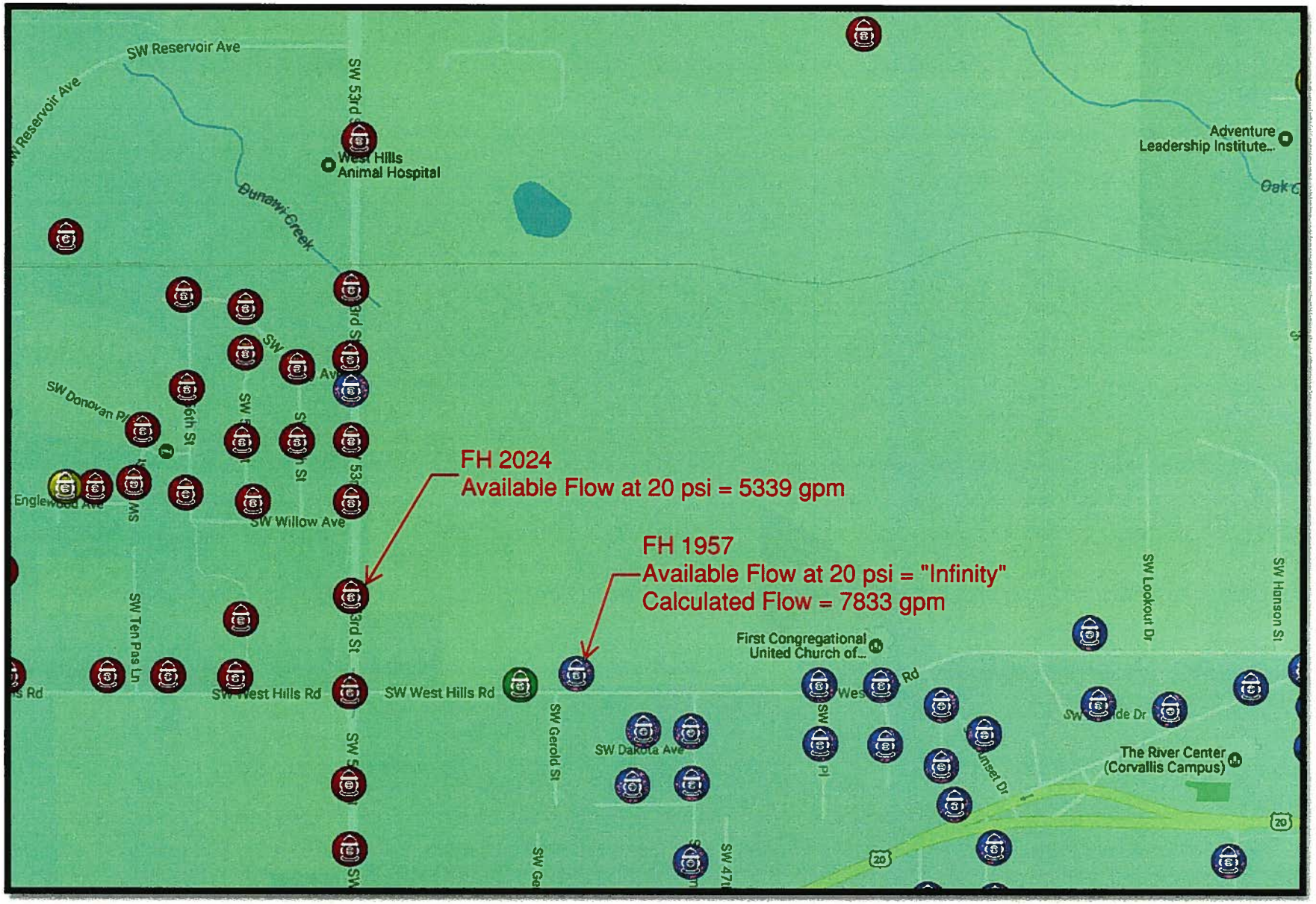
AT POINT H



$H_H = H_G - h_{GH}$ $\qquad H_G = 96.1'$

$$H_H = 96.1' - \frac{10.44\,(450')(7250\text{ GPM})^{1.85}}{100^{1.85}\,18^{4.8655}} = 86.0' = 37.2 \text{ PSI}$$

* PRESSURE AT POINT H WITH REQ'D FIRE FLOWS = 37.2 PSI


SW Reservoir Ave
SW 53rd St
West Hills Animal Hospital
Dunawi Creek
Adventure Leadership Institute...
SW Donovan Pl
SW 6th St
SW Willow Ave
FH 2024
Available Flow at 20 psi = 5339 gpm
FH 1957
Available Flow at 20 psi = "Infinity"
Calculated Flow = 7833 gpm
SW Ten Pas Ln
SW West Hills Rd
SW Gerold St
SW Dakota Ave
First Congregational United Church of...
SW Lookout Dr
SW Hanson St
The River Center (Corvallis Campus)
20

Hydrant Number	1957
Hydrant Location	Lat: 44.556346507, Long: -123.307702437
Hydrant Address	*4801-4999 SW West Hills Rd

Inspection Date: 7/27/2011 9:13 AM

Collected By	ksundbaum
Last Hydrant Flush	
Flow Test Date	7/27/2011 9:13 AM
Flow Hydrant Number	2053
Port 1 Pitot (2.5)	10
Port 2 Pitot (2.5)	10
Port 3 Pitot (4.0)	17
Static PSI	52
Residual PSI	52
***Total Observed Flow**	2531
***Available Flow at 20 PSI**	Infinity
Notes	NEEDS BLUE DOT

Hydrant Number	2024
Hydrant Location	Lat: 44.5574151612, Long: -123.312089544
Hydrant Address	*906-998 SW 53rd St

Inspection Date: 7/27/2011 9:32 AM

Collected By	ksundbaum
Last Hydrant Flush	7/27/2011 9:38 AM
Flow Test Date	
Flow Hydrant Number	1895
Port 1 Pitot (2.5)	1
Port 2 Pitot (2.5)	14
Port 3 Pitot (4.0)	19
Static PSI	52
Residual PSI	45
***Total Observed Flow**	2350
***Available Flow at 20 PSI**	5339

Notes

EXECUTIVE SUMMARY

The Corvallis water distribution system needs to be expanded to improve operational characteristics and to accommodate planned growth in the community. This facility plan evaluates the existing water distribution system, identifies the planned growth for the community, projects water demand which will accompany the future growth, and recommends improvements to the water distribution system. Also included as part of the development of the facility plan is a computer model of the water distribution system to evaluate system operation and the impact of proposed improvements.

The 1996 Comprehensive Plan for the City of Corvallis is the basis for the growth projections in the water system facility plan. Service is planned for the urban growth boundary of Corvallis based upon the zoning that is currently designated for the growth areas. No provisions for water service are included in the facility plan for areas outside the urban growth area.

POPULATION AND WATER DEMAND PROJECTIONS

To develop the water facility plan, land use and population are the primary criteria for estimating future water demands. The projected population for the City of Corvallis are as follows:

Planning Period	Population
1997	50,000
Within 10 to 20 years	60,000
Within 20 to 40 years	80,000
At build out of urban growth boundary	120,000

The annual average water demand for Corvallis for the years 1992 through June 1997 was 7.5 million gallons per day (mgd) while the peak monthly water demand was 11.9 mgd, occurring in July 1996. Based on current water use records, existing development, and the existing population in Corvallis, the following unit water consumption values have been developed for the City of Corvallis:

Land use	Annual Average water consumption
Residential	76 gallons per capita per day
Commercial	1,000 gallons per acre per day
Industrial	3,750 gallons per acre per day
Institutional	1,550 gallons per acre per day

Experience shows that water demand in Corvallis varies seasonally based upon temperature and irrigation needs. Based on recent water production records and on residential water use data, the peaking factors used to estimate water use variations are shown in Table 1.

Table 1. Peaking Factors[a]

Description	Factor
Maximum month demand	1.5
Maximum daily demand	
Residential only	4.0
Average for city	2.0
Peak hourly demand	
Residential only	11.75
Average for city	4.6

[a] The annual average demand multiplied by the peaking factor yields the respective peak demand.

Given these factors and the unit consumption values presented above, the water demand for the community is summarized in Table 2.

Table 2. Water Demand Summary

Population inside urban growth boundary	Average daily water demands, mgd	Maximum daily water demand, mgd
50,000	7.5	15
60,000	10.0	20
80,000	13.5	27
120,000	20.0	40

Table 4-5. Corvallis Water Use for 1996/1997

Month	Average daily demand, mg	Peak daily demand, mg
July	11.92	14.42
August	11.41	13.10
September	8.46	11.42
October	7.05	8.10
November	6.76	8.16
December	6.28	7.22
January	6.62	7.35
February	6.52	7.22
March	6.34	6.90
April	6.60	7.01
May	8.10	10.12
June	8.54	9.87
Average	7.90	-----

The average annual demand over the 5-year period was 7.49 million gallons per day (mgd). The peak monthly demand occurred in July 1996 and averaged 11.92 mgd. The lowest monthly demand occurred in December 1994 and averaged 5.66 mgd. The peak daily demand of 14.94 mgd occurred in July 1994.

Table 4-6 shows the average daily water demand for 1992 to 1997 divided by the population for those years. The average daily water demand varies from 153 gallons per capita per day (gpcd) to 160 gpcd, with an average of 157 gpcd. Note that these demands include all uses, including residential, commercial, industrial, and public/institutional.

Unit Consumption Values

An evaluation of the water use records for individual classes of users was prepared. These data are useful in planning future water demands based upon current consumption patterns and land use plans for future growth. Table 4-7 shows the water use of selected customers for the year 1992/1993. As shown in Table 4-6, the average demand in 1992/1993 was 153 gpcd, a value 2.6 percent lower than the average demand between 1992 and 1997 of 157 gpcd. Therefore, the demand values from Table 4-7 should be increased by 2.6 percent to more closely approximate average demand.

Residential Water Use. The average annual residential water use in 1992/1993 was 3.42 mgd. Since the population was approximately 46,000 people, residential demand averaged 74 gpcd. A value of 76 gpcd is calculated by increasing the value by 2.6 percent. For planning purposes, the average residential water demand of 76 gpcd is used for residential development.

Table 4-6. Corvallis Water Use for 1992 to 1997, gpcd

Year	Population	Average demand, mgd	Average demand*, gpcd
1992-1993	46,260	7.06	153
1993-1994	46,195	7.23	157
1994-1995	47,485	7.59	160
1995-1996	49,275	7.68	156
1996-1997	50,000	7.90	158

* Demands include all uses, including residential, commercial, industrial, and public/institutional.

Table 4-7. Corvallis Water Use of Customer Classes for 1992/1993

Month	Demand (mgd)			
	All residential	All commercial/industrial	Hewlett-Packard	OSU
December	2.86	2.04	0.55	0.71
January	2.52	1.89	0.60	0.55
February	2.97	2.04	0.61	0.74
March	2.70	1.77	0.52	0.63
April	2.77	1.83	0.60	0.59
May	2.62	1.94	0.58	0.73
June	3.38	2.29	0.58	0.74
July	4.21	2.68	0.67	0.85
August	4.74	3.07	0.71	1.08
September	5.17	3.15	0.74	1.10
October	4.15	2.97	0.74	0.93
November	2.93	2.29	0.66	0.77
Annual average	3.42	2.33	0.63	0.79
Percent of total annual average demand	47.7	32.5	8.8	11.0

Commercial Water Use. Commercial water demand was estimated based on an average use rate of 1,000 gallons per acre per day (gpad). This planning value represents a typical value for commercial development.

Industrial Water Use. Using the total of 1992 to 1993 water used by all industrial and commercial users and assuming an average commercial water use of 1,000 gpad, the average industrial water use was 3,560 gpad. Increasing the total industrial and commercial use by 2.6 percent and assuming an average commercial use of 1,000 gpad, the average industrial water use is 3,653 gpad. Hewlett-Packard's water use was 3,778 gpad, spread out over the 167 acres the Hewlett-Packard property covers. For planning purposes, the average industrial demand of 3,750 gpad is used.

Public/Institutional Water Use. Institutional water use in Corvallis includes churches, schools, hospitals, parks, and the airport. Oregon State University, which covers approximately 532 acres, represents approximately 65 percent of the public and institutional land area within the current city limits. The water use for Oregon State University for 1992 to 1993 averaged 1,477 gpad. With an increase of 2.6 percent, the average demand is 1,515 gpad. For planning purposes, the public and institutional average demand of 1,550 gpad is used.

The water use values derived above were used to calculate existing water demand as well as future demand.

Nonrevenue Water Production

Water supply and distribution systems experience unaccounted water losses due to the combined effect of unmetered customers, leakage, inaccurate meters, system flushing, and miscellaneous hydrant uses. As a result, a portion of the water produced cannot be accounted for when the results of treatment plant production are compared to the summation of metered uses.

Nonrevenue water production for Corvallis has been determined by comparison of the total of all metered water consumption with the amount of water metered at the water treatment plants. A 5-year history of unaccounted water is shown in Table 4-8. A rate of 10 to 15 percent is considered good performance.

The city has a program to test and repair meters and all customers are metered. An audit of the system may or may not discover additional savings. As new pipes are added to the system and older pipes replaced, the loss of water through leakage may be reduced.

Table 4-8. Unaccounted for Water; 1992 to 1997

Year	Million gallons	Percent of total water production
1992/1993	157.38	6.1
1993/1994	315.42	12.0
1994/1995	248.41	9.0
1995/1996	287.09	10.2
1996/1997	177.74	6.2

Rates of Water Use

Effective planning and design of water supply, treatment and distribution facilities requires consideration of short-term water demand variations as well as average annual usage. Treatment plant design and operation is influenced by monthly and daily demands, and transmission and distribution mains, storage reservoirs and pumping stations are sized based on peak demands. Factors have been developed to convert average demands to peak demands based on water use records for the Corvallis system. These factors are discussed below.

Annual Water Demand. As shown in Tables 4-1 through 4-5, the average annual water demand varied between 7.06 and 7.90 mgd. Average annual demand for the Corvallis water system for the years 1992 to 1997 was 7.49 mgd.

Monthly Water Variations. Monthly water demand variations for the Corvallis water distribution systems are shown in Tables 4-1 through 4-5. The tables illustrate the seasonal nature of water demand in Corvallis. The monthly water use ranges from a low of 75 percent of the average annual demand, to a maximum of 153 percent of average annual demand. The maximum monthly water use averaged 149 percent of the average annual demand. This variation is mainly due to water use for irrigation during the summer months. For this study, maximum month water demand is determined by multiplying average day demand by a factor of 1.5.

Maximum Daily Demand. Maximum daily demand varies with the extremes of climate and the mix of customers using the water. Maximum daily demand is almost always on days of highest summer temperatures, when landscape irrigation and other uses peak. Table 4-9 shows that for the period between 1992 and 1997, the ratio of peak to average is approximately 2.0. This is a relatively low peak to average ratio, perhaps as a result of larger industrial demands that tend to be uniform around the year. A typical value is 2.5. For comparison, the peaking factor in Portland is approximately 2.4.

Table 4-9. Maximum Daily Demand Ratio for Corvallis; 1992 to 1997

Year	Annual average demand, mgd	Peak day demand, mgd	Ratio of maximum day to annual average demand
1992/1993	7.06	13.39	1.90
1993/1994	7.23	14.87	2.06
1994/1995	7.59	14.94	1.97
1995/1996	7.68	14.65	1.91
1996/1997	7.90	14.42	1.83
Average	7.49	14.45	1.92

For this study the maximum daily water demand was determined by multiplying average daily demand by a factor of 4.0 for areas which are predominantly residential (second and third service levels). For the combination of all users within the service area, including residential, commercial, industrial, and public/institutional users, the maximum daily water demand was determined by multiplying average daily demand by a factor of 2.0. The same value is used for projecting future water demands.

Peak Hourly Demand. Based on actual water meter readings in specific areas of the city, this study uses a peak hourly demand factor of 11.75 for residential users and by a factor of 4.6 for the combination of all users within the service area to estimate peak hourly demand.

The peaking factors used in this study are presented in Table 4-10.

Table 4-10. Peaking Factors[a]

Description	Factor
Maximum month demand	1.5
Maximum daily demand	
Residential only	4.0
Average for city	2.0
Peak hourly demand	
Residential only	11.75
Average for city	4.6

[a] The average demand multiplied by the peaking factor yields the respective peak demand.

FUTURE WATER USE

Planning of water supply and distribution systems requires projection of future water requirements, based on population forecasts, land use plans and unit water use values.

Present Water Use

Currently, the population within the urban growth boundary is approximately 50,000. The average daily water demand is 7.5 mgd and maximum daily demand is 15 mgd.

Water Demand in 10 to 20 Years

The anticipated 10 to 20-year growth is an increase of 10,000 people and a population of 60,000 within the city limits. Average daily water demands is projected to be 10 mgd with a corresponding maximum daily demand of 20 mgd.

Water Demand in 20 to 40 Years

The projected population in 20 to 40 years is 80,000 within the city limits. Average daily water demand is projected to be 13.5 mgd and the maximum daily demand 27 mgd.

Build Out Development

The projected population within the urban growth boundary at build out development is 120,000. Average daily water demands for build out development is 20 mgd and the maximum daily demand 40 mgd.

Water demands are summarized in Table 4-11.

Table 4-11. Water Demand Summary

Population inside urban growth boundary	Average daily water demands, mgd	Maximum daily water demand, mgd
50,000	7.5	15
60,000	10.0	20
80,000	13.5	27
120,000	20.0	40

water supply and distribution system. The adequacy of the system is determined by comparing it to an ideal system. Forty percent of the ISO rating is determined by the condition and adequacy of the water system.

Fire Flow Requirements. The ISO has also developed a method of determining the required fire flow for structures that is based on the structures, size, materials of construction and exposure distance to adjacent buildings. A water system should be designed to deliver the required fire flow during a maximum day demand for the prescribed duration. Using ISO guidelines, the fire flow requirements within the Corvallis urban growth boundary have been established by the Corvallis Fire Department. These requirements are shown in Table 5-1. The table shows the total volume of water required for one typical fire. These values were used to size storage reservoirs. The reservoirs are sized for each service level by using the largest volume from one typical fire occurring on that service level. As an example, the largest fire flow volume which may be needed on the first service level is 2.3 MG. The reservoirs on the first service level are sized to accommodate this volume.

Fire Pressure Requirements. The fire flow standards set by the ISO require a minimum residual water pressure of 20 psi during a fire. Residual pressure, in this instance, is defined as the pressure in the main system near or within the zone where hydrant flows are occurring.

Pipeline Network. The distribution system should be designed with looped systems. The looped systems allow water to be delivered to a demand through more than one pipeline, increasing system reliability, improving water quality, and reducing headlosses. The ISO standards require that primary and secondary feeders extend throughout the system. These should be of sufficient size, considering their length and the characteristics of the area served, to deliver fire flow and consumption demands to all areas. The grid of distribution mains should consist of mains described in Table 5-2, which shows the minimum size recommended for the distribution system. If street layout or topography are not well suited to this arrangement, or dead ends and poor griding are unavoidable, the minimum main size should be determined by hydraulic evaluation.

Because this report is concerned with larger distribution pipelines, a detailed layout of minor distribution pipelines is beyond its scope. Minor distribution pipelines carry water to customers throughout the service area. Transmission and distribution pipelines should be routed through proposed new roadway right-of-ways and past planned residential developments and schools to provide the highest degree of fire protection.

