

CREDLE ENGINEERING COMPANY, INC.
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"SERVING THE COMMUNITY SINCE 1920"

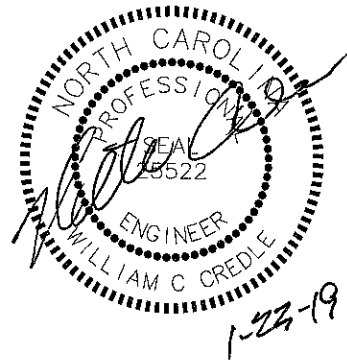
STORMWATER ANALYSIS

SANDERWAY SUBDIVISION

FOR
GH-2, LLC

Hillsborough Street
Chapel Hill, N.C. 27704
Pin 9779142354

SEPTEMBER 21, 2018
REV. JANUARY 23, 2019



STORMWATER ANALYSIS

ENGINEERING STUDY

INTRODUCTION

The pre-development and post-development for the 1-year, 2-year, 10-yr and 25-year storms at the discharge point for The Sanderway subdivision were analyzed. This study utilized the SCS Method for pre-developed conditions, compared those conditions to the post-developed condition.

EXISTING CONDITIONS

The existing condition on the site is mostly a wooded lot with a residential house located to the east of the stream. See the site plan existing conditions for a more particular description.

IMPROVEMENTS

The proposed improvements will be an 18-lot residential subdivision to the east of the stream. The details and impervious surface calculations can be found on the site plan.

POINT OF DISCHARGE

There are two points of interest for this analysis. The first point of interest is the point that an existing ditch flows under the existing driveway north of the proposed improvements. This is a point of an existing 12" pipe (see attached maps). The second point of interest is the point that the stormwater leaves the property on the north end of the property

DRAINAGE AREAS

The drainage area is shown on the attached map and is 8.58 ac at the point of interest.

The soil type for this site has been determined by the Soil Survey of Orange County, North Carolina to be Georgeville "GeC" & Enon "EnB" (See attachment).

RESULTS

Below is a tabulation of the findings for the first point of interest in this report:

Summary of Analysis of at driveway pipe (Point 1)				
	1-yr Event	2-yr Event	10-yr Event	25-yr Event
Pre-Development	8.1	12.6	27.9	37.8
Routed	4.7	6.7	11.4	13.8
Change	-41.9%	-46.5%	-59.3%	-63.4%

The culvert under the greenway is acting as storage for the drainage area and is shown as part of the modeling. The point at the driveway pipe is less than the pre-development conditions

The 100-yr flow is reduced by 36.17 cfs also

Below is a tabulation of the findings for the first point of interest in this report:

Summary of Analysis of entire area results (Point 2)				
	1-yr Event	2-yr Event	10-yr Event	25-yr Event
Pre-Development	200.4	317.5	720.3	976.1
Routed	199.7	317.0	717.5	969.0
Change	-0.4%	-0.2%	-0.4%	-0.7%

CONCLUSION

The post development flows are less than the pre-development flow at the point of exit for stormwater for this property.

The 100-yr flow is reduced by 15.22 cfs also

These reductions at the neighbor's driveway pipe were achieved by re-routing the storm pipe to the larger creek further downstream of the neighbor's pipe

There is a small portion of the non-vehicular greenway path that is not treated for nutrient removal, but was modeled for the stormwater run-off

The impervious surface calculations for pre-post can be found on the post-development drainage map

DRAINAGE MAPS

Drainage Area

OFF-SITE PRE LAND USE CALCS "B":

HOUSE	0.06
DRIVE	0.03
R/W	0.84
GRASS	0.23
WOODS	0.00

NOTE: TO POINT OF INTEREST #1

PRE LAND USE CALCS "B":

HOUSE	0.00
DRIVE	0.00
R/W	0.17
GRASS	0.50
WOODS	2.74

NOTE: TO POINT OF INTEREST #1

OFF-SITE PRE LAND USE CALCS "C":

HOUSE	0.09
DRIVE	0.04
R/W	0.00
GRASS	1.04
WOODS	0.00

NOTE: TO POINT OF INTEREST #1

PRE LAND USE CALCS "C":