Table 5-1. Fire Flow Requirements

Land-use classifications	Recommended fire flows*		
	Quantity, gpm	Duration, hours	Total volume for one typical fire, MG
Principal Business District	4,500	4	1.10
Minor Business Districts			
Partially or Unsprinklered Businesses	4,500	4	1.10
Fully Sprinklered Businesses	3,000	3	0.54
Schools and Institutions			
Elementary and Junior High Schools			
Typical Without Sprinkler Systems	4,000	4	1.00
Typical With Sprinkler System	3,000	3	0.54
High Schools			
Corvallis	5,500	5	1.60
Crescent Valley	5,500	5	1.60
Oregon State University			
Low Fire Hazard—1-2 stories, sprinklered, separated from nearby structures	3,000	3	0.54
Medium Fire Hazard—multi-story, sprinklered, some exposure to nearby structures	5,000	5	1.50
High Fire Hazard—multi-story, partly (or not at all) sprinklered, exposed to nearby structures	6,500	6	2.30
Hospital			
Good Samaritan	1,750	2	0.21
Industrial Areas and Tracts			
Partially or Unsprinklered Buildings	4,500	4	1.10
Fully Sprinklered Buildings	3,000	3	0.54
Hewlett-Packard	4,500	4	1.10
Residential			
Rural	1,000	2	0.12
Single-Family, Low Density	1,000	2	0.12
Single-Family, Medium Density	1,500	2	0.18
Single-Family, High Density	2,000	2	0.24
Multi-Family, High Density	3,000	3	0.54
Apartments and Dormitories	4,000	4	1.10

* Recommended fire flows were determined by following ISO guidelines and were reviewed by the Corvallis Fire Department in 1994.

Table 5-2. Minimum Size of Distribution Pipelines

Area*	Minimum diameter (inches)
Residential, low density	8
Residential, low density	8
Residential, medium density	10
Commercial	10
Industrial	12
Public use	10

* Guide for Determination of Required Fire Flow, Insurance Services Office, December 1974.

Valves. To isolate sections of main in the event of a break or for new construction, ISO standards require that the system be equipped with an adequate number of properly located valves. Table 5-3 presents the maximum valve spacing for long runs of pipelines that serve different functions. Connections of smaller mains in the distribution system to transmission pipelines should be valved so that the service disruption in any of the smaller mains does not require the major transmission line to be shut down. Service taps to transmission pipelines larger than 12-inches should be avoided. Within the distribution gridwork, valves should be placed on all but one leg at tees and crosses in an organized pattern that minimizes the length of pipeline shut down whenever repairs are needed.

Table 5-3. Maximum Valve Spacing Recommended by ISO

Pipeline function	Maximum spacing
Supply pipeline	1 mile
Transmission pipeline	1/4 mile
Residential distribution	800 feet
Commercial distribution	500 feet

Stormwater Calculations

DEVCO engineering inc.

Physical Address
245 NE Conifer Blvd.
Corvallis, OR 97330

Mailing Address
P.O. BOX 1211
Corvallis, OR 97339

www.devcoengineering.com

(541) 757-8991
Fax: (541) 757-9885

PROJECT:	Mary's Annexation	PROJECT NO:	16447	DESIGN:	K.E.	DATE:	08/17

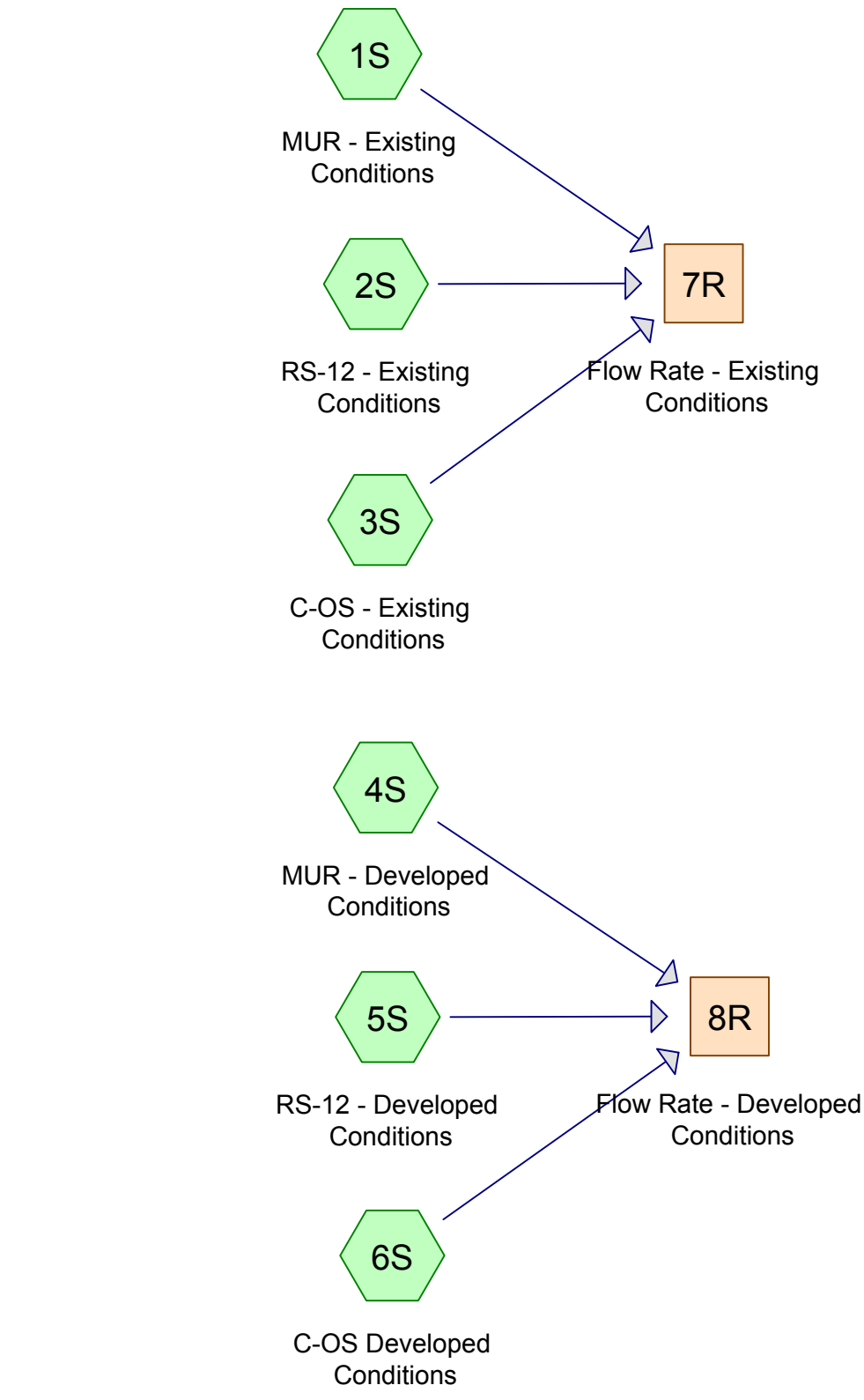
Stormwater Calculations

Stormwater Calculations for the Marysville Annexation were calculated using HydroCAD software. The zones being annexed in are RS-12, MUR, and C-OS.

A summary of the stormwater calculations for the existing conditions and the proposed annexation areas are below.

- Existing Conditions:
  - The 10-year peak stormwater runoff is 21.96 cfs.
- Proposed Annexation Area:
  - The 10-year peak stormwater runoff is 79.07 cfs.
- It is expected that there will be a 260% increase in stormwater runoff due to the proposed annexation change for the 10-year, 24-hour storm event.

Under the requirements of the City's Stormwater Design Standards, the rate of stormwater discharge from the site will match or be less than the existing rate of discharge up to the 10-year, 24-hour rainfall event with the use of stormwater detention facilities. The detention facilities on site shall be sized to detain stormwater runoff and discharge at a rate allowed per the City of Corvallis Standards. This is due to the requirement of the development to provide detention facilities and flow control structures to limit stormwater runoff to historic pre-developed runoff rates.



Subcat Reach Pond Link

Drainage Diagram for 16-447_Stormwater Calculations
Prepared by {enter your company name here}, Printed 8/25/2017

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
10.640	65	Woods/grass comb., Fair, HSG B (1S, 2S)
62.790	76	Woods/grass comb., Fair, HSG C (1S, 2S)
29.610	79	Woods/grass comb., Fair, HSG C/D (1S, 2S, 3S, 6S)
25.090	82	Woods/grass comb., Fair, HSG D (1S, 2S, 3S, 6S)
9.690	85	1/8 acre lots, 65% imp, HSG B (5S)
52.590	90	1/8 acre lots, 65% imp, HSG C (5S)
14.140	91	1/8 acre lots, 65% imp, HSG C/D (5S)
14.730	92	1/8 acre lots, 65% imp, HSG D (5S)
0.950	92	Urban commercial, 85% imp, HSG B (4S)
10.200	94	Urban commercial, 85% imp, HSG C (4S)
4.070	94	Urban commercial, 85% imp, HSG C/D (4S)
2.760	95	Urban commercial, 85% imp, HSG D (4S)
237.260		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
21.280	HSG B	1S, 2S, 4S, 5S
173.400	HSG C	1S, 2S, 3S, 4S, 5S, 6S
42.580	HSG D	1S, 2S, 3S, 4S, 5S, 6S
0.000	Other	
237.260		**TOTAL AREA**

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

Subcatchment1S: MUR - Existing Runoff Area=17.980 ac 0.00% Impervious Runoff Depth>0.59"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=77 Runoff=1.44 cfs 0.883 af

Subcatchment2S: RS-12 - Existing Runoff Area=91.150 ac 0.00% Impervious Runoff Depth>0.55"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=76 Runoff=6.48 cfs 4.170 af

Subcatchment3S: C-OS - Existing Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>0.77"
Tc=0.0 min CN=80 Runoff=1.85 cfs 0.612 af

Subcatchment4S: MUR - Developed Runoff Area=17.980 ac 85.00% Impervious Runoff Depth>1.63"
Tc=5.0 min CN=94 Runoff=9.03 cfs 2.438 af

Subcatchment5S: RS-12 - Developed Runoff Area=91.150 ac 65.00% Impervious Runoff Depth>1.35"
Tc=5.0 min CN=90 Runoff=36.32 cfs 10.283 af

Subcatchment6S: C-OS Developed Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>0.77"
Tc=0.0 min CN=80 Runoff=1.85 cfs 0.612 af

Reach 7R: Flow Rate - Existing Conditions Inflow=8.60 cfs 5.664 af
Outflow=8.60 cfs 5.664 af

Reach 8R: Flow Rate - Developed Conditions Inflow=47.14 cfs 13.332 af
Outflow=47.14 cfs 13.332 af

Total Runoff Area = 237.260 ac Runoff Volume = 18.996 af Average Runoff Depth = 0.96"
68.59% Pervious = 162.730 ac 31.41% Impervious = 74.531 ac

Summary for Subcatchment 1S: MUR - Existing Conditions

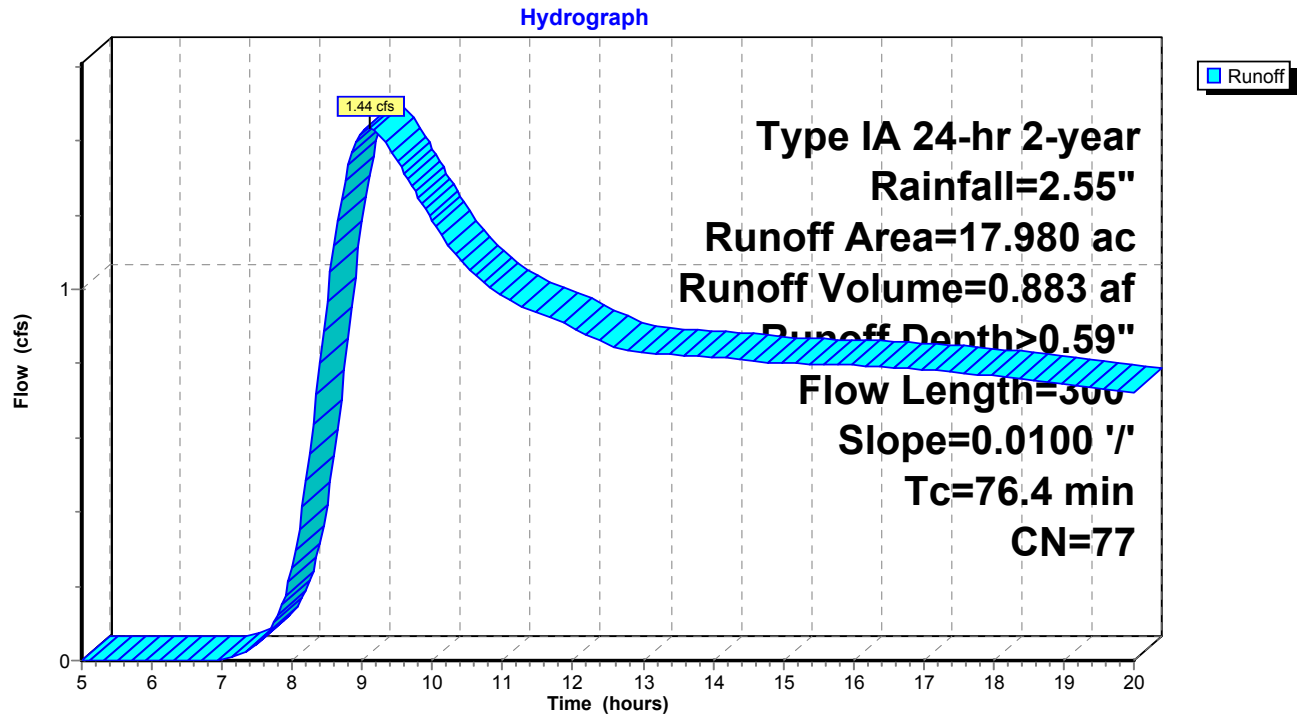
Runoff = 1.44 cfs @ 9.09 hrs, Volume= 0.883 af, Depth> 0.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.55"

	Area (ac)	CN	Description
	0.950	65	Woods/grass comb., Fair, HSG B
	10.200	76	Woods/grass comb., Fair, HSG C
*	4.070	79	Woods/grass comb., Fair, HSG C/D
	2.760	82	Woods/grass comb., Fair, HSG D
	17.980	77	Weighted Average
	17.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 1S: MUR - Existing Conditions



Summary for Subcatchment 2S: RS-12 - Existing Conditions

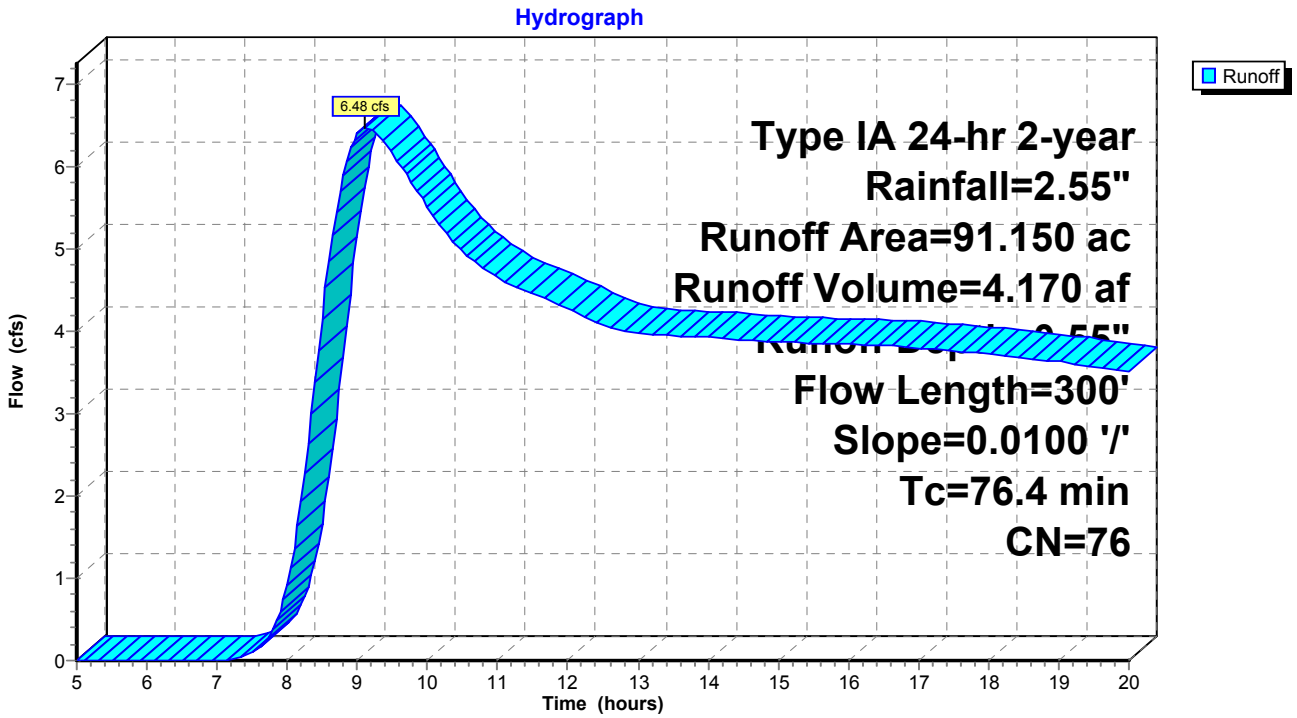
Runoff = 6.48 cfs @ 9.12 hrs, Volume= 4.170 af, Depth> 0.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.55"

	Area (ac)	CN	Description
	9.690	65	Woods/grass comb., Fair, HSG B
	52.590	76	Woods/grass comb., Fair, HSG C
*	14.140	79	Woods/grass comb., Fair, HSG C/D
	14.730	82	Woods/grass comb., Fair, HSG D
	91.150	76	Weighted Average
	91.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 2S: RS-12 - Existing Conditions



Summary for Subcatchment 3S: C-OS - Existing Conditions

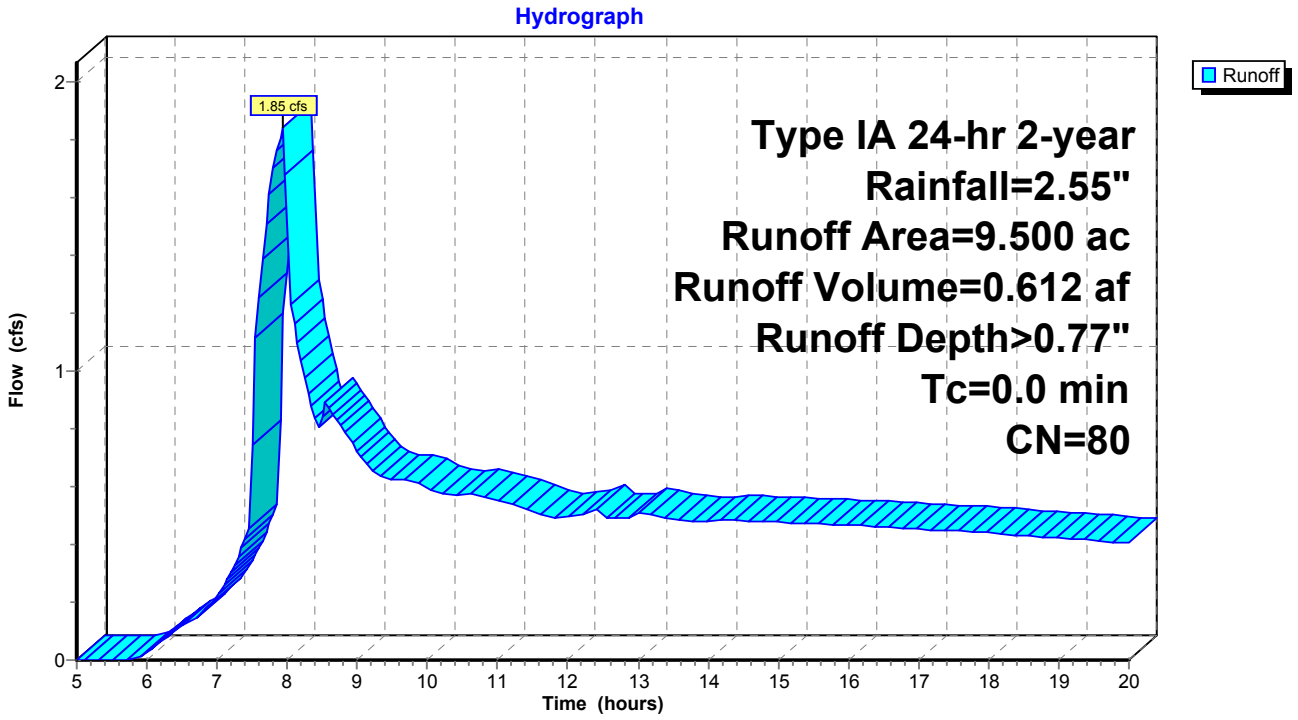
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 1.85 cfs @ 7.93 hrs, Volume= 0.612 af, Depth> 0.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.55"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 3S: C-OS - Existing Conditions



Summary for Subcatchment 4S: MUR - Developed Conditions

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

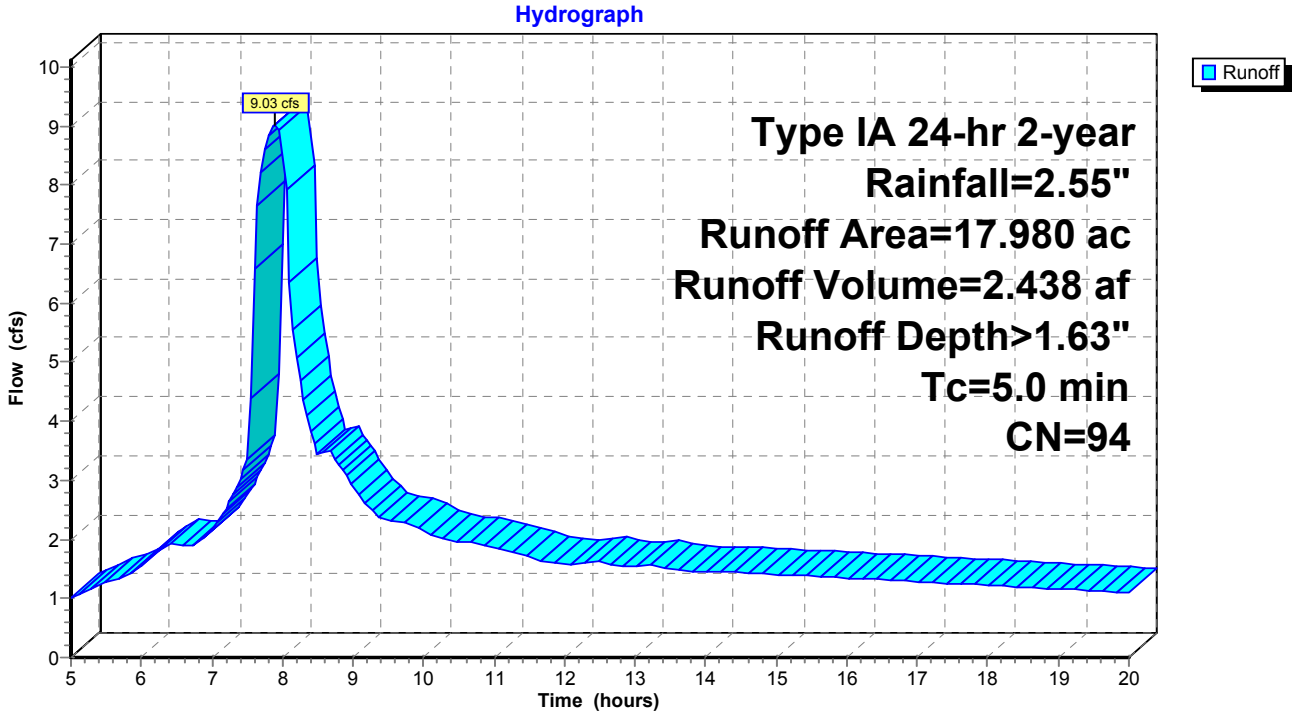
Runoff = 9.03 cfs @ 7.89 hrs, Volume= 2.438 af, Depth> 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.55"

	Area (ac)	CN	Description
	0.950	92	Urban commercial, 85% imp, HSG B
	10.200	94	Urban commercial, 85% imp, HSG C
*	4.070	94	Urban commercial, 85% imp, HSG C/D
	2.760	95	Urban commercial, 85% imp, HSG D
	17.980	94	Weighted Average
	2.697		15.00% Pervious Area
	15.283		85.00% Impervious Area

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

Subcatchment 4S: MUR - Developed Conditions



Summary for Subcatchment 5S: RS-12 - Developed Conditions

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

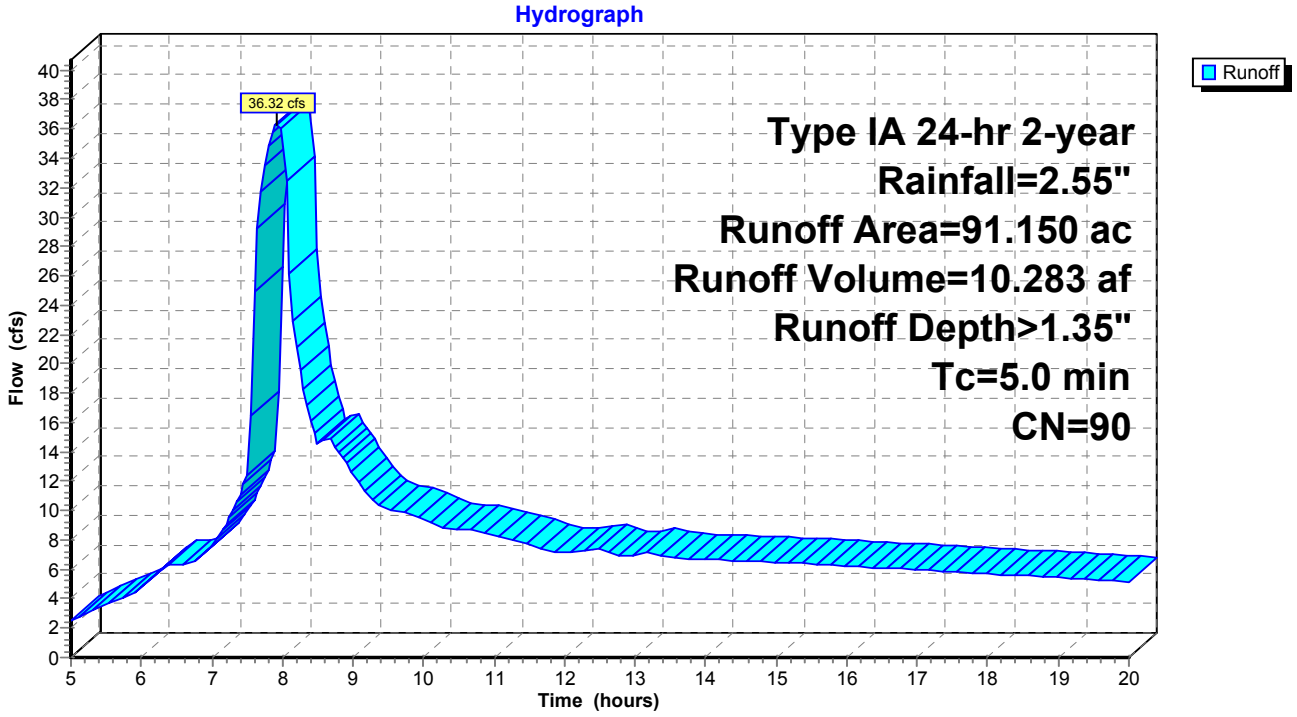
Runoff = 36.32 cfs @ 7.93 hrs, Volume= 10.283 af, Depth> 1.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.55"

	Area (ac)	CN	Description
	9.690	85	1/8 acre lots, 65% imp, HSG B
	52.590	90	1/8 acre lots, 65% imp, HSG C
*	14.140	91	1/8 acre lots, 65% imp, HSG C/D
	14.730	92	1/8 acre lots, 65% imp, HSG D
	91.150	90	Weighted Average
	31.903		35.00% Pervious Area
	59.248		65.00% Impervious Area

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

Subcatchment 5S: RS-12 - Developed Conditions



Summary for Subcatchment 6S: C-OS Developed Conditions

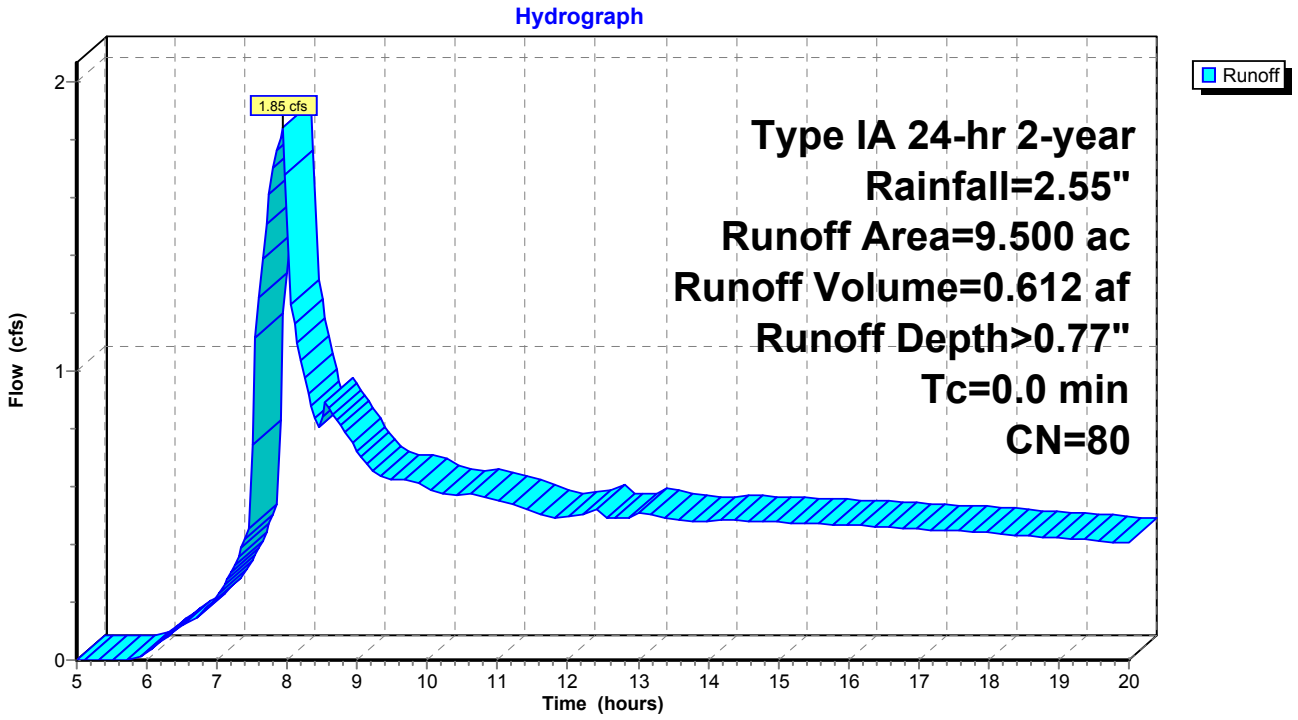
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 1.85 cfs @ 7.93 hrs, Volume= 0.612 af, Depth> 0.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Rainfall=2.55"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 6S: C-OS Developed Conditions



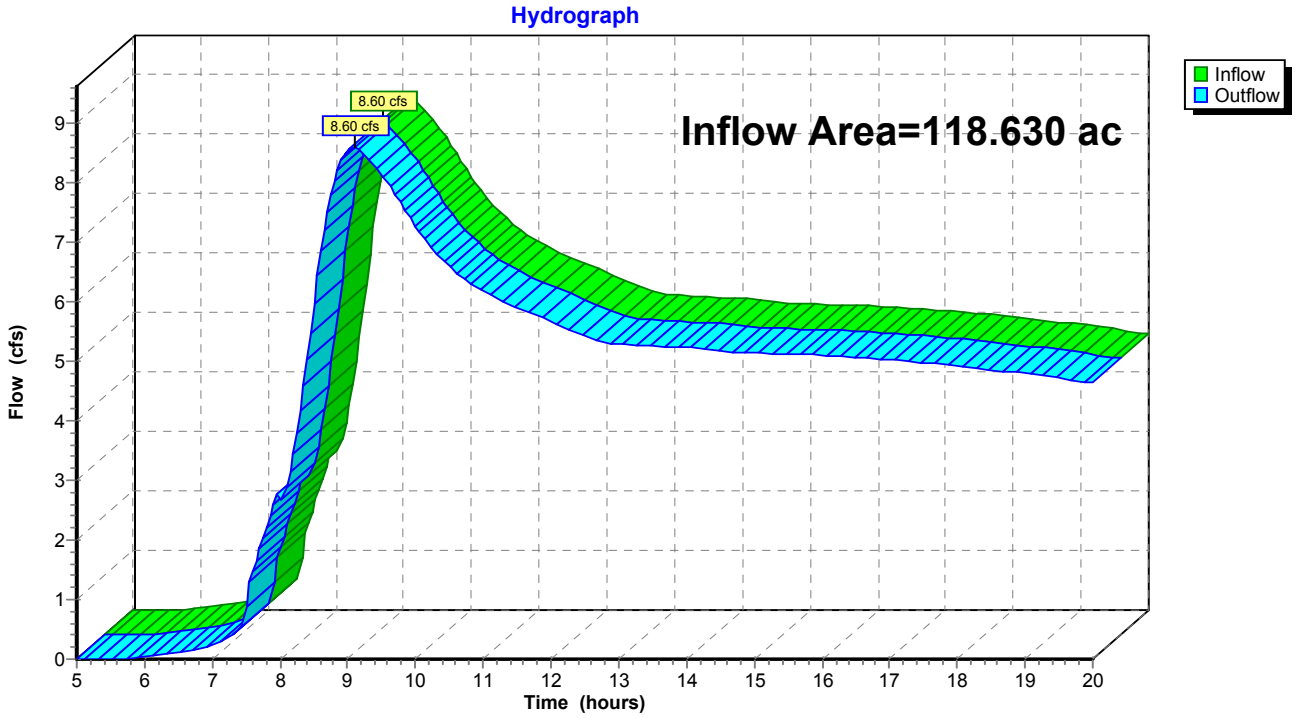
Summary for Reach 7R: Flow Rate - Existing Conditions

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

Inflow Area = 118.630 ac, 0.00% Impervious, Inflow Depth > 0.57" for 2-year event
Inflow = 8.60 cfs @ 9.10 hrs, Volume= 5.664 af
Outflow = 8.60 cfs @ 9.10 hrs, Volume= 5.664 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 7R: Flow Rate - Existing Conditions



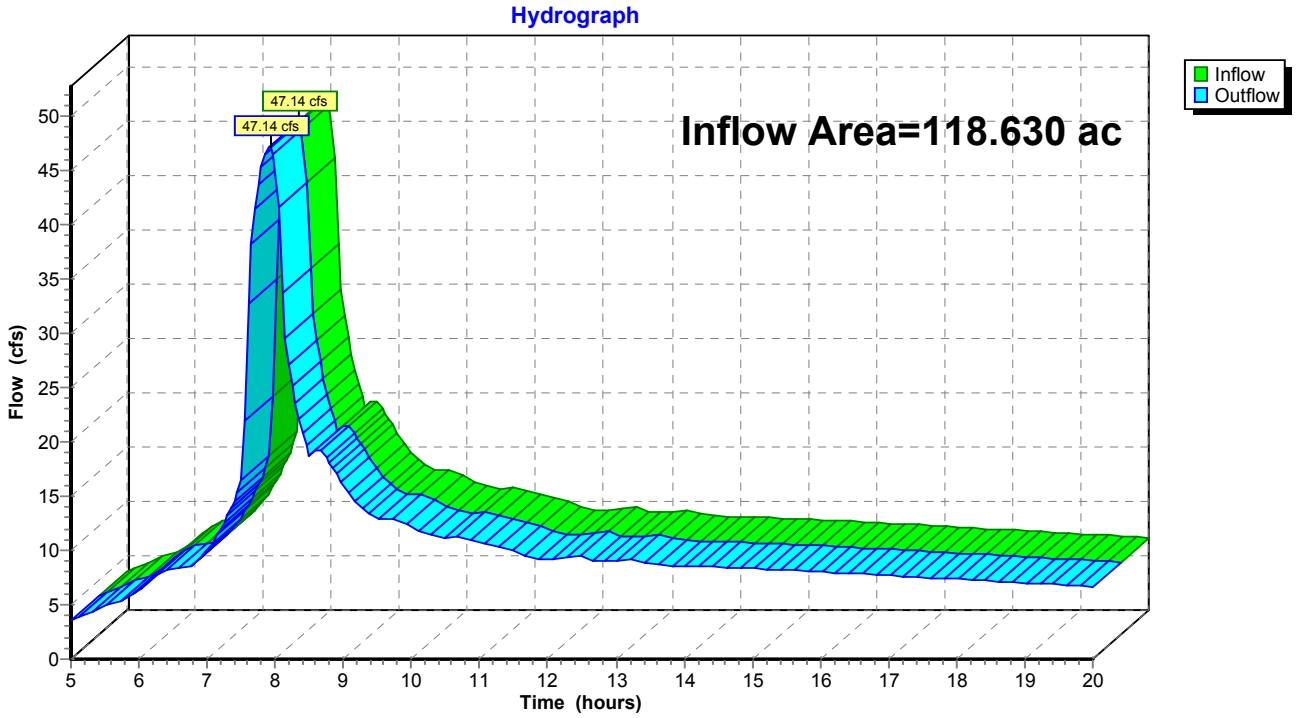
Summary for Reach 8R: Flow Rate - Developed Conditions

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

Inflow Area = 118.630 ac, 62.83% Impervious, Inflow Depth > 1.35" for 2-year event
Inflow = 47.14 cfs @ 7.92 hrs, Volume= 13.332 af
Outflow = 47.14 cfs @ 7.92 hrs, Volume= 13.332 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 8R: Flow Rate - Developed Conditions



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

Subcatchment1S: MUR - Existing Runoff Area=17.980 ac 0.00% Impervious Runoff Depth>0.78"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=77 Runoff=2.08 cfs 1.174 af

Subcatchment2S: RS-12 - Existing Runoff Area=91.150 ac 0.00% Impervious Runoff Depth>0.74"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=76 Runoff=9.59 cfs 5.594 af

Subcatchment3S: C-OS - Existing Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>1.00"
Tc=0.0 min CN=80 Runoff=2.46 cfs 0.791 af

Subcatchment4S: MUR - Developed Runoff Area=17.980 ac 85.00% Impervious Runoff Depth>1.91"
Tc=5.0 min CN=94 Runoff=10.69 cfs 2.864 af

Subcatchment5S: RS-12 - Developed Runoff Area=91.150 ac 65.00% Impervious Runoff Depth>1.63"
Tc=5.0 min CN=90 Runoff=44.41 cfs 12.392 af

Subcatchment6S: C-OS Developed Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>1.00"
Tc=0.0 min CN=80 Runoff=2.46 cfs 0.791 af

Reach 7R: Flow Rate - Existing Conditions Inflow=12.60 cfs 7.560 af
Outflow=12.60 cfs 7.560 af

Reach 8R: Flow Rate - Developed Conditions Inflow=57.54 cfs 16.047 af
Outflow=57.54 cfs 16.047 af

Total Runoff Area = 237.260 ac Runoff Volume = 23.607 af Average Runoff Depth = 1.19"
68.59% Pervious = 162.730 ac 31.41% Impervious = 74.531 ac