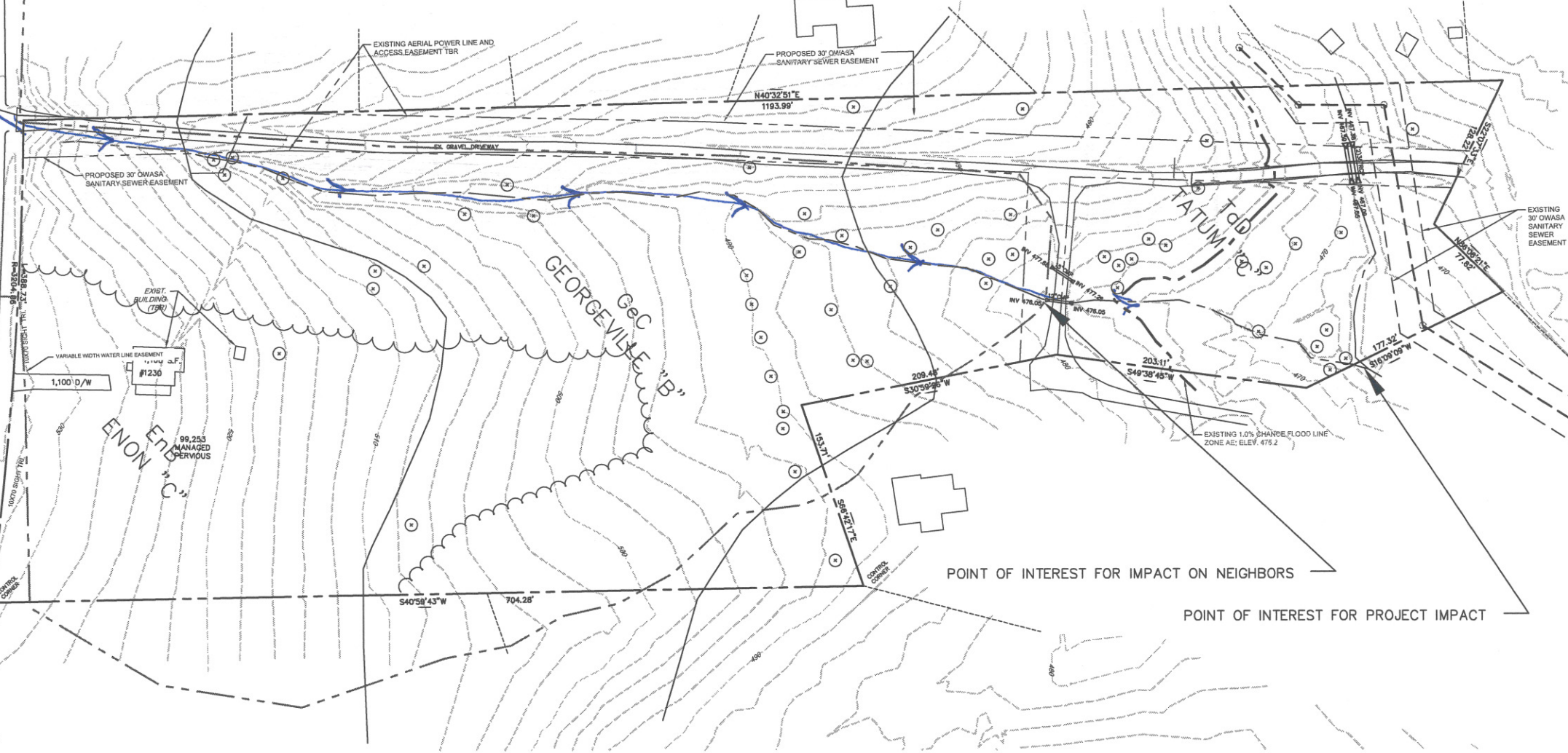
HOUSE	0.03
DRIVE	0.03
R/W	0.11
GRASS	1.73
WOODS	1.15

NOTE: TO POINT OF INTEREST #1

- LEGEND
- PROPERTY LINE
 - R/W LINE
 - OVERHEAD UTILITY LINES
 - UNDERGROUND ELEC. LINES
 - SANITARY SEWER LINE
 - BLDG. SETBACK
 - TREE PROTECTION AREA
 - BUFFER AREA
 - EXISTING IRON PIPE
 - LIGHT POLES
 - UTILITY POLE
 - SEWER CLEANOUT
 - WATER METER
 - CURB INLET
 - EX. SEWER MAN HOLE

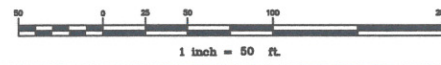
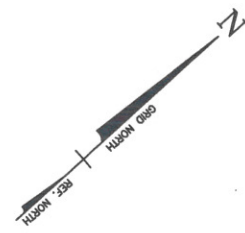
START
ENB
"C"

HILLSBOROUGH ROAD
(EX. VARIABLE WIDTH PUBLIC R/W) (S.R. 1009)



POINT OF INTEREST FOR IMPACT ON NEIGHBORS

POINT OF INTEREST FOR PROJECT IMPACT



CREDLE ENGINEERING COMPANY, INC.
ENGINEERS/PLANNERS/SURVEYORS
204 E. MARKHAM AVE., DURHAM, N.C. 27701 (919) 682-2006 PH (919) 682-2005 FX

SANDERWAY SUBDIVISION
PROPERTY OF
GH-2, LLC
121 SOUTH ESTES DRIVE, STE 100, CHAPEL HILL, N.C. 27514

STORMWATER DRAINAGE PRE

REVISIONS

NO.	DATE	DESCRIPTION
1		
2		
3		
4		
5		

DATE: SEPTEMBER 10, 2016
SCALE: 1"=50'
LICENSE: C-0254
JOB: 2017/170211/Rev 171017
SHEET NUMBER

C0520
OF 10 SHEETS

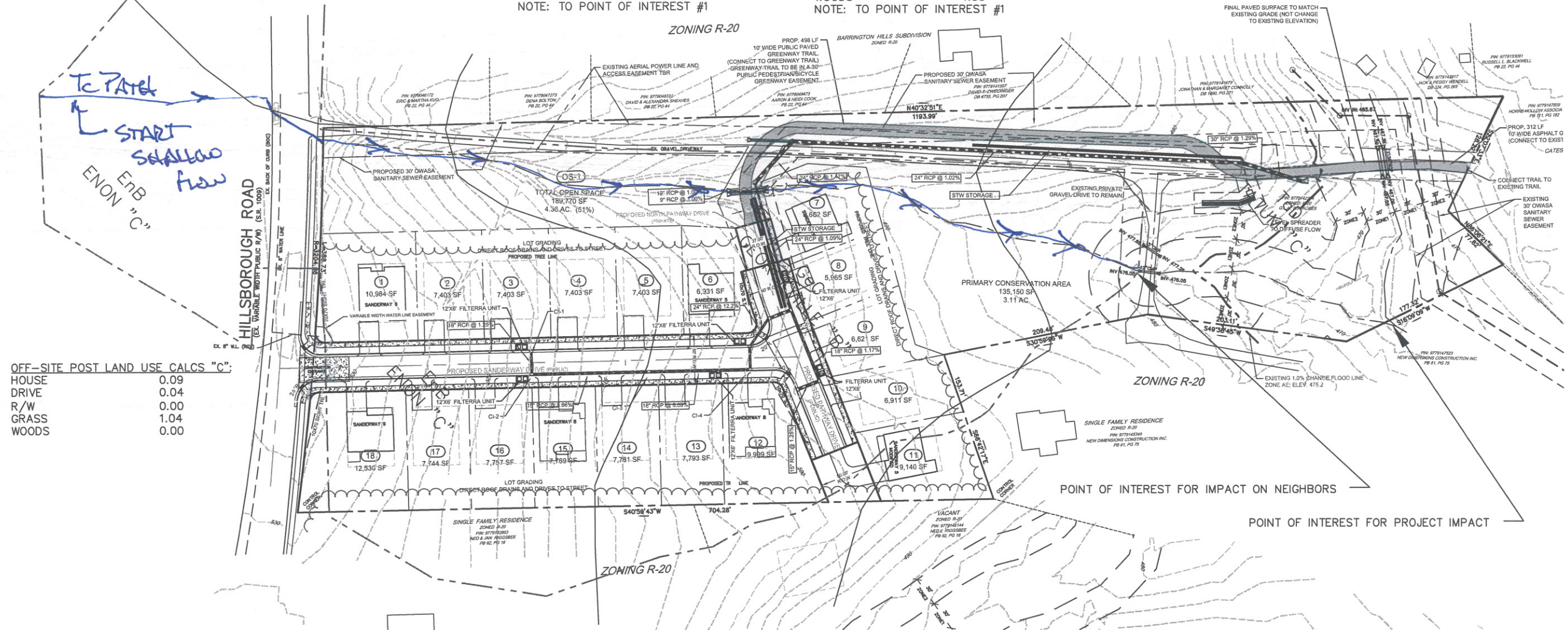
PRE-DEVELOPMENT IMPERVIOUS AREA =	15
POST-DEVELOPMENT IMPERVIOUS AREA =	89
IMPERVIOUS AREA REQUIRED TO BE TREATED = POST-PRE	73
IMPERVIOUS AREA PROVIDED TO BE TREATED =	68
NET AREA NOT TREATED:	5
NOTE: NON-VEHICULAR GREENWAY PAVEMENT IS NOT TREATED	

15,274 S.F. (0.35)
89,140 S.F. (2.05 AC.)
73,866 S.F. (1.70 AC.)
68,305 S.F. (1.56 AC.)
5,561 S.F. (0.13 AC.)

OFF-SITE POST LAND USE CALCS "B":	
HOUSE	0.06
DRIVE	0.03
R/W	0.84
GRASS	0.23
WOODS	0.00
NOTE: TO POINT OF INTEREST #1	

<u>POST LAND USE CALCS NON-TREATED "B":</u>	
HOUSE	0.00
DRIVE	0.00
R/W	0.10
GRASS	0.73
WOODS	1.45
NOTE: TO POINT OF INTEREST #1	

POST LAND USE CALCS NON-TREATED "C":	
HOUSE	0.00
DRIVE	0.02
R/W	0.12
GRASS	0.45
WOODS	1.35
NOTE: TO POINT OF INTEREST #1	



OFF-SITE POST LAND USE CALCS "C":	
HOUSE	0.09
DRIVE	0.04
R/W	0.00
GRASS	1.04
WOODS	0.00

<u>POST LAND USE CALCS TREATED "C":</u>	
HOUSE	0.41
DRIVE	0.15
R/W	0.19
GRASS	0.32
WOODS	0.00
NOTE: TO POINT OF INTEREST #1	

POST LAND USE CALCS TREATED "B":	
HOUSE	0.41
DRIVE	0.18
R/W	0.22
GRASS	0.36
WOODS	0.00
NOTE: TO POINT OF INTEREST #1	

- LEGEND
- | | |
|-------------------------|-----------|
| PROPERTY LINE | ———— |
| R/W LINE | ———— |
| OVERHEAD UTILITY LINES | — · — · — |
| UNDERGROUND ELEC. LINES | ---- |
| SANITARY SEWER LINE | ---- |
| BLDG. SETBACK | SB |
| TREE PROTECTION AREA | TPA |
| BUFFER AREA | B |
| EXISTING IRON PIPE | • |
| LIGHT POLES | ✱ |
| UTILITY POLE | ⚡ |
| SEWER CLEANOUT | ⊙ |
| WATER METER | ⊠ |
| CURB INLET | ⊞ |
| EX. SEWER MAN HOLE | ⊗ |

ENGINEERS/PPLANNERS/SURVEYORS

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SANDERWAY SUBDIVISION

PROPERTY OF

STORMWATER DRAINAGE POST

SANDERWAY SUBDIVISION
PROPERTY OF
GH-2, LLC
H ESTES DRIVE, STE 100, CHAPEL HILL, N. C.

121 SOUTH ESTES DRIVE, STE 100, CHAPEL HILL, N.C. 27514

[illegible]

DATE	SEPTEMBER 10, 2016
SCALE	1"=50'
LICENSE	C-0254
JOB	\\2017\170211\Bose 171017
SHEET NUMBER	

C0530

OF 10 SHEETS

TR-55 CALCULATIONS

Storm Water Impact Analysis Worksheet

1

Project: **Sanderway**
 Location: **Hillsborough St**
 Date: **9/15/2018**

Composite "C" Drainage area to culvert at driveway before relocation of output

Pre-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>	<u>Rational "C"</u>		
Off-site	0.00	woods	B	55	0.0	0.20	0.00
	0.23	grass	B	79	18.2	0.35	0.08
	0.93	impervious	B	98	91.1	0.95	0.88
	0.00	woods	C	70	0.0	0.20	0.00
	1.04	grass	C	74	77.0	0.35	0.36
	0.13	impervious	C	98	12.7	0.95	0.12
On-site	2.74	woods	B	55	150.7	0.20	0.55
	0.50	grass	B	79	39.5	0.35	0.18
	0.17	impervious	B	98	16.7	0.95	0.16
	1.15	woods	C	70	80.5	0.20	0.23
	1.73	grass	C	74	128.0	0.35	0.61
	0.17	impervious	C	98	16.7	0.95	0.16