Summary for Subcatchment 1S: MUR - Existing Conditions

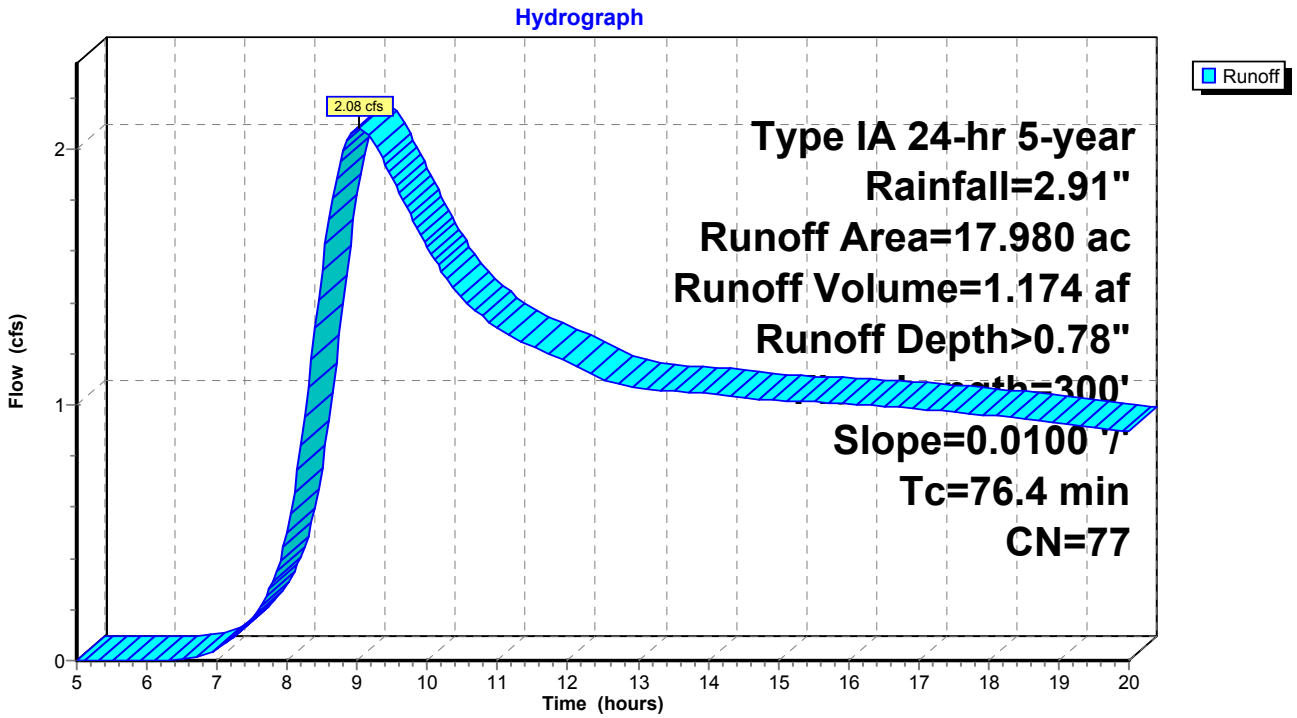
Runoff = 2.08 cfs @ 9.02 hrs, Volume= 1.174 af, Depth> 0.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-year Rainfall=2.91"

	Area (ac)	CN	Description
	0.950	65	Woods/grass comb., Fair, HSG B
	10.200	76	Woods/grass comb., Fair, HSG C
*	4.070	79	Woods/grass comb., Fair, HSG C/D
	2.760	82	Woods/grass comb., Fair, HSG D
	17.980	77	Weighted Average
	17.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 1S: MUR - Existing Conditions



Summary for Subcatchment 2S: RS-12 - Existing Conditions

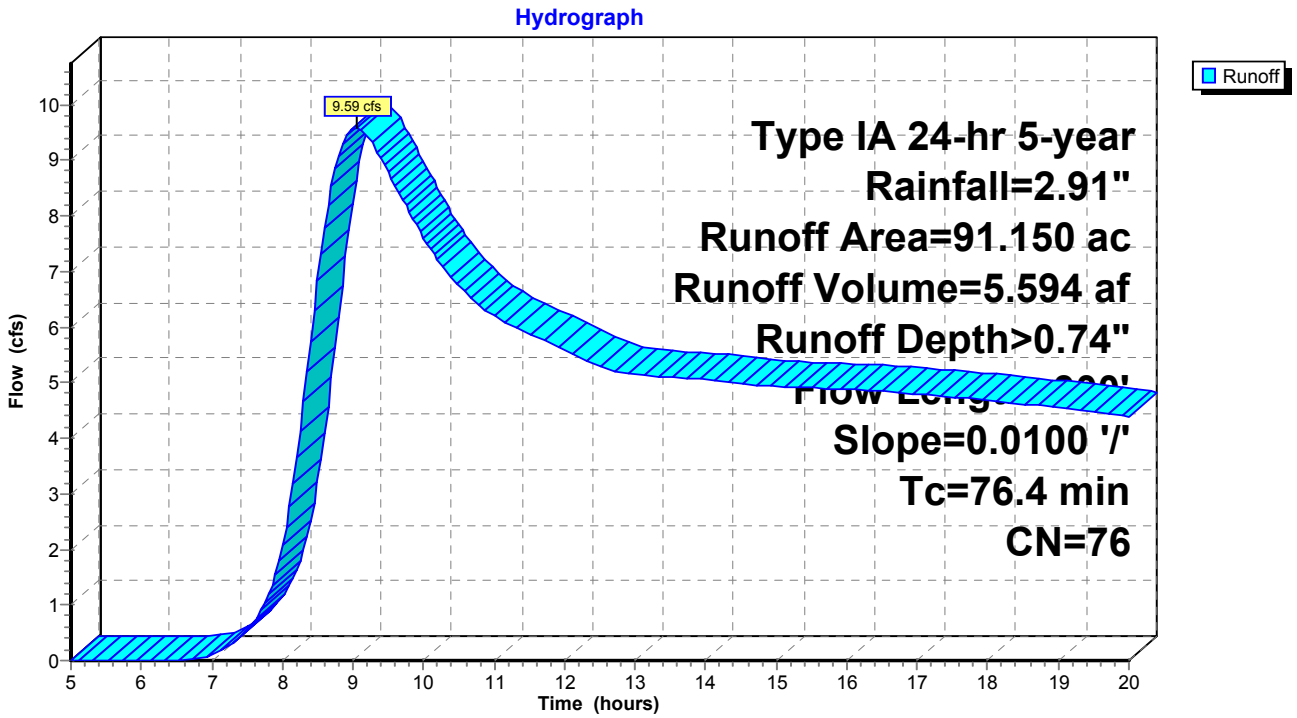
Runoff = 9.59 cfs @ 9.05 hrs, Volume= 5.594 af, Depth> 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-year Rainfall=2.91"

	Area (ac)	CN	Description
	9.690	65	Woods/grass comb., Fair, HSG B
	52.590	76	Woods/grass comb., Fair, HSG C
*	14.140	79	Woods/grass comb., Fair, HSG C/D
	14.730	82	Woods/grass comb., Fair, HSG D
	91.150	76	Weighted Average
	91.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 2S: RS-12 - Existing Conditions



Summary for Subcatchment 3S: C-OS - Existing Conditions

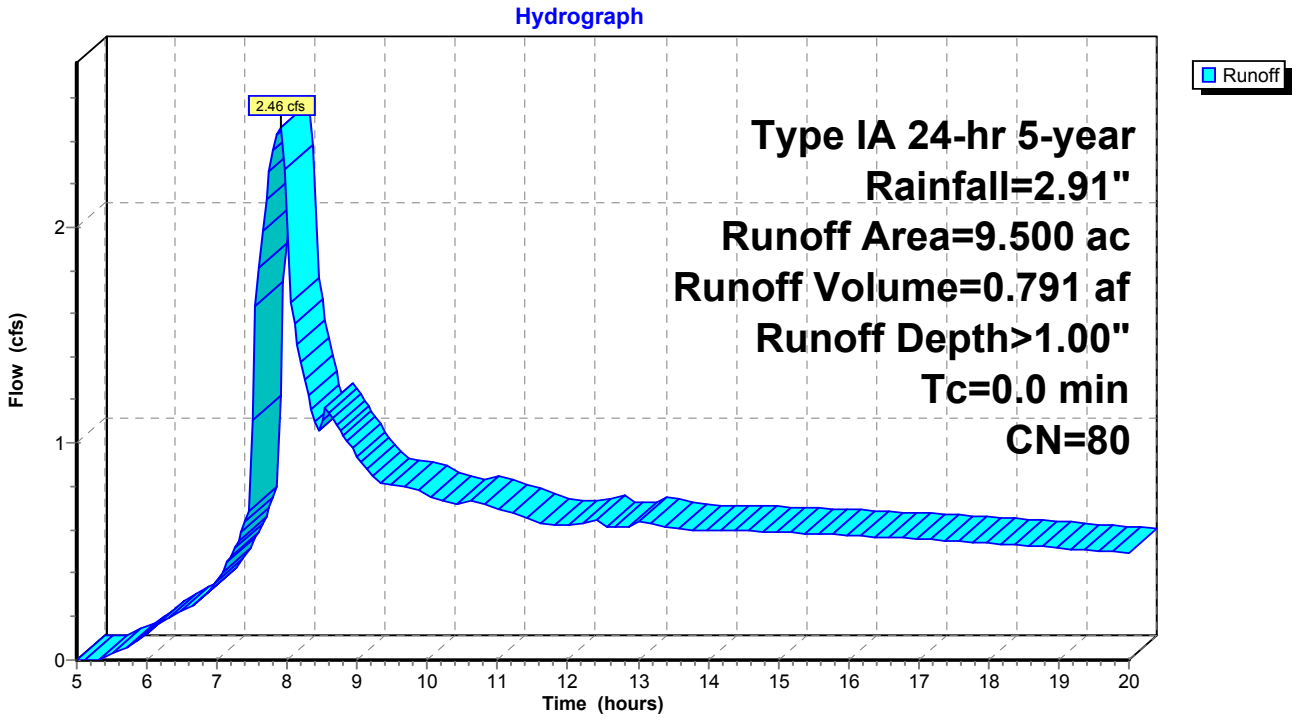
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 2.46 cfs @ 7.92 hrs, Volume= 0.791 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-year Rainfall=2.91"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 3S: C-OS - Existing Conditions



Summary for Subcatchment 4S: MUR - Developed Conditions

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

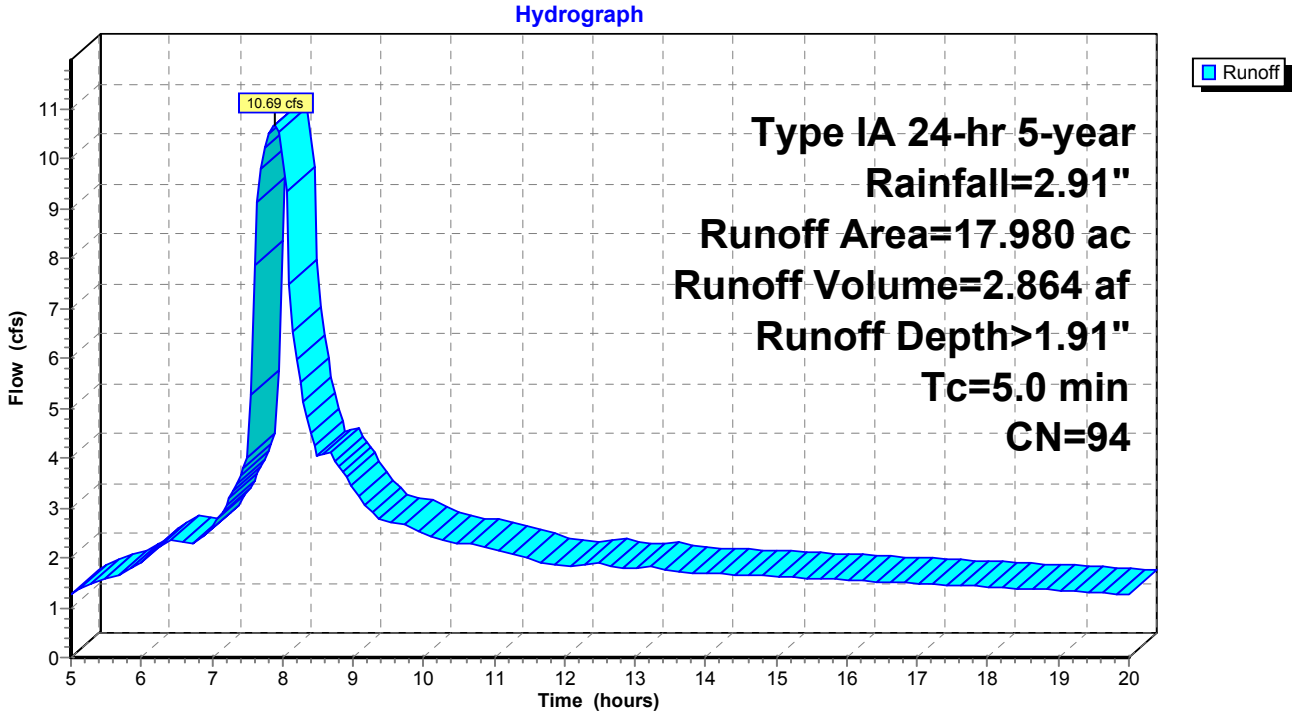
Runoff = 10.69 cfs @ 7.89 hrs, Volume= 2.864 af, Depth> 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-year Rainfall=2.91"

	Area (ac)	CN	Description
	0.950	92	Urban commercial, 85% imp, HSG B
	10.200	94	Urban commercial, 85% imp, HSG C
*	4.070	94	Urban commercial, 85% imp, HSG C/D
	2.760	95	Urban commercial, 85% imp, HSG D
	17.980	94	Weighted Average
	2.697		15.00% Pervious Area
	15.283		85.00% Impervious Area

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

Subcatchment 4S: MUR - Developed Conditions



Summary for Subcatchment 5S: RS-12 - Developed Conditions

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

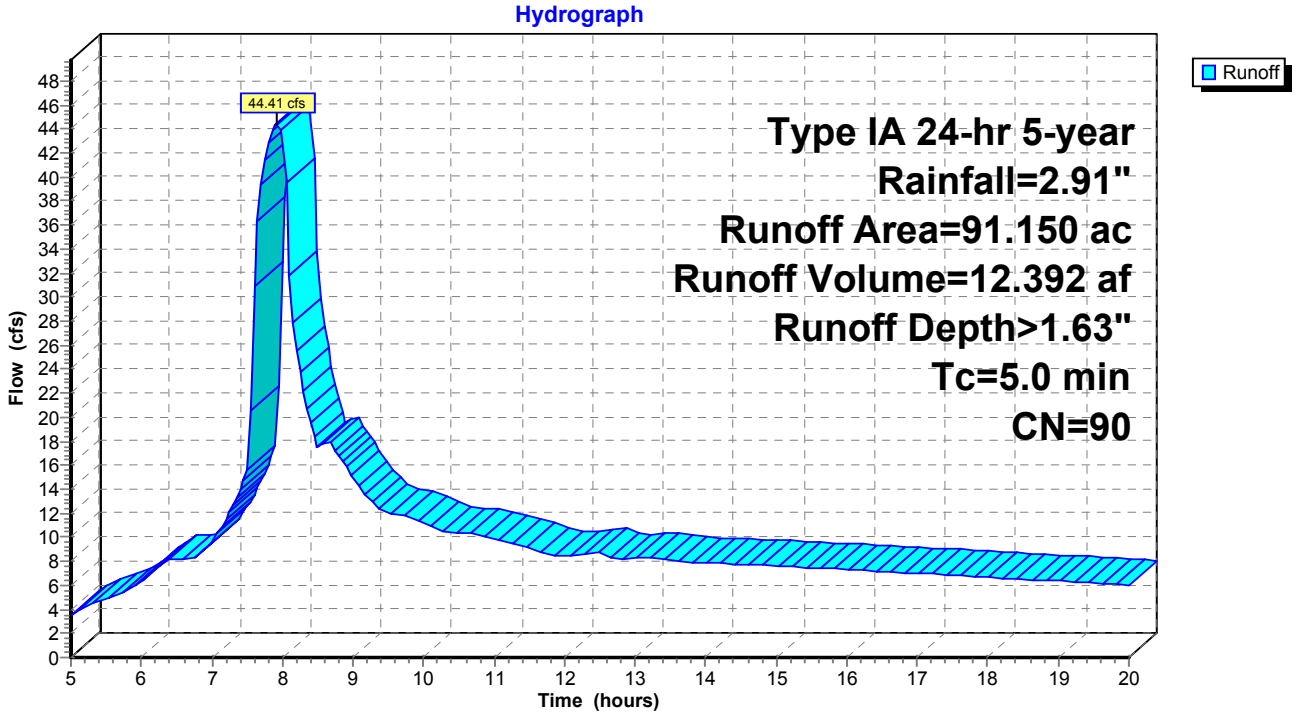
Runoff = 44.41 cfs @ 7.92 hrs, Volume= 12.392 af, Depth> 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-year Rainfall=2.91"

	Area (ac)	CN	Description
	9.690	85	1/8 acre lots, 65% imp, HSG B
	52.590	90	1/8 acre lots, 65% imp, HSG C
*	14.140	91	1/8 acre lots, 65% imp, HSG C/D
	14.730	92	1/8 acre lots, 65% imp, HSG D
	91.150	90	Weighted Average
	31.903		35.00% Pervious Area
	59.248		65.00% Impervious Area

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

Subcatchment 5S: RS-12 - Developed Conditions



Summary for Subcatchment 6S: C-OS Developed Conditions

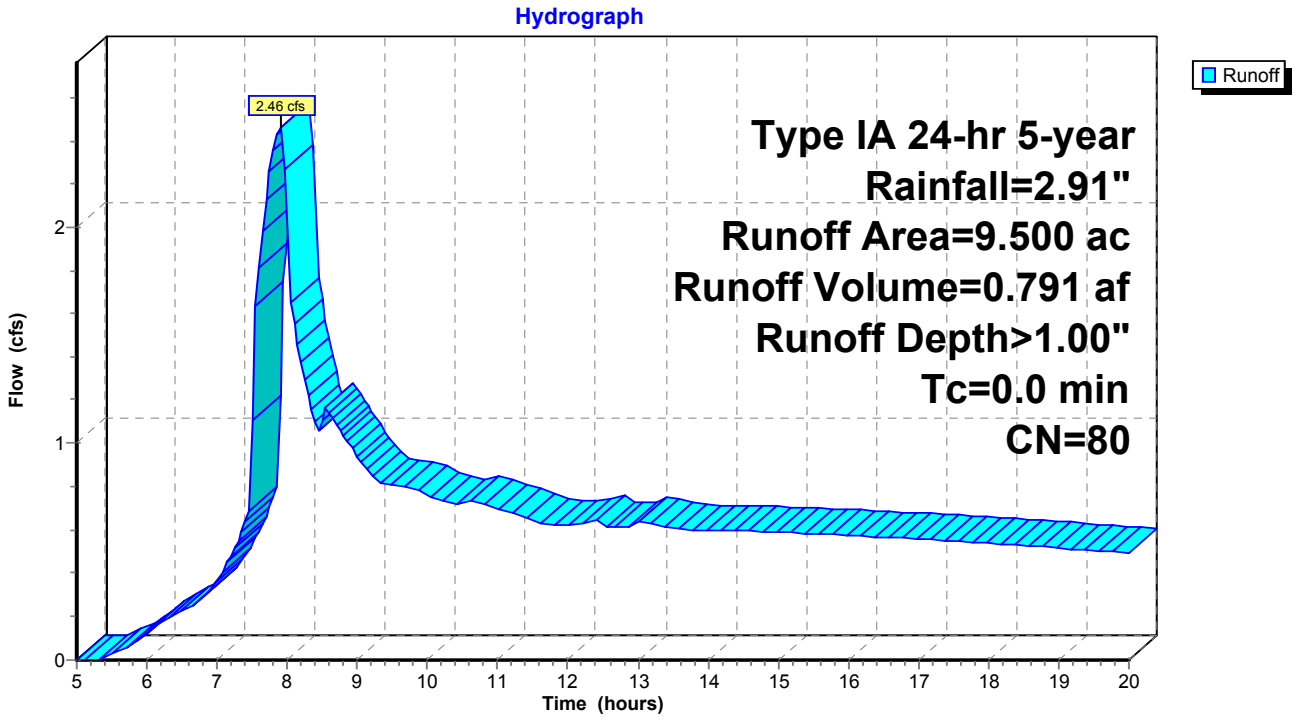
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 2.46 cfs @ 7.92 hrs, Volume= 0.791 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-year Rainfall=2.91"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 6S: C-OS Developed Conditions