8.79 Total
 Composite "CN" = 71.3
 Composite "C" = 0.37

Post-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>			
Off-site	0.00	woods	B	55	0.0	0.20	0.00
	0.23	grass	B	79	18.2	0.35	0.08
	0.93	impervious	B	98	91.1	0.95	0.88
	0.00	woods	C	70	0.0	0.20	0.00
	1.04	grass	C	74	77.0	0.35	0.36
	0.13	impervious	C	98	12.7	0.95	0.12
On-site	1.45	woods	B	55	79.8	0.20	0.29
	1.09	grass	B	79	86.1	0.35	0.38
	0.91	impervious	B	98	89.2	0.95	0.86
	1.35	woods	C	70	94.5	0.20	0.27
	0.77	grass	C	74	57.0	0.35	0.27
	0.89	impervious	C	98	87.2	0.95	0.85

8.79 Total
 Composite "CN" = 76.6

Storm Water Impact Analysis Worksheet

1 Con't

Project: Sanderway
 Location: Hillsborough St
 Date: 9/15/18

Flow area:

1	Total area	a	ac.	8.58
2	Total area	s.f.	s.f.	373744

Post-Development

1.45	Sheet flow								
0.8	3	Surface description	(TR-55,table 3-1)						
3.74									
2.53	Sheet flow			Segment ID					
0.06	3	Surface description	(TR-55,table 3-1)		Woods	Grass			
4		Manning's roughness coeff.	n (TR-55,table3-1)		0.4	0.24			
5		Flow Length	L (total L < 300 ft)	ft	0	50			
8.58	Total	Two-yr 24-hr rainfall	P2	in	3.6	3.6			
7		Land slope	s	ft/ft	0.04	0.02			
8		$Tt = 0.007 * (nL)^{0.8} / P2^{0.5} s^{0.4}$	Tt	hr	0.00	0.13	=	0.13	
		Shallow concentrated flow		Segment ID					
9		Surface description	(paved or unpaved)		unpaved	paved			
10		Flow length	L	ft	225	60			
11		Watercourse slope	s	ft/ft	0.0561	0.02			
		Channel flow		ft/s	3.6	3			
1.45	14	Bottom width		hr	0.02	0.01	=	0.02	
0.8	15	Depth of flow	(TR-55,table 3-1)						
2.72	Channel flow			Segment ID					
2.04	14	Bottom width	B	ft	2	4			
1.57	15	Depth of flow	y	ft	1	2			
16		Side Slope	M	ft/1ft	2	2			
17		Channel slope, s	s	ft/ft	0.063	0.063			
8.58	Total	Manning's roughness coeff., n	n		0.035	0.035			
19		Cross sectional flow area, a	a	ft^2	4	16			
20		Wetted perimeter, Pw	Pw	ft	6.47	12.94			
21		Hydraulic radius, $r=a/Pw$	r	ft	0.62	1.24			
22		$V = (1.49*r^{2/3}*s^{1/2})/n$	V	ft/s	3.96	6.24			
23		Flow length, L		ft	820	0			
24		$Tt = L / (3600 v)$	Tt	hr	0.06	0.00	=	0.06	
		Pipe flow		Segment ID					
25		Dia. of pipe	D	in	24	48			
26		Channel slope, s	s	ft/ft	0.01	0.01			
27		Manning's roughness coeff., n	n		0.013	0.013			
28		$V = (1.49*D/12/4*s^{1/2})/n$	V	ft/s	7.2	11.5			
29		Flow length, L		ft	0	0			
30		$Tt = L / (3600 v)$	Tt	hr	0.00	0.00	=	0.00	
31		Watershed or subarea Tc or Tt (add Tt in steps 8,13, 24, and 30)		hr =				0.21	
		If Tt < 5.00 min, use 5.00 min.		min =				12.56	

Storm Water Impact Analysis Worksheet

1

Project: **Sanderway**
 Location: **Hillsborough St**
 Date: **9/15/2018**

Composite "C" Drainage area to culvert at driveway

Pre-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>	<u>Rational "C"</u>		
Off-site	0.00	woods	B	55	0.0	0.20	0.00
	0.23	grass	B	79	18.2	0.35	0.08
	0.93	impervious	B	98	91.1	0.95	0.88
	0.00	woods	C	70	0.0	0.20	0.00
	1.04	grass	C	74	77.0	0.35	0.36
	0.13	impervious	C	98	12.7	0.95	0.12
On-site	2.74	woods	B	55	150.7	0.20	0.55
	0.50	grass	B	79	39.5	0.35	0.18
	0.17	impervious	B	98	16.7	0.95	0.16
	1.15	woods	C	70	80.5	0.20	0.23
	1.73	grass	C	74	128.0	0.35	0.61
	0.17	impervious	C	98	16.7	0.95	0.16

8.79 Total
 Composite "CN" = 71.3
 Composite "C" = 0.37

Post-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>			
Off-site	0.00	woods	B	55	0.0	0.20	0.00
	0.23	grass	B	79	18.2	0.35	0.08
	0.93	impervious	B	98	91.1	0.95	0.88
	0.00	woods	C	70	0.0	0.20	0.00
	1.04	grass	C	74	77.0	0.35	0.36
	0.13	impervious	C	98	12.7	0.95	0.12
On-site	1.45	woods	B	55	79.8	0.20	0.29
	0.73	grass	B	79	57.7	0.35	0.26
	0.10	impervious	B	98	9.8	0.95	0.10
	1.35	woods	C	70	94.5	0.20	0.27
	0.45	grass	C	74	33.3	0.35	0.16
	0.14	impervious	C	98	13.7	0.95	0.13

6.55 Total
 Composite "CN" = 74.0

Storm Water Impact Analysis Worksheet

1

Project: **Sanderway**
 Location: **Hillsborough St**
 Date: **9/15/2018**

Composite "C" Culvert

Pre-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>	<u>Rational "C"</u>	
Off-site	0.00	woods	C	70	0.0	0.20
	0.00	grass	C	74	0.0	0.35
	0.00	impervious	C	98	0.0	0.95
On-site	0.00	woods	B	55	0.0	0.20
	0.00	grass	B	79	0.0	0.35
	0.00	impervious	B	98	0.0	0.95