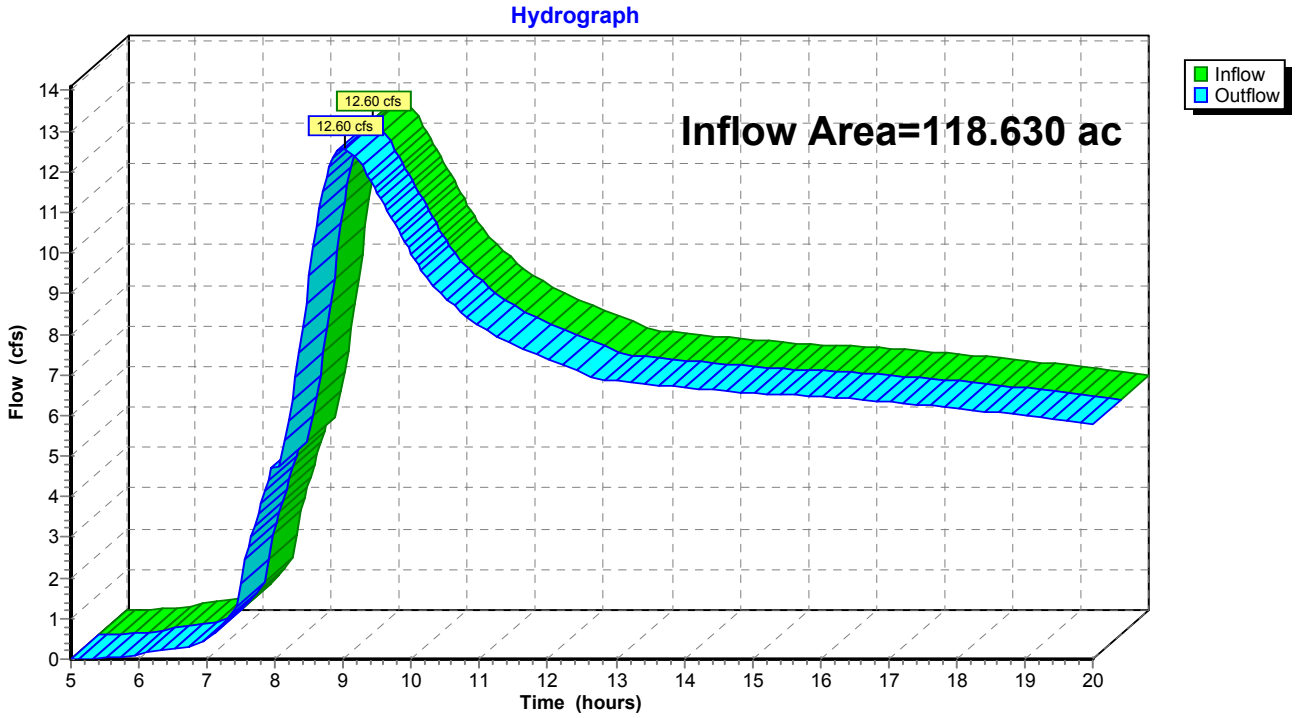
Summary for Reach 7R: Flow Rate - Existing Conditions

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

Inflow Area = 118.630 ac, 0.00% Impervious, Inflow Depth > 0.76" for 5-year event
Inflow = 12.60 cfs @ 9.01 hrs, Volume= 7.560 af
Outflow = 12.60 cfs @ 9.01 hrs, Volume= 7.560 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 7R: Flow Rate - Existing Conditions



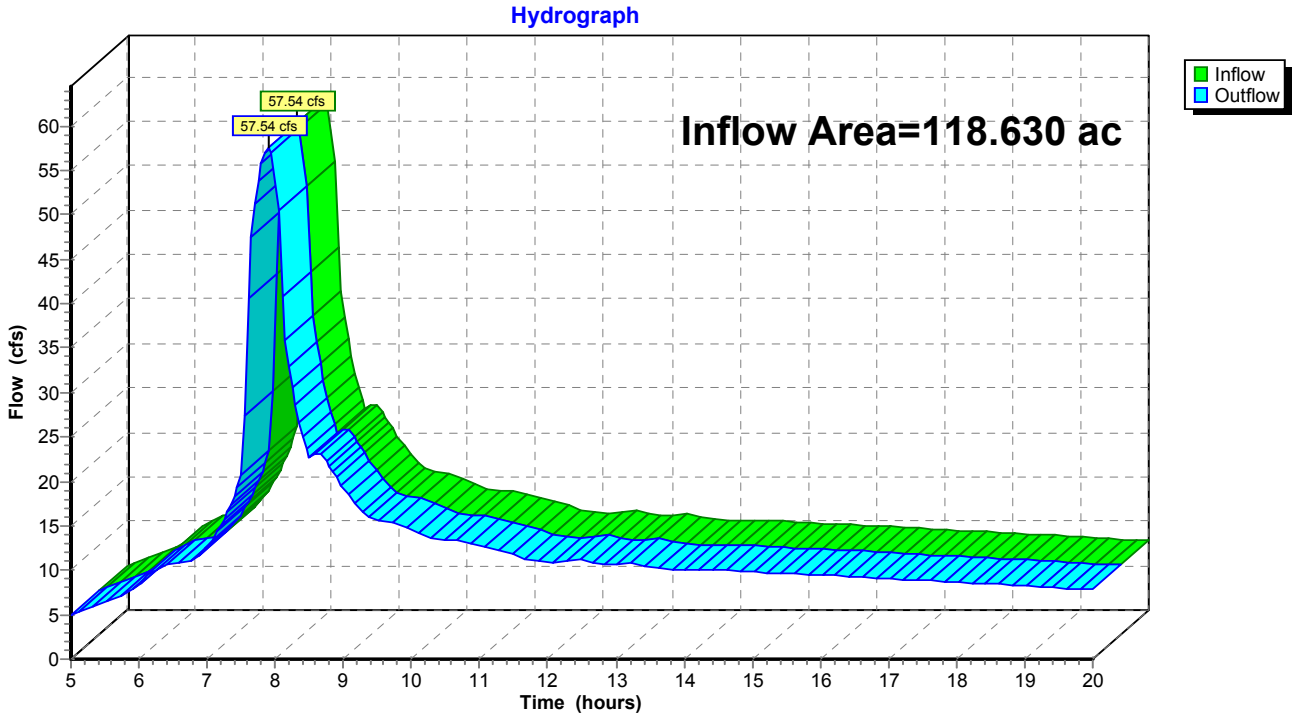
Summary for Reach 8R: Flow Rate - Developed Conditions

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

Inflow Area = 118.630 ac, 62.83% Impervious, Inflow Depth > 1.62" for 5-year event
Inflow = 57.54 cfs @ 7.91 hrs, Volume= 16.047 af
Outflow = 57.54 cfs @ 7.91 hrs, Volume= 16.047 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 8R: Flow Rate - Developed Conditions



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

Subcatchment1S: MUR - Existing Runoff Area=17.980 ac 0.00% Impervious Runoff Depth>1.22"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=77 Runoff=3.59 cfs 1.830 af

Subcatchment2S: RS-12 - Existing Runoff Area=91.150 ac 0.00% Impervious Runoff Depth>1.16"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=76 Runoff=16.93 cfs 8.819 af

Subcatchment3S: C-OS - Existing Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>1.50"
Tc=0.0 min CN=80 Runoff=3.89 cfs 1.185 af

Subcatchment4S: MUR - Developed Runoff Area=17.980 ac 85.00% Impervious Runoff Depth>2.49"
Tc=5.0 min CN=94 Runoff=14.04 cfs 3.729 af

Subcatchment5S: RS-12 - Developed Runoff Area=91.150 ac 65.00% Impervious Runoff Depth>2.20"
Tc=5.0 min CN=90 Runoff=61.16 cfs 16.727 af

Subcatchment6S: C-OS Developed Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>1.50"
Tc=0.0 min CN=80 Runoff=3.89 cfs 1.185 af

Reach 7R: Flow Rate - Existing Conditions Inflow=21.96 cfs 11.834 af
Outflow=21.96 cfs 11.834 af

Reach 8R: Flow Rate - Developed Conditions Inflow=79.07 cfs 21.641 af
Outflow=79.07 cfs 21.641 af

Total Runoff Area = 237.260 ac Runoff Volume = 33.475 af Average Runoff Depth = 1.69"
68.59% Pervious = 162.730 ac 31.41% Impervious = 74.531 ac

Summary for Subcatchment 1S: MUR - Existing Conditions

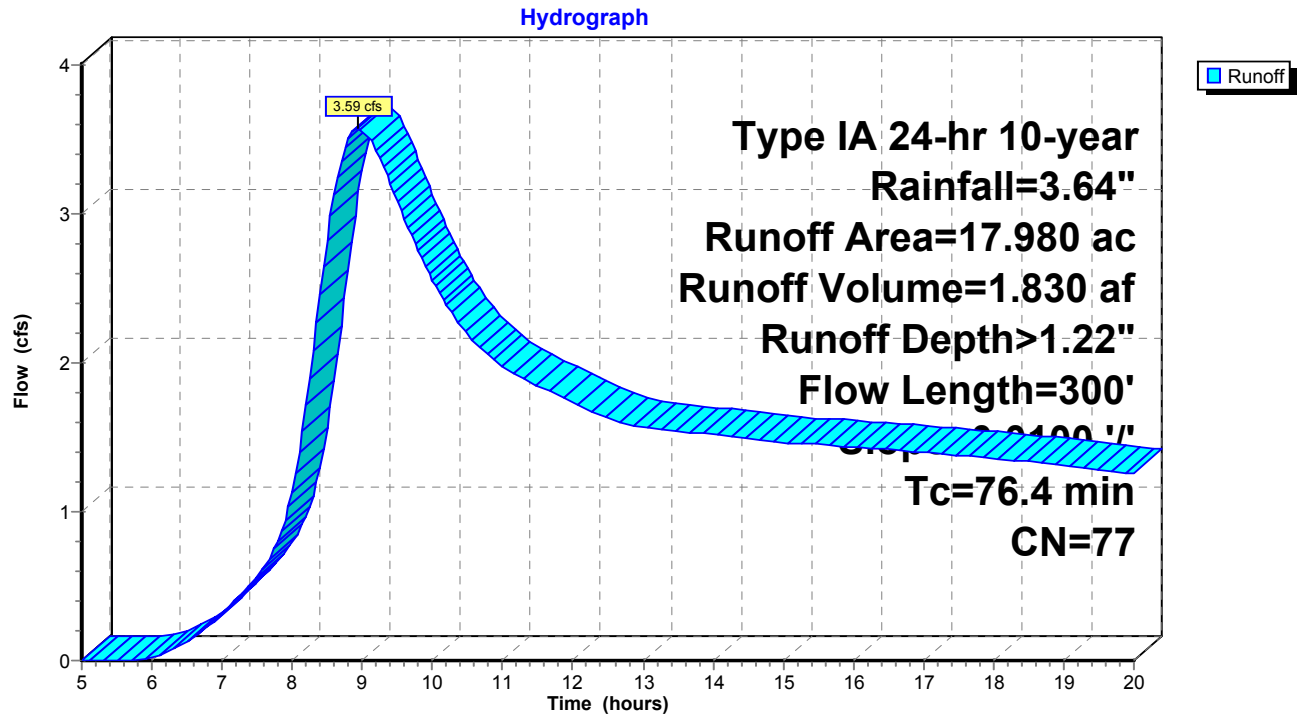
Runoff = 3.59 cfs @ 8.94 hrs, Volume= 1.830 af, Depth> 1.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.64"

	Area (ac)	CN	Description
	0.950	65	Woods/grass comb., Fair, HSG B
	10.200	76	Woods/grass comb., Fair, HSG C
*	4.070	79	Woods/grass comb., Fair, HSG C/D
	2.760	82	Woods/grass comb., Fair, HSG D
	17.980	77	Weighted Average
	17.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 1S: MUR - Existing Conditions



Summary for Subcatchment 2S: RS-12 - Existing Conditions

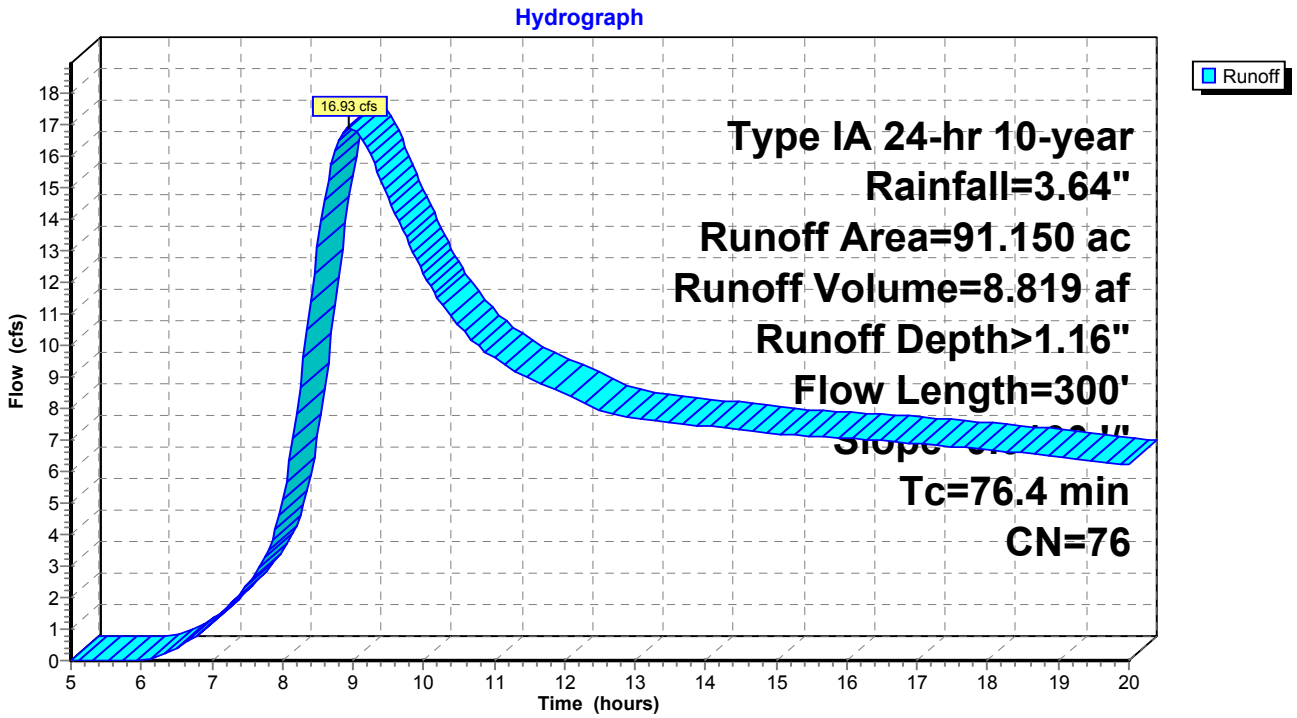
Runoff = 16.93 cfs @ 8.95 hrs, Volume= 8.819 af, Depth> 1.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.64"

	Area (ac)	CN	Description
	9.690	65	Woods/grass comb., Fair, HSG B
	52.590	76	Woods/grass comb., Fair, HSG C
*	14.140	79	Woods/grass comb., Fair, HSG C/D
	14.730	82	Woods/grass comb., Fair, HSG D
	91.150	76	Weighted Average
	91.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 2S: RS-12 - Existing Conditions



Summary for Subcatchment 3S: C-OS - Existing Conditions

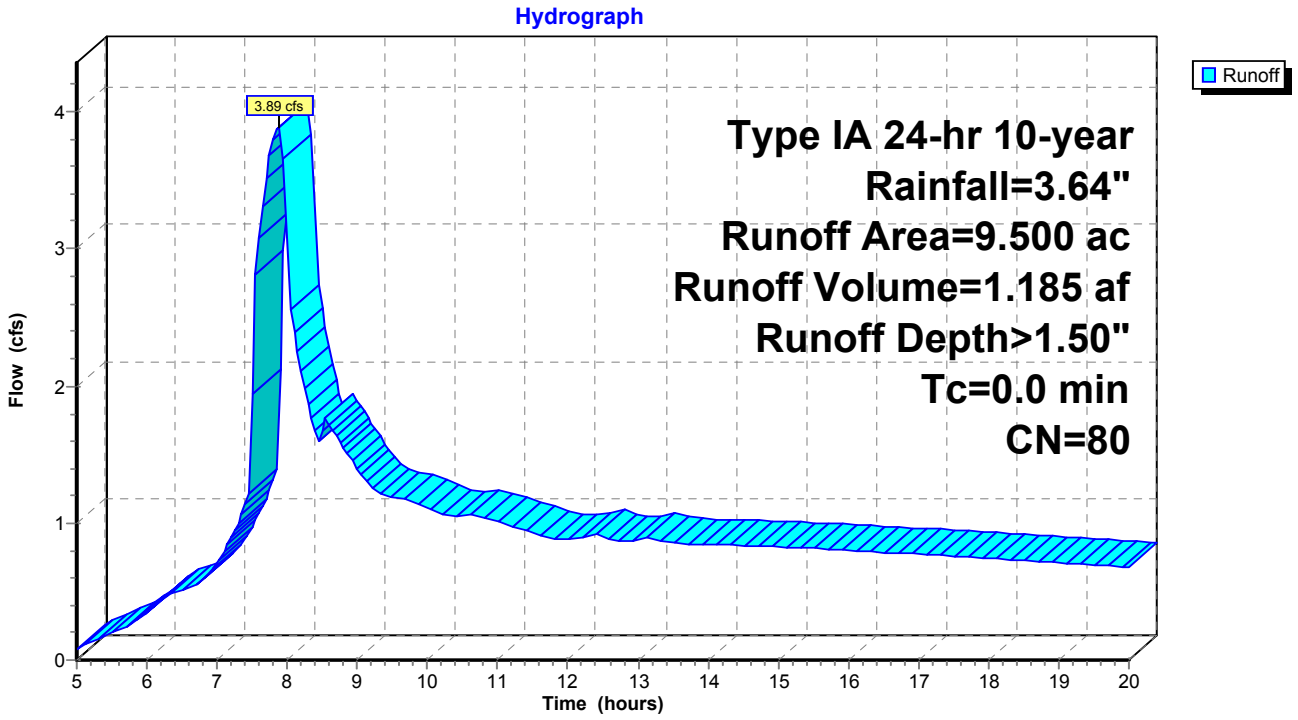
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 3.89 cfs @ 7.89 hrs, Volume= 1.185 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.64"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 3S: C-OS - Existing Conditions



Summary for Subcatchment 4S: MUR - Developed Conditions

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

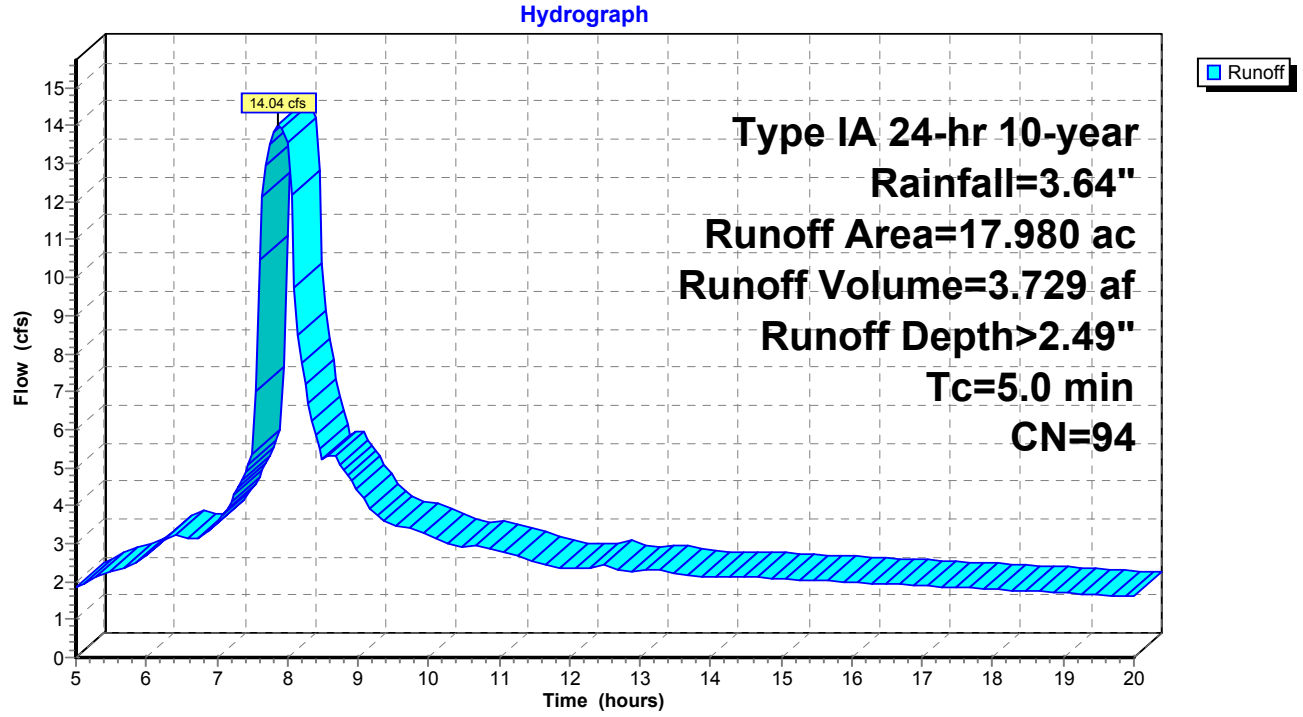
Runoff = 14.04 cfs @ 7.88 hrs, Volume= 3.729 af, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.64"