0.00 Total
 Composite "CN" = #DIV/0!
 Composite "C" = #DIV/0!

Post-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>		
Off-site	0.00	woods	B	55	0.0	0.20
	0.23	grass	B	79	18.2	0.35
	0.93	impervious	B	98	91.1	0.95
	0.00	woods	C	70	0.0	0.20
	1.04	grass	C	74	77.0	0.35
	0.13	impervious	C	98	12.7	0.95
On-site	0.48	woods	B	55	26.4	0.20
	0.08	grass	B	79	6.3	0.35
	0.05	impervious	B	98	4.9	0.95
	0.48	woods	C	70	33.6	0.20
	0.03	grass	C	74	2.2	0.35
	0.04	impervious	C	98	3.9	0.95

3.49 Total
 Composite "CN" = 79.2
 Composite "C" = 0.51

Storm Water Impact Analysis Worksheet

1

Project: **Sanderway**
 Location: **Hillsborough St**
 Date: **9/15/2018**

Composite "C" Non Treated

Post-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>			
Off-site	0.00	woods	B	55	0.0	0.20	0.00
	0.00	grass	B	79	0.0	0.35	0.00
	0.00	impervious	B	98	0.0	0.95	0.00
	0.00	woods	C	70	0.0	0.20	0.00
	0.00	grass	C	74	0.0	0.35	0.00
	0.00	impervious	C	98	0.0	0.95	0.00
On-site	0.97	woods	B	55	53.4	0.20	0.19
	0.63	grass	B	79	49.8	0.35	0.22
	0.05	impervious	B	98	4.9	0.95	0.05
	0.87	woods	C	70	60.9	0.20	0.17
	0.42	grass	C	74	31.1	0.35	0.15
	0.10	impervious	C	98	9.8	0.95	0.10

3.04 Total
 Composite "CN" = 69.0
 Composite "C" = 0.29

Storm Water Impact Analysis Worksheet

1

Project: **Sanderway**
 Location: **Hillsborough St**
 Date: **9/15/2018**

Composite "C" Treated

Post-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>			
Off-site	0.00	woods	C	70	0.0	0.20	0.00
	0.00	grass	C	74	0.0	0.35	0.00
	0.00	impervious	C	98	0.0	0.95	0.00
On-site	0.32	grass	C	74	23.7	0.20	0.06
	0.36	grass	B	79	28.4	0.35	0.13
	1.56	impervious	B	98	152.9	0.95	1.48

2.24 Total
 Composite "CN" = 91.5
 Composite "C" = 0.75

Storm Water Impact Analysis Worksheet

1

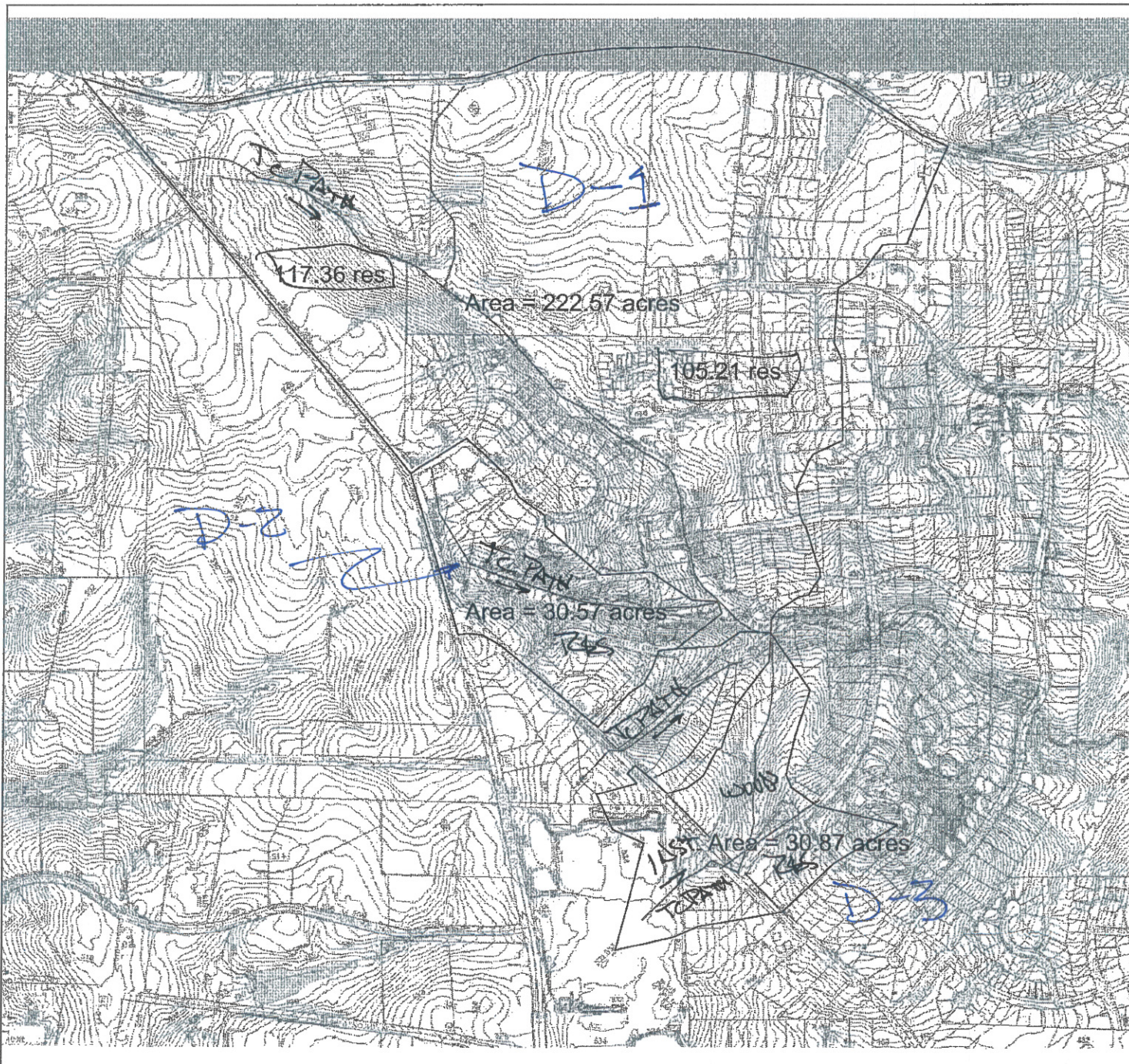
Project: **Sanderway**
 Location: **Hillsborough St**
 Date: **9/15/2018**