	Area (ac)	CN	Description
	0.950	92	Urban commercial, 85% imp, HSG B
	10.200	94	Urban commercial, 85% imp, HSG C
*	4.070	94	Urban commercial, 85% imp, HSG C/D
	2.760	95	Urban commercial, 85% imp, HSG D
	17.980	94	Weighted Average
	2.697		15.00% Pervious Area
	15.283		85.00% Impervious Area

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

Subcatchment 4S: MUR - Developed Conditions



Summary for Subcatchment 5S: RS-12 - Developed Conditions

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

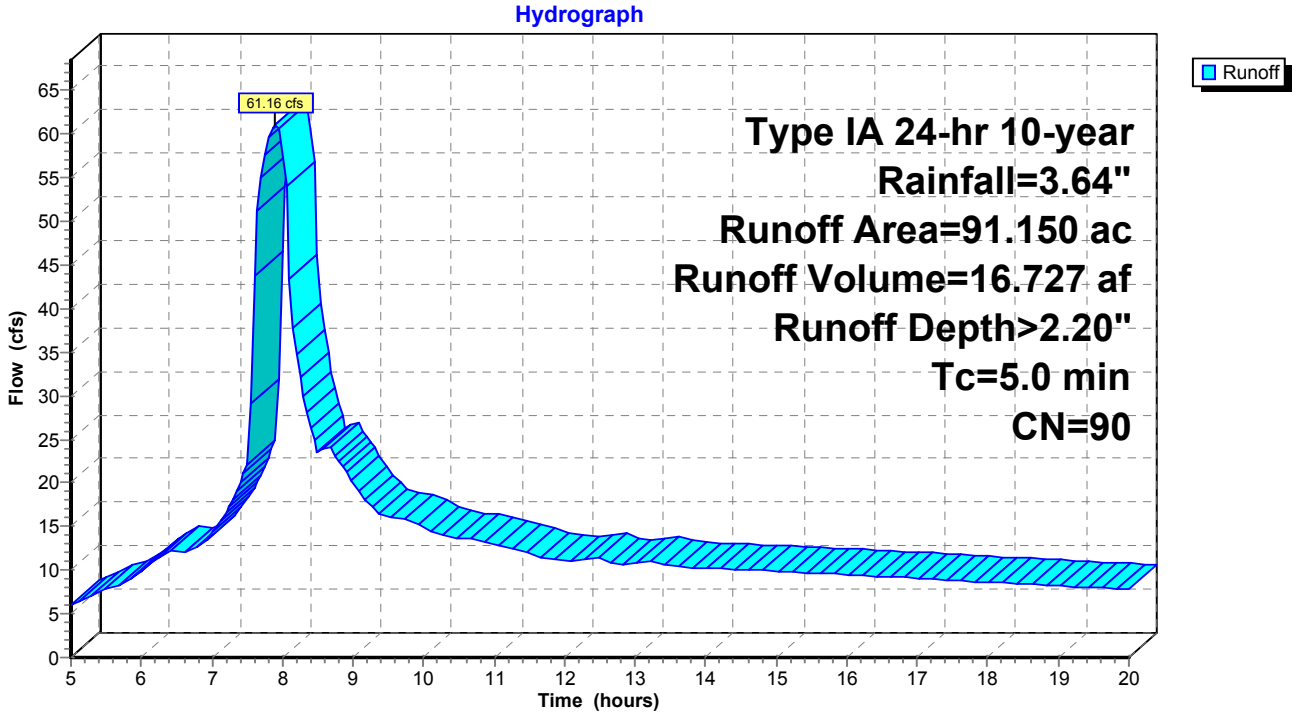
Runoff = 61.16 cfs @ 7.90 hrs, Volume= 16.727 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.64"

	Area (ac)	CN	Description
	9.690	85	1/8 acre lots, 65% imp, HSG B
	52.590	90	1/8 acre lots, 65% imp, HSG C
*	14.140	91	1/8 acre lots, 65% imp, HSG C/D
	14.730	92	1/8 acre lots, 65% imp, HSG D
	91.150	90	Weighted Average
	31.903		35.00% Pervious Area
	59.248		65.00% Impervious Area

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

Subcatchment 5S: RS-12 - Developed Conditions



Summary for Subcatchment 6S: C-OS Developed Conditions

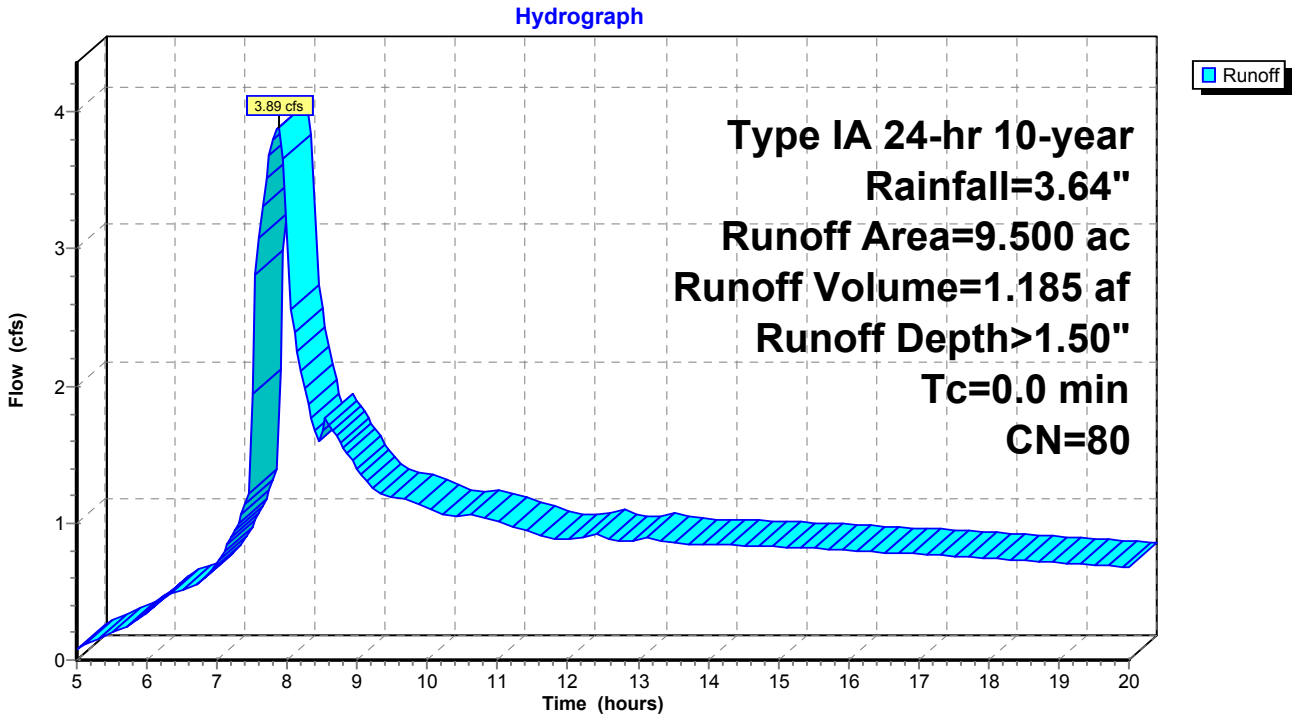
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 3.89 cfs @ 7.89 hrs, Volume= 1.185 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Rainfall=3.64"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 6S: C-OS Developed Conditions



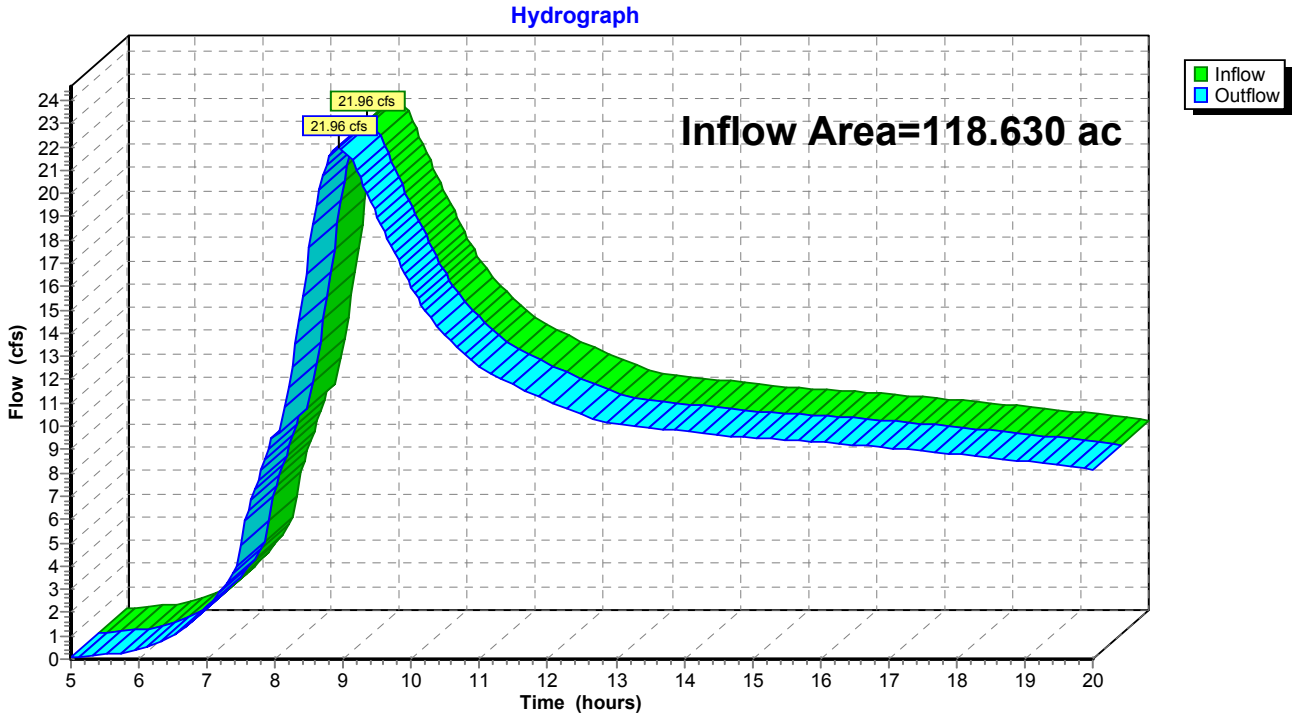
Summary for Reach 7R: Flow Rate - Existing Conditions

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

Inflow Area = 118.630 ac, 0.00% Impervious, Inflow Depth > 1.20" for 10-year event
Inflow = 21.96 cfs @ 8.93 hrs, Volume= 11.834 af
Outflow = 21.96 cfs @ 8.93 hrs, Volume= 11.834 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 7R: Flow Rate - Existing Conditions



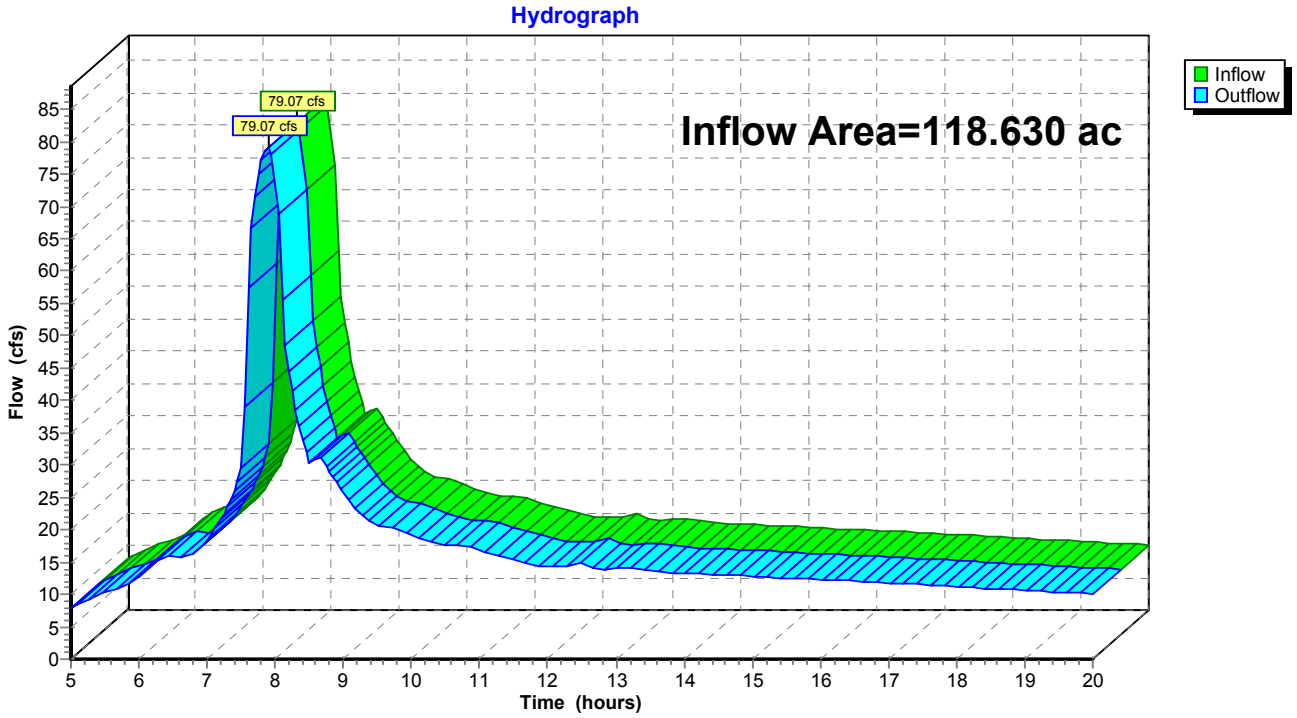
Summary for Reach 8R: Flow Rate - Developed Conditions

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

Inflow Area = 118.630 ac, 62.83% Impervious, Inflow Depth > 2.19" for 10-year event
Inflow = 79.07 cfs @ 7.90 hrs, Volume= 21.641 af
Outflow = 79.07 cfs @ 7.90 hrs, Volume= 21.641 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 8R: Flow Rate - Developed Conditions



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

Subcatchment1S: MUR - Existing Runoff Area=17.980 ac 0.00% Impervious Runoff Depth>1.95"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=77 Runoff=6.15 cfs 2.921 af

Subcatchment2S: RS-12 - Existing Runoff Area=91.150 ac 0.00% Impervious Runoff Depth>1.87"
Flow Length=300' Slope=0.0100 '/' Tc=76.4 min CN=76 Runoff=29.59 cfs 14.232 af

Subcatchment3S: C-OS - Existing Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>2.29"
Tc=0.0 min CN=80 Runoff=6.24 cfs 1.812 af

Subcatchment4S: MUR - Developed Runoff Area=17.980 ac 85.00% Impervious Runoff Depth>3.35"
Tc=5.0 min CN=94 Runoff=19.02 cfs 5.014 af

Subcatchment5S: RS-12 - Developed Runoff Area=91.150 ac 65.00% Impervious Runoff Depth>3.06"
Tc=5.0 min CN=90 Runoff=86.50 cfs 23.262 af

Subcatchment6S: C-OS Developed Runoff Area=9.500 ac 0.00% Impervious Runoff Depth>2.29"
Tc=0.0 min CN=80 Runoff=6.24 cfs 1.812 af

Reach 7R: Flow Rate - Existing Conditions Inflow=37.97 cfs 18.965 af
Outflow=37.97 cfs 18.965 af

Reach 8R: Flow Rate - Developed Conditions Inflow=111.74 cfs 30.088 af
Outflow=111.74 cfs 30.088 af

Total Runoff Area = 237.260 ac Runoff Volume = 49.054 af Average Runoff Depth = 2.48"
68.59% Pervious = 162.730 ac 31.41% Impervious = 74.531 ac

Summary for Subcatchment 1S: MUR - Existing Conditions

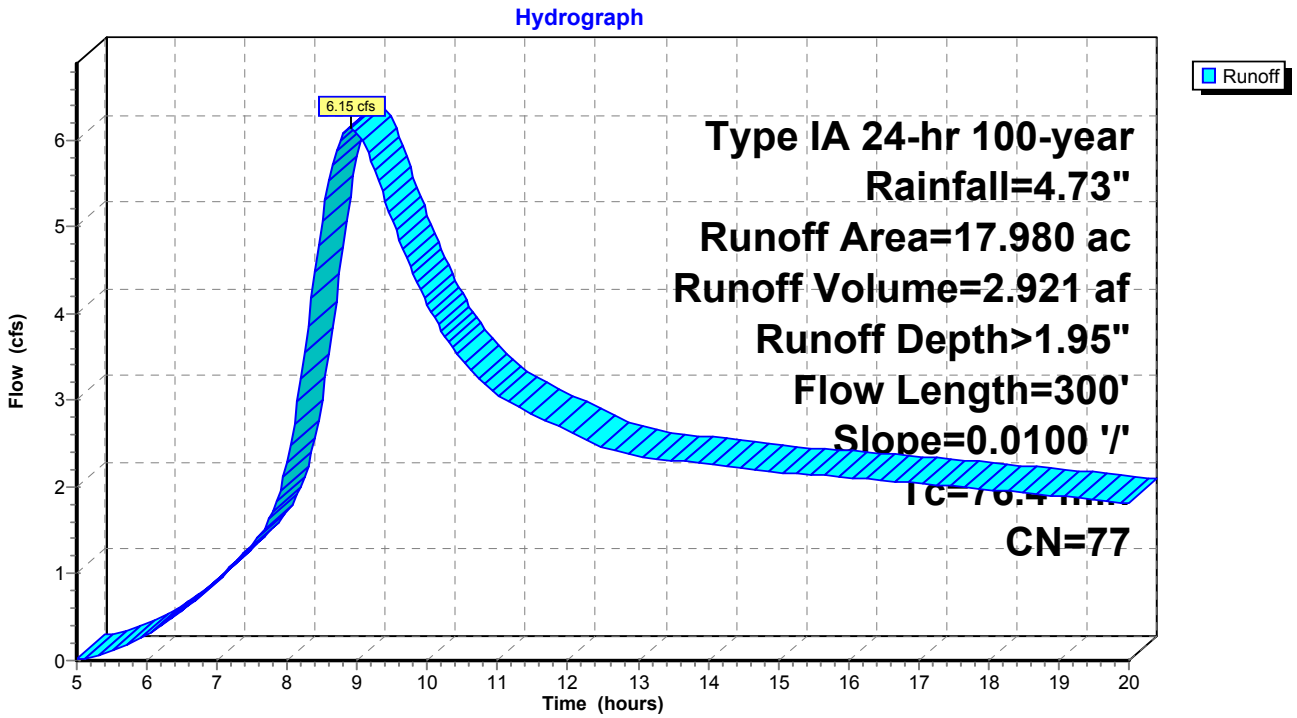
Runoff = 6.15 cfs @ 8.90 hrs, Volume= 2.921 af, Depth> 1.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=4.73"

	Area (ac)	CN	Description
	0.950	65	Woods/grass comb., Fair, HSG B
	10.200	76	Woods/grass comb., Fair, HSG C
*	4.070	79	Woods/grass comb., Fair, HSG C/D
	2.760	82	Woods/grass comb., Fair, HSG D
	17.980	77	Weighted Average
	17.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 1S: MUR - Existing Conditions



Summary for Subcatchment 2S: RS-12 - Existing Conditions

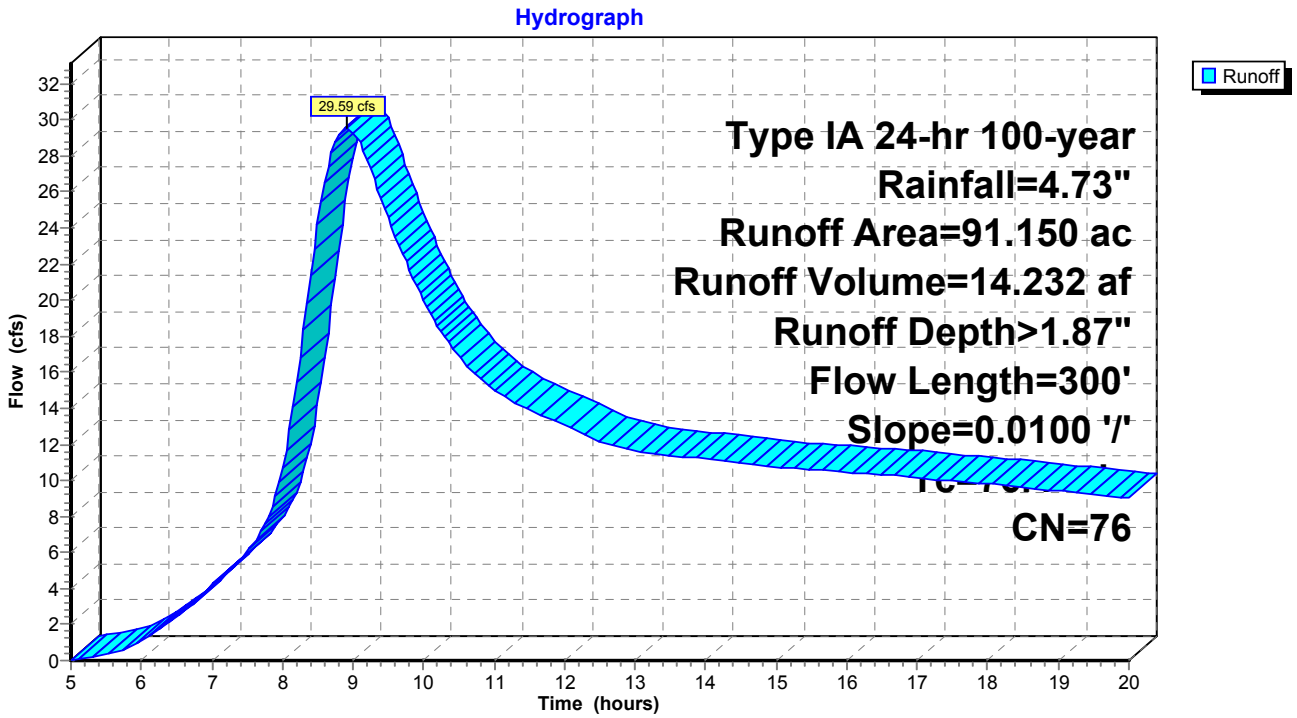
Runoff = 29.59 cfs @ 8.91 hrs, Volume= 14.232 af, Depth> 1.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=4.73"

	Area (ac)	CN	Description
	9.690	65	Woods/grass comb., Fair, HSG B
	52.590	76	Woods/grass comb., Fair, HSG C
*	14.140	79	Woods/grass comb., Fair, HSG C/D
	14.730	82	Woods/grass comb., Fair, HSG D
	91.150	76	Weighted Average
	91.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.4	300	0.0100	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.55"

Subcatchment 2S: RS-12 - Existing Conditions



Summary for Subcatchment 3S: C-OS - Existing Conditions

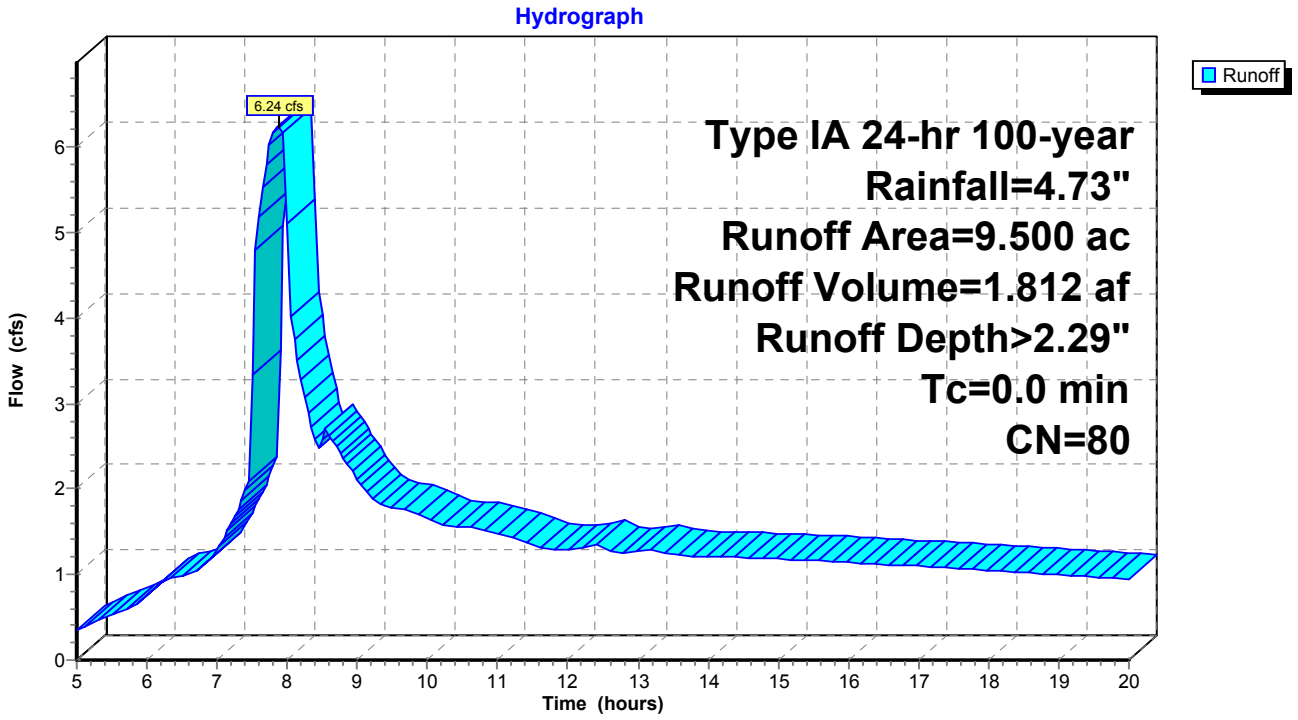
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 6.24 cfs @ 7.87 hrs, Volume= 1.812 af, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=4.73"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 3S: C-OS - Existing Conditions



Summary for Subcatchment 4S: MUR - Developed Conditions

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

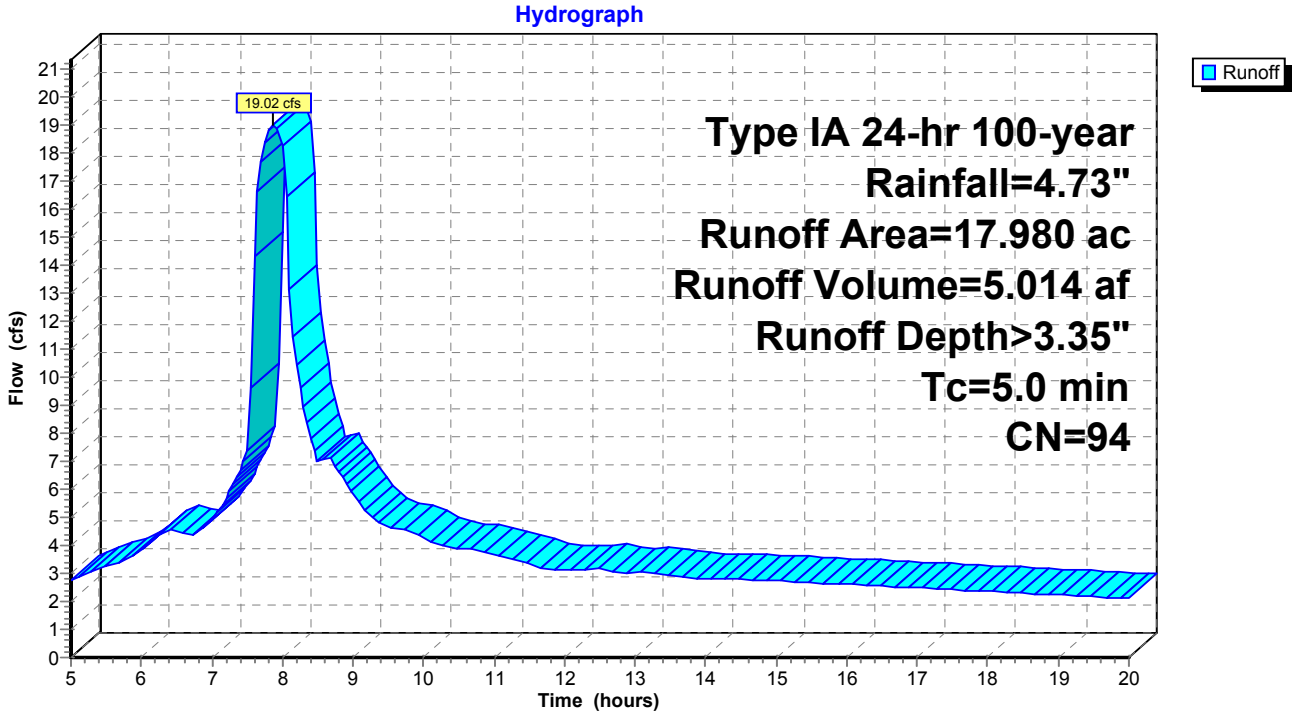
Runoff = 19.02 cfs @ 7.87 hrs, Volume= 5.014 af, Depth> 3.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=4.73"

	Area (ac)	CN	Description
	0.950	92	Urban commercial, 85% imp, HSG B
	10.200	94	Urban commercial, 85% imp, HSG C
*	4.070	94	Urban commercial, 85% imp, HSG C/D
	2.760	95	Urban commercial, 85% imp, HSG D
	17.980	94	Weighted Average
	2.697		15.00% Pervious Area
	15.283		85.00% Impervious Area

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

Subcatchment 4S: MUR - Developed Conditions



Summary for Subcatchment 5S: RS-12 - Developed Conditions

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

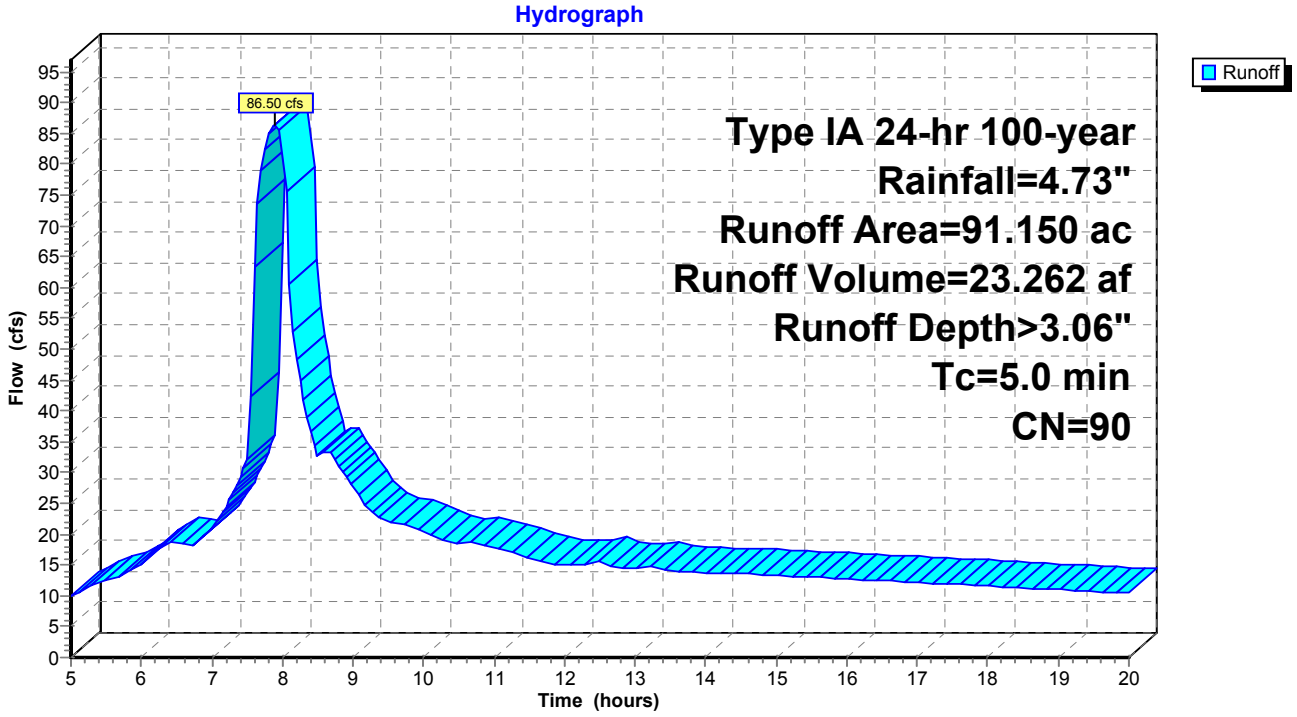
Runoff = 86.50 cfs @ 7.89 hrs, Volume= 23.262 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=4.73"

	Area (ac)	CN	Description
	9.690	85	1/8 acre lots, 65% imp, HSG B
	52.590	90	1/8 acre lots, 65% imp, HSG C
*	14.140	91	1/8 acre lots, 65% imp, HSG C/D
	14.730	92	1/8 acre lots, 65% imp, HSG D
	91.150	90	Weighted Average
	31.903		35.00% Pervious Area
	59.248		65.00% Impervious Area

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

Subcatchment 5S: RS-12 - Developed Conditions



Summary for Subcatchment 6S: C-OS Developed Conditions

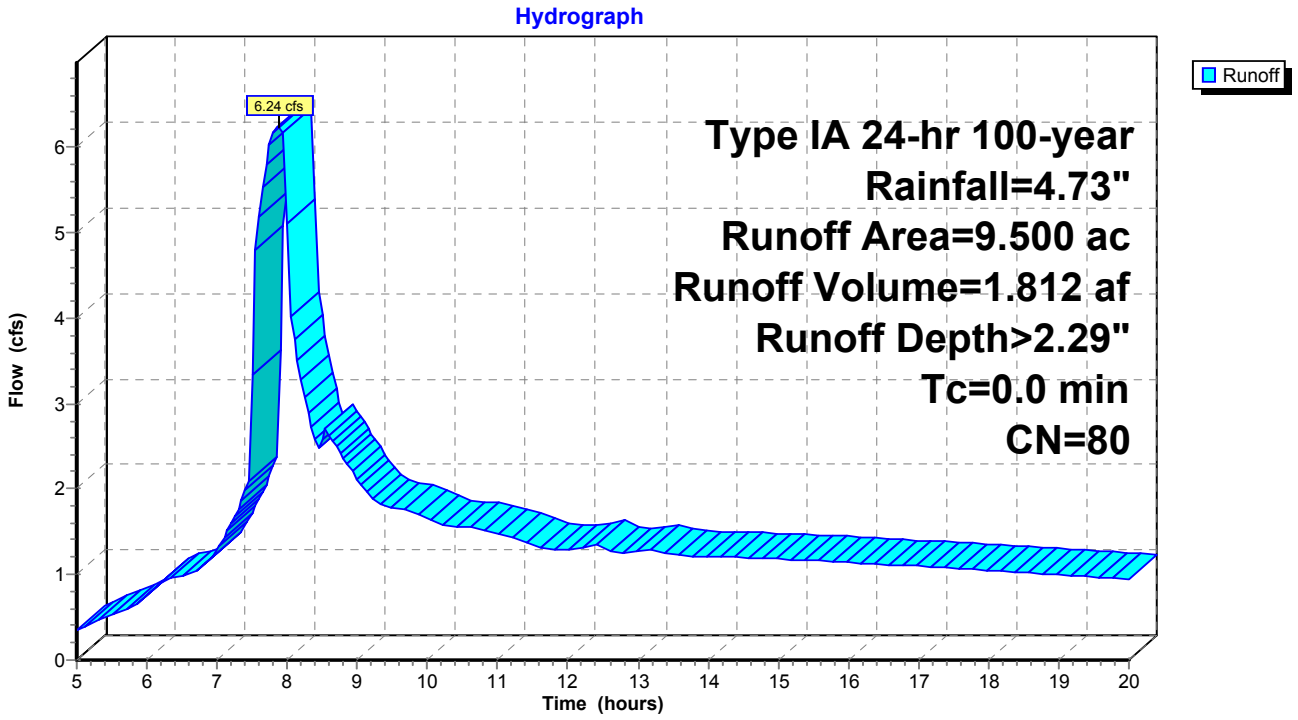
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 6.24 cfs @ 7.87 hrs, Volume= 1.812 af, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Rainfall=4.73"

	Area (ac)	CN	Description
*	5.700	79	Woods/grass comb., Fair, HSG C/D
	3.800	82	Woods/grass comb., Fair, HSG D
	9.500	80	Weighted Average
	9.500		100.00% Pervious Area

Subcatchment 6S: C-OS Developed Conditions



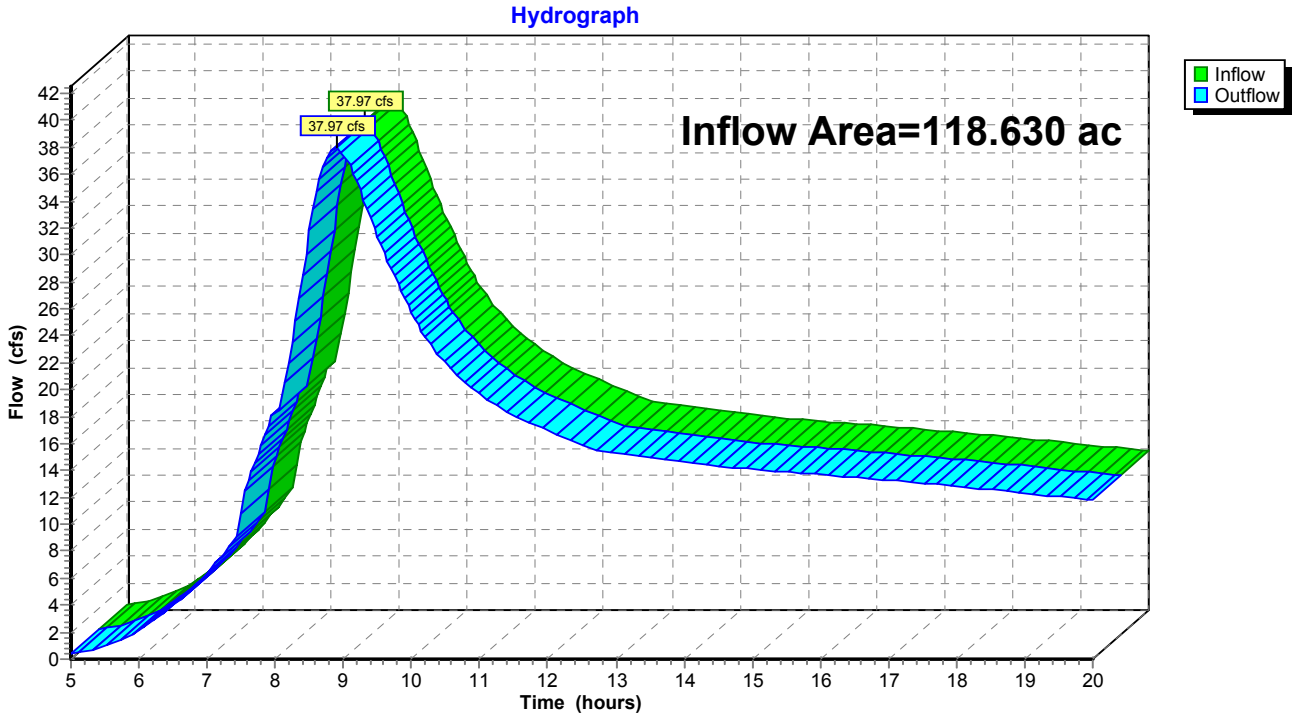
Summary for Reach 7R: Flow Rate - Existing Conditions