Composite "C"

Post-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>			
Off-site	0.00	woods	C	70	0.0	0.20	0.00
	0.00	grass	C	74	0.0	0.35	0.00
	0.00	impervious	C	98	0.0	0.95	0.00
On-site	0.57	grass	C	74	42.2	0.20	0.11
	0.57	grass	B	79	45.0	0.35	0.20
	1.63	impervious	B	98	159.7	0.95	1.55

2.77 Total
 Composite "CN" = 89.2
 Composite "C" = 0.67



DRAINAGE AREAS

D-1 222.57 ac
CN 69.7

D-2 30.87 ac
CN 74.0

D-3 30.57 ac
CN 75

Storm Water Impact Analysis Worksheet

1

Project: Sanderway
 Location: Hillsborough St
 Date: 9/15/2018

Composite "C"

Pre-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>	<u>Rational "C"</u>	
Off-site	0.00	Institutional	B	88	0.0	0.20
	105.21	Res	B	75	7890.8	0.35
	117.36	Res	B	65	7628.4	0.95
	0.00	Institutional	C	91	0.0	0.20
	0.00	Res	C	83	0.0	0.35
	0.00	Com	C	98	0.0	0.95
On-site	0.00	woods	B	55	0.0	0.20
	0.00	grass	B	79	0.0	0.35
	0.00	impervious	B	98	0.0	0.95
	0.00	woods	C	70	0.0	0.20
	0.00	grass	C	74	0.0	0.35
	0.00	impervious	C	98	0.0	0.95

222.57 Total
 Composite "CN" = 69.7
 Composite "C" = 0.67

Storm Water Impact Analysis Worksheet

1

Project: Sanderway
Location: Hillsborough St
Date: 9/15/18

Flow area:

1	Total area	a	ac.	222.57
2	Total area	s.f.	s.f.	9695149.2

Pre-Development

1.45 Sheet flow
0.8 3 Surface description (TR-55,table 3-1)
3.74

2.53 Sheet flow		Segment ID		
0.06 3	Surface description	(TR-55,table 3-1)		Woods Grass
4	Manning's roughness coeff.	n (TR-55,table3-1)		0.4 0.24
5	Flow Length	L (total L < 300 ft)	ft	0 50
8.58 Total	Two-yr 24-hr rainfall	P2	in	3.6 3.6
7	Land slope	s	ft/ft	0.04 0.02
8	$Tt = 0.007 * (nL)^{0.8} / P2^{0.5} s^{0.4}$	Tt	hr	0.00 0.13 = 0.13

Shallow concentrated flow

9 Surface description (paved or unpaved)
10 Flow length L
11 Watercourse slope s

Segment ID		
.....	unpaved	paved
.....ft	1275	60
....ft/ft	0.0561	0.02
....ft/s	3.2	3
.....hr	0.11	0.01 = 0.12

Channel flow

1.45 14 Bottom width
0.8 15 Depth of flow (TR-55,table 3-1)

2.72 Channel flow

2.04 14 Bottom width B
1.57 15 Depth of flow y
16 Side Slope M
17 Channel slope, s
8.58 Total Manning's roughness coeff., n
19 Cross sectional flow area, a
20 Wetted perimeter, Pw
21 Hydraulic radius, $r = a/Pw$
22 $V = (1.49 * r^{2/3} * s^{1/2}) / n$
23 Flow length, L
24 $Tt = L / (3600 v)$

Segment ID		
.....ft	2	4
.....ft	1	2
....ft/ft	2	2
....ft/ft	0.017	0.017
.....	0.035	0.035
....ft^2	4	16
.....ft	6.47	12.94
.....ft	0.62	1.24
....ft/s	3.96	6.24
.....ft	1521	19.3
.....hr	0.11	0.00 = 0.11

Pipe flow

25 Dia. of pipe D
26 Channel slope, s
27 Manning's roughness coeff., n
28 $V = (1.49 * D^{1/2} * s^{1/2}) / n$
29 Flow length, L
30 $Tt = L / (3600 v)$

Segment ID		
.....in	24	48
....ft/ft	0.01	0.01
.....	0.013	0.013
....ft/s	7.2	11.5
.....ft	0	0
.....hr	0.00	0.00 = 0.00

31 Watershed or subarea Tc or Tt (add Tt in steps 8,13, 24, and 30)
If Tt < 5.00 min, use 5.00 min.

.....hr =	0.35
.....min =	21.16

Storm Water Impact Analysis Worksheet

1

Project: Sanderway
Location: Hillsborough St
Date: 9/15/2018

Composite "C"

Pre-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>	<u>Rational "C"</u>	
Off-site	0.00	Institutional	B	88	0.0	0.20
	6.10	Res	B	75	457.5	0.35
	11.84	Woods	B	55	651.2	0.95
	12.93	Institutional	C	91	1176.6	0.20
	0.00	Res	C	83	0.0	0.35
	0.00	Com	C	98	0.0	0.95
On-site	0.00	woods	B	55	0.0	0.20
	0.00	grass	B	79	0.0	0.35
	0.00	impervious	B	98	0.0	0.95
	0.00	woods	C	70	0.0	0.20
	0.00	grass	C	74	0.0	0.35
	0.00	impervious	C	98	0.0	0.95

30.87 Total
Composite "CN" = 74.0
Composite "C" = 0.52

Storm Water Impact Analysis Worksheet

1

Project: Sanderway
Location: Hillsborough St
Date: 9/15/18

Flow area:

1	Total area	a	ac.	30.87
2	Total area	s.f.	s.f.	1344697.2

Pre-Development

1.45	Sheet flow	
0.8	3	Surface description (TR-55, table 3-1)
3.74		
2.53	Sheet flow	
0.06	3	Surface description (TR-55, table 3-1)
4		Manning's roughness coeff. n (TR-55, table 3-1)
5		Flow Length L (total L < 300 ft)
8.58	Total	Two-yr 24-hr rainfall P2
7		Land slope s
8		$Tt = 0.007 * (nL)^{0.8} / P2^{0.5} s^{0.4}$ Tt

Segment ID		
.....	Woods	Grass
.....	0.4	0.24
.....ft	0	50
.....in	3.6	3.6
....ft/ft	0.04	0.02
.....hr	0.00	0.13

	Shallow concentrated flow	
9		Surface description (paved or unpaved)
10		Flow length L
11		Watercourse slope s

Segment ID		
.....	unpaved	paved
.....ft	490	60
....ft/ft	0.0561	0.02
....ft/s	3.2	3
.....hr	0.04	0.01

	Channel flow	
1.45	14	Bottom width B
0.8	15	Depth of flow y
2.72	Channel flow	
2.04	14	Bottom width B
1.57	15	Depth of flow y
16		Side Slope M
17		Channel slope, s
8.58	Total	Manning's roughness coeff., n
19		Cross sectional flow area, a
20		Wetted perimeter, Pw
21		Hydraulic radius, $r = a/Pw$
22		$V = (1.49 * r^{2/3} * s^{1/2}) / n$
23		Flow length, L
24		$Tt = L / (3600 v)$ Tt

Segment ID		
.....ft	2	4
.....ft	1	2
....ft/ft	2	2
....ft/ft	0.017	0.017
.....	0.035	0.035
....ft^2	4	16
.....ft	6.47	12.94
.....ft	0.62	1.24
....ft/s	3.96	6.24
.....ft	817	800
.....hr	0.06	0.04

	Pipe flow	
25		Dia. of pipe D
26		Channel slope, s
27		Manning's roughness coeff., n
28		$V = (1.49 * D^{2/3} * s^{1/2}) / n$
29		Flow length, L
30		$Tt = L / (3600 v)$ Tt

Segment ID		
.....in	24	48
....ft/ft	0.01	0.01
.....	0.013	0.013
....ft/s	7.2	11.5
.....ft	0	0
.....hr	0.00	0.00

31	Watershed or subarea Tc or Tt (add Tt in steps 8, 13, 24, and 30)	hr =	0.27
	If Tt < 5.00 min, use 5.00 min.	min =	16.19

Storm Water Impact Analysis Worksheet

1

Project: Sanderway
Location: Hillsborough St
Date: 9/15/2018

Composite "C"

Pre-Development

	<u>Area (ac)</u>	<u>Use</u>	<u>Soil type</u>	<u>Curve Number "CN"</u>	<u>Rational "C"</u>	
Off-site	0.00	Institutional	B	88	0.0	0.20
	30.57	Res	B	75	2292.8	0.35
	0.00	Res	B	65	0.0	0.95
	0.00	Institutional	C	91	0.0	0.20
	0.00	Res	C	83	0.0	0.35
	0.00	Com	C	98	0.0	0.95
On-site	0.00	woods	B	55	0.0	0.20
	0.00	grass	B	79	0.0	0.35
	0.00	Impervious	B	98	0.0	0.95
	0.00	woods	C	70	0.0	0.20
	0.00	grass	C	74	0.0	0.35
	0.00	Impervious	C	98	0.0	0.95

30.57 Total
Composite "CN" = 75.0
Composite "C" = 0.35

Storm Water Impact Analysis Worksheet

1

Project: Sanderway
Location: Hillsborough St
Date: 9/15/18

Flow area:

1	Total area	a	ac.	30.57
2	Total area	s.f.	s.f.	1331629.2

Pre-Development

1.45 Sheet flow

0.8 3 Surface description (TR-55, table 3-1)
3.74

2.53 Sheet flow

0.06 3 Surface description (TR-55, table 3-1)
4 Manning's roughness coeff. n (TR-55, table 3-1)
5 Flow Length L (total L < 300 ft)

8.58 Total Two-yr 24-hr rainfall P2

7 Land slope s

8 $T_t = 0.007 * (nL)^{0.8} / P2^{0.5} s^{0.4}$

Segment ID		
.....	Woods	Grass
.....	0.4	0.24
.....ft	0	50
.....in	3.6	3.6
.....ft/ft	0.04	0.02
.....hr	0.00	0.13

= 0.13

Shallow concentrated flow

9 Surface description (paved or unpaved)
10 Flow length L
11 Watercourse slope s

Channel flow

1.45 14 Bottom width

0.8 15 Depth of flow

2.72 Channel flow

2.04 14 Bottom width

1.57 15 Depth of flow

16 Side Slope

17 Channel slope, s

8.58 Total Manning's roughness coeff., n

19 Cross sectional flow area, a

20 Wetted perimeter, Pw

21 Hydraulic radius, $r = a/Pw$

22 $V = (1.49 * r^{2/3} * s^{1/2}) / n$

23 Flow length, L

24 $T_t = L / (3600 v)$

Segment ID		
.....	unpaved	paved
.....ft	661	60
.....ft/ft	0.0561	0.02
.....ft/s	3.6	3
.....hr	0.05	0.01

= 0.06

Segment ID		
.....ft	2	4
.....ft	1	2
.....ft/ft	2	2
.....ft/ft	0.017	0.017
.....	0.035	0.035
.....ft^2	4	16
.....ft	6.47	12.94
.....ft	0.62	1.24
.....ft/s	3.96	6.24
.....ft	702	700
.....hr	0.05	0.03