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

Inflow Area = 118.630 ac, 0.00% Impervious, Inflow Depth > 1.92" for 100-year event
Inflow = 37.97 cfs @ 8.90 hrs, Volume= 18.965 af
Outflow = 37.97 cfs @ 8.90 hrs, Volume= 18.965 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 7R: Flow Rate - Existing Conditions



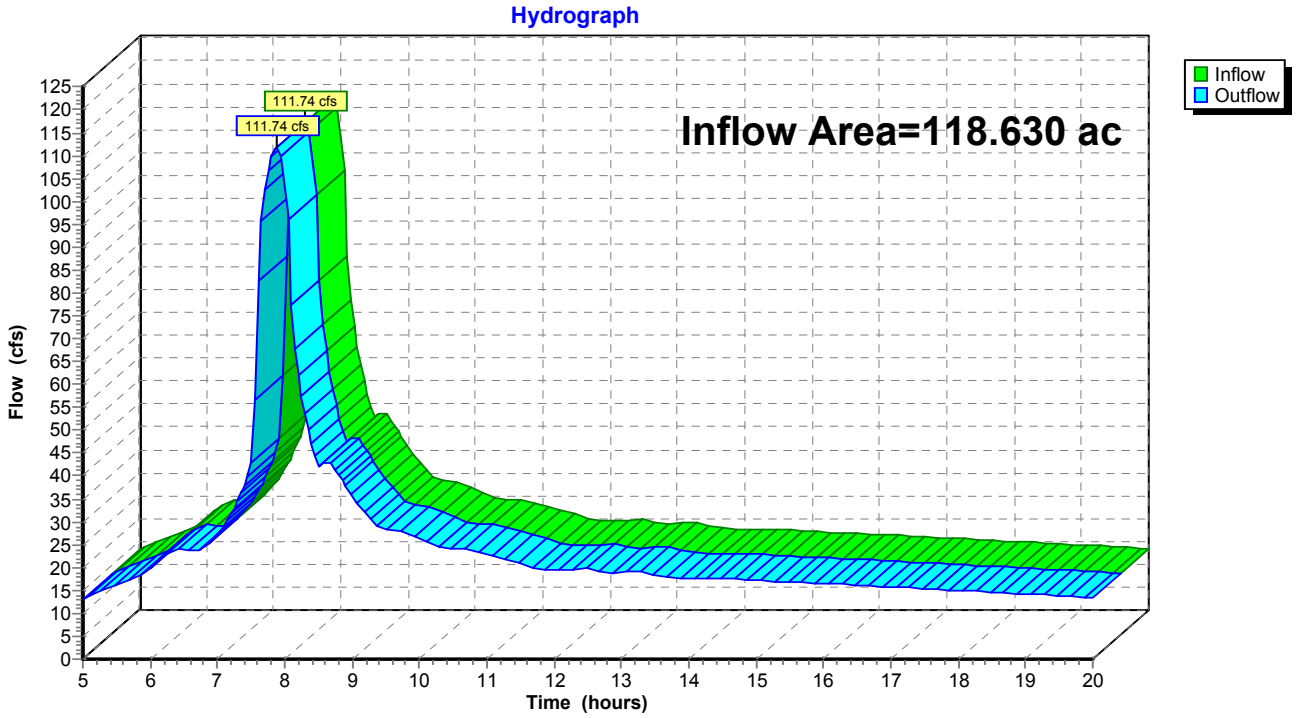
Summary for Reach 8R: Flow Rate - Developed Conditions

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

Inflow Area = 118.630 ac, 62.83% Impervious, Inflow Depth > 3.04" for 100-year event
Inflow = 111.74 cfs @ 7.89 hrs, Volume= 30.088 af
Outflow = 111.74 cfs @ 7.89 hrs, Volume= 30.088 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 8R: Flow Rate - Developed Conditions



FILE: I:\CIVIL3D Projects\16447\Reports\Annexation Utility Calculations – April 2017\Stormwater\16447_UTIL_EXHB_STRM.dwg [STRM] 4/19/2017 8:09 AM – Kyle

SCALE: 1" = 250'

0 125 250 500

SCALE IN FEET

DRAWING STATUS:	DATE:
☒ PRELIMINARY	04/18/17
☐ SUBMITTED	
☐ BID SET	
☐ PERMIT SET	
☐ CONST. SET	

No.	REVISION:	DATE:

PRELIMINARY

JOB NO. 16447
DRAWN BY: DEVCO
SHEET TITLE: STORM
DRAWING:

PROJECT:
MARY'S ANNEXATION

PROJECT LOCATION:
CORVALLIS, OR

CLIENT:
CLIENT

DEVCO engineering inc.
Corvallis Oregon
(541) 757-0991
245 NE CONIFER, P.O. BOX 1211
CORVALLIS, OR 97339
WWW.DEVCOENGINEERING.COM

Detention facilities within the regulated riparian corridor shall be located outside of the applicable riparian easement area unless it is deemed necessary by the City Engineer. The riparian easement area is identified in Corvallis LDC 4.13.70 and this standard shall apply regardless of whether an easement has been granted. The impacted area within the riparian corridor shall be re-vegetated consistent with Sections 4.13.50.d.1 and 4.13.50.d.2 of Chapter 4.13: Riparian Corridor and Wetland Provisions.

Parking areas should not be used as detention facilities except for larger storm events. Up to 6 inches of water depth is allowed to be detained in parking areas for storm events larger than the 10-year, 24-hour design storm.

A geotechnical evaluation is required if detention facilities are proposed in areas where slopes exceed 15 percent. Detention facilities with an infiltration component shall not be allowed in areas with slopes over 10 percent.

Setback requirements for individual detention facilities are described in Section 3.3.

3.2.4 SIZING CRITERIA

Detention facilities shall be designed so that the peak flow rates from post-development conditions shall be less than or equal to the peak flow rates from pre-development conditions for the 2-year, 5-year, and 10-year, 24-hour design storm based on the standard NRCS Type 1A rainfall distribution. Pre-developed conditions for all redeveloped impervious area shall assume a runoff pattern based on good condition grass and the corresponding native hydrologic soil group. Pre-developed conditions for all new impervious area shall assume the current land use condition and native hydrologic soil group.

For redevelopment projects, flows from existing developed areas (impervious surface, landscaped areas, etc. that are not being replaced) that are routed through the detention facility may be treated as “flow-through” flows. Those areas shall be modeled as the current development land use. No additional detention for those areas is required.

An analytical model capable of performing hydrograph method peak flow and volume calculations and level-pool routing (or equivalent) detention calculation must be used to determine the peak flow rates and volumes, and to size the proposed detention facilities. The NRCS TR-55, TR-20, or SBUH are recommended hydrologic calculation methods. Coefficients and curve numbers used in the calculations shall be consistent with the ODOT Hydraulics Manual. The use of alternative hydrograph methods may be allowed but requires preapproval by the City.

Table 3-2 shows the 24-hour design storm depths for the City of Corvallis.

Table 3-2. City of Corvallis 24-hour Design Storms

Recurrence interval, years	24-hour total precipitation, inches
2	2.55
5	2.91
10	3.64
25	4.00
100	4.73

Source: Corvallis Storm Water Master Plan

1.2.1 GENERAL DEVELOPMENT EXEMPTIONS

The following development categories are generally exempt from the requirements of these Standards:

A. Stream enhancement or restoration projects approved by the City

B. **Farming practices** as defined by Oregon Revised Statutes (ORS) 30.930 and **farm use** as defined in ORS 214.200, except that buildings and pollution generating impervious pavement associated with farm practices and farm use are subject to the requirements of these Standards

C. Actions by a public utility or any other governmental agency **to remove or alleviate an emergency condition**

D. **Road and parking area preservation/maintenance projects** such as pothole and square cut patching, surface sealing, replacement or overlay of existing pavement, grind-inlays, and full depth pavement reconstruction.

E. **Pedestrian and bicycle improvements** (sidewalks, trails, pathways, and bicycle paths) where no other impervious surfaces are created or replaced, built to direct stormwater runoff to adjacent vegetated areas

F. **Underground utility projects** that replace the ground surface with materials that have similar runoff characteristics

G. **Maintenance or repair** of existing utilities

1.2.2 IMPERVIOUS AREA THRESHOLDS

New development, expansion to existing development, or redevelopment activities that result in changes to the overall impervious surface for a site are subject to requirements for water quality and/or detention as defined by impervious area thresholds below. The impervious area thresholds must be considered for current development activities or cumulative development activities within an approved phasing plan.

Developers must complete the **Stormwater Facility Tracking Form** to define the addition and modification of impervious surfaces at a site and to specify the water quality and/or detention facilities proposed for a site. The Stormwater Facility Tracking Form shall be submitted to Community Development for private facilities concurrent with the building permit submittal. The Stormwater Facility Tracking Form shall be submitted to Public Works for public facilities concurrent with the PIPC permit submittal. The Stormwater Facility Tracking Form is provided at the end of this chapter.

1.2.2.1 IMPERVIOUS AREA THRESHOLDS FOR WATER QUALITY

Water quality facilities must be installed for new development, expansion to existing development, and redevelopment activities that cumulatively add and/or replace 5,000 square feet or more pollution-generating impervious surface area.

Pollution-generating impervious surface area is defined as impervious area accessible to motor vehicles and rooftop areas containing galvanized metal components. See Section 1.2.3 for a list of impervious areas exempt from the water quality impervious area threshold calculation, as they are not considered pollution-generating surfaces for purposes of these Standards.

1.2.2.2 IMPERVIOUS AREA THRESHOLDS FOR DETENTION

To reduce the risk of flooding and degradation to downstream properties, detention facilities must be installed for new development, expansion to existing development, or redevelopment in accordance with the following thresholds:

1. New development that creates impervious surfaces of 25,000 square feet or more.
2. Development that creates new or redeveloped impervious area totaling 10,000 square feet or more, that results in a total post-development project site impervious area of 25,000 square feet or greater. Redeveloped impervious area consists of roof area and replaced impervious area, minus any reduction in overall impervious area, associated with improvement or replacement of structures. Only runoff from new and replaced portions needs to be detained.

Impervious surfaces applicable to detention standards include all impervious surfaces such as roads, driveways, parking lots, walks, patios, and roofs.

1.2.3 AREA EXEMPTIONS

The following area exemptions may be considered in the calculation of new and redeveloped impervious area subject to water quality and/or detention requirements. Please note that area exemptions apply solely to the impervious area threshold that triggers the water quality and/or detention requirements. Once the requirements are triggered, the area exemptions do not apply to the design of water quality and/or detention facilities.

Area exemptions must be noted on the Stormwater Facility Tracking Form.

1.2.3.1 WATER QUALITY AREA EXEMPTIONS

The water quality impervious area threshold defined in Section 1.2.2.2 applies to pollution-generating impervious surface area. The following areas are not considered pollution generating impervious surfaces:

1. Impervious surface areas including paved surfaces not accessible to motor vehicles (i.e., sidewalks, pathways, and courtyards).
2. Rooftop areas without galvanized metal components.
3. Porous pavement.
4. Development sites that drain to a combined sewer system on a case by case basis.

It should be noted that non-pollution-generating impervious surfaces (defined above) may need to be considered in the design of water quality facilities (see Chapter 2) if the area is not hydraulically separated from pollution-generating impervious surface area and conveyed to a separate point of discharge from the site.

1.2.3.2 DETENTION AREA EXEMPTIONS

Projects located in any of the following areas are exempt from detention requirements:

1. Areas that discharge directly to the Mary's River or Willamette River where the conveyance system between the project site and the ordinary high water line is composed entirely of man-made elements (e.g., piped systems) with sufficient hydraulic capacity and erosion stabilization measures to meet the conveyance system requirements in Appendix A.

2.2.4 SIZING CRITERIA

Water quality facilities shall be designed to remove 70 percent of TSS entering the facility during a water quality design storm.

When water quality facilities are located upstream (prior to) a detention facility, the water quality design storm shall be a storm event equivalent to two-thirds of the 2-year, 24-hour design storm. In Corvallis, this equates to a water quality design storm of 1.6 inches over 24 hours based on the standard Natural Resources Conservation Service (NRCS) Type 1A rainfall distribution.

Calculation of the water quality design flow for the water quality design storm shall be based on a hydrograph method. The NRCS TR-55 or TR-20 or the Santa Barbara Urban Hydrograph Method (SBUH) are the recommended hydrologic calculation methods. Coefficients and curve numbers used in the calculations shall be consistent with the Oregon Department of Transportation (ODOT) Hydraulics Manual. The use of alternative hydrograph methods may be allowed but requires pre-approval by the City.

If water quality facilities are located downstream of a detention facility, the water quality design flow shall be the full 2-year release rate from the detention facility. Note that flow-based water quality facilities may be smaller when located downstream of detention because the detention facility routing sequence stores peaks within the pond and releases them at a slow rate. However, the facility should be expected to collect similar levels of pollutants to those in a facility located upstream of detention and these pollutant levels should be accounted for when establishing maintenance schedules and inspections.

Additional facility sizing criteria for individual water quality facilities are included in Section 2.3 below.

2.3 FACILITY DESIGN CRITERIA AND SPECIFICATIONS

This section presents water quality facility-specific design criteria and should be used in conjunction with the facility design drawings in Appendix B.

General design criteria that apply to all water quality facilities are outlined in Section 2.3.1. Facility-specific analysis and design criteria for biofiltration swales (basic, continuous, and wet), filter strips (basic and narrow), wet ponds, stormwater wetlands, and StormFilters are included in Sections 2.3.2 through 2.3.6.

2.3.1 GENERAL DESIGN CRITERIA

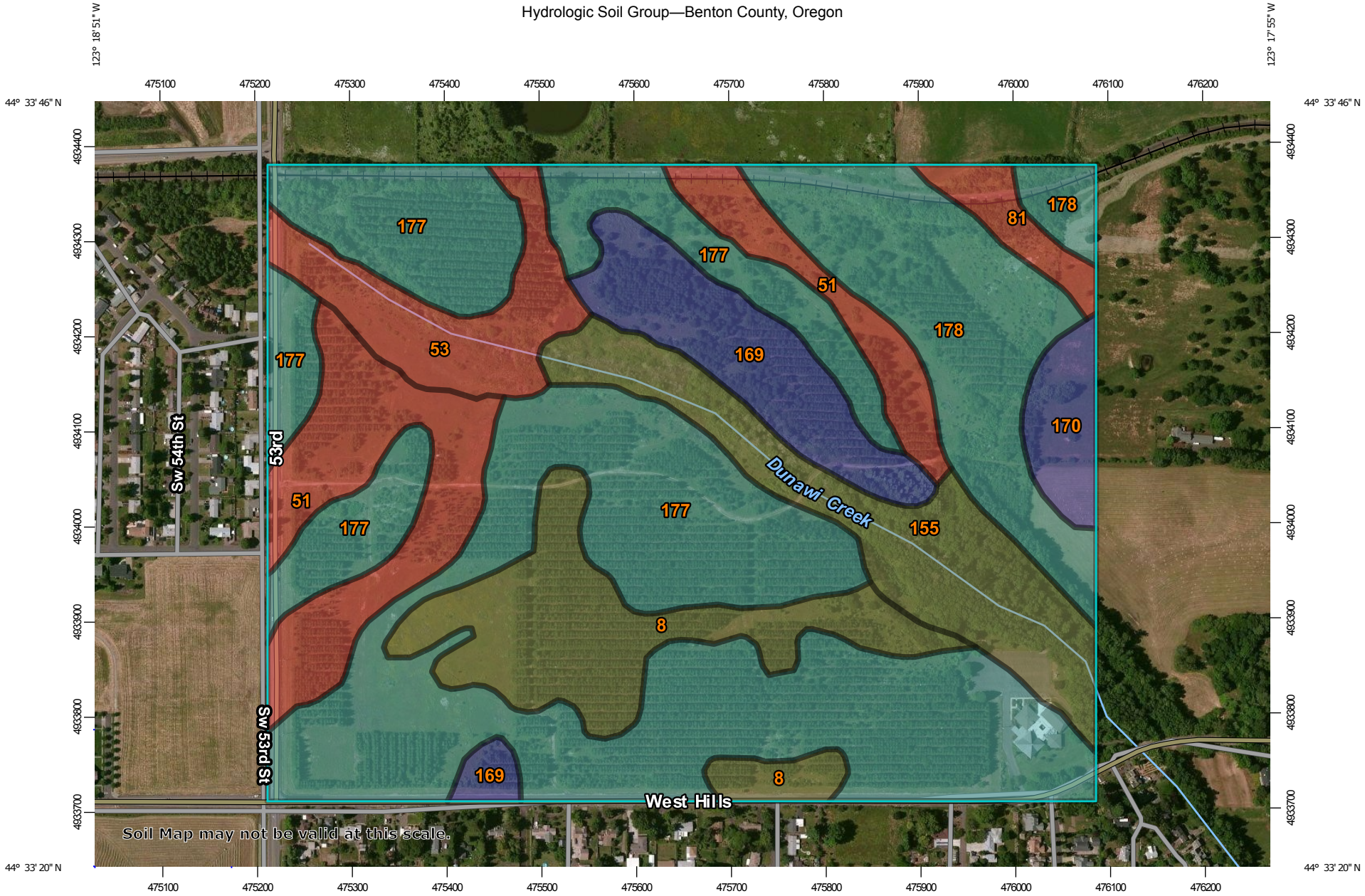
The following general design criteria apply to all water quality treatment facilities.

Peak Flow

Water quality facilities must be designed to safely pass, without damage to the facility, flows in excess of the water quality design storm up to the 100-year, 24-hour event. For some facilities, a bypass system will be required.

High Flow Bypass

Most water quality facilities may be designed as flow-through, or online, systems with flows above the water quality design flow or volume simply passing through the facility untreated. However, it is sometimes desirable to restrict flows to water quality treatment facilities and bypass the remaining higher flows around them (offline facilities). This can be accomplished by splitting flows in excess of the water quality design flow upstream of



Map Scale: 1:5,670 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

46

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 1:24,000.

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: Benton County, Oregon
Survey Area Data: Version 14, Sep 16, 2016

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

Date(s) aerial images were photographed: Jul 5, 2011—Jul 6, 2011

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

Hydrologic Soil Group— Summary by Map Unit — Benton County, Oregon (OR003)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
8	Amity silt loam, 0 to 3 percent slopes	C/D	14.5	10.0%
51	Concord silt loam, 0 to 2 percent slopes	D	15.8	10.9%
53	Dayton silt loam, 0 to 2 percent slopes	D	7.7	5.3%
81	Helmick silt loam, 3 to 12 percent slopes	D	2.4	1.6%
155	Waldo silty clay loam, 0 to 3 percent slopes	C/D	13.3	9.2%
169	Willamette silt loam, 0 to 3 percent slopes	B	9.8	6.8%
170	Willamette silt loam, 3 to 12 percent slopes	B	3.3	2.3%
177	Woodburn silt loam, 0 to 3 percent slopes	C	61.4	42.3%
178	Woodburn silt loam, 3 to 12 percent slopes	C	17.1	11.8%
Totals for Area of Interest			**145.2**	**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