= 0.08

Pipe flow

25 Dia. of pipe

26 Channel slope, s

27 Manning's roughness coeff., n

28 $V = (1.49 * D^{2/3} * s^{1/2}) / n$

29 Flow length, L

30 $T_t = L / (3600 v)$

Segment ID		
.....in	24	48
.....ft/ft	0.01	0.01
.....	0.013	0.013
.....ft/s	7.2	11.5
.....ft	0	0
.....hr	0.00	0.00

= 0.00

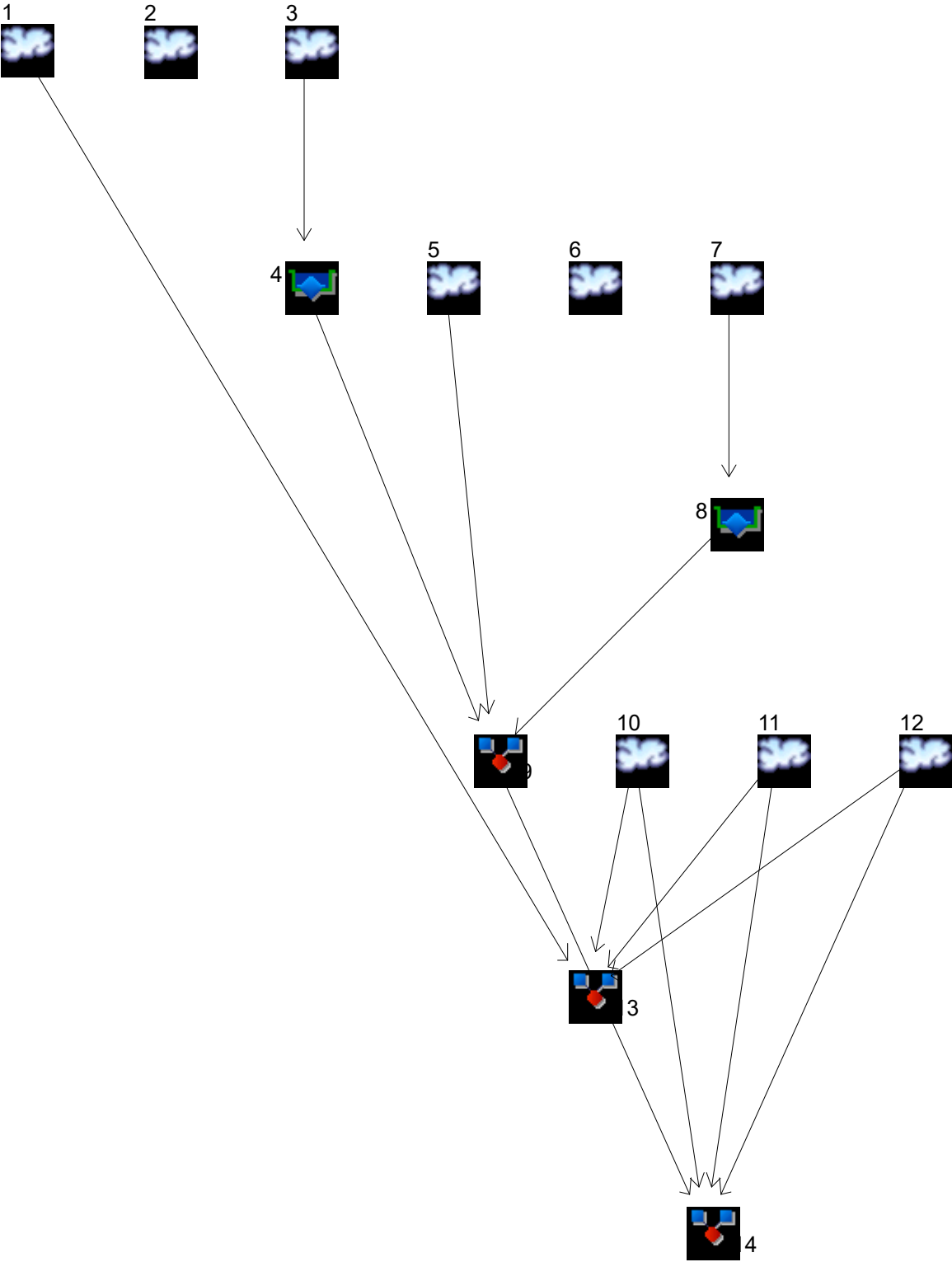
31 Watershed or subarea T_c or T_t (add T_t in steps 8, 13, 24, and 30)
If $T_t < 5.00$ min, use 5.00 min.

.....hr = 0.27
.....min = 15.95

HYDROGRAPHS

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



Hydrograph Return Period Recap

Hydratlow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-----	8.127	12.56	-----	-----	-----	-----	-----	-----	Property
2	SCS Runoff	-----	12.52	17.80	-----	-----	-----	-----	-----	-----	Property Post
3	SCS Runoff	-----	5.498	7.702	-----	-----	-----	-----	-----	-----	Culvert
4	Reservoir	3	4.500	6.279	-----	-----	-----	-----	-----	-----	Culver
5	SCS Runoff	-----	0.369	0.887	-----	-----	-----	-----	-----	-----	Non Treated Remainder
6	SCS Runoff	-----	7.927	11.54	-----	-----	-----	-----	-----	-----	Non-Treated Area Post
7	SCS Runoff	-----	6.968	8.735	-----	-----	-----	-----	-----	-----	Treated Area Post
8	Reservoir	7	1.508	3.557	-----	-----	-----	-----	-----	-----	Total area needed
9	Combine	4, 5,	4.727	6.721	-----	-----	-----	-----	-----	-----	Post with Culvert at Drive
10	SCS Runoff	-----	135.55	217.87	-----	-----	-----	-----	-----	-----	DA1
11	SCS Runoff	-----	30.84	45.79	-----	-----	-----	-----	-----	-----	DA2
12	SCS Runoff	-----	32.65	47.81	-----	-----	-----	-----	-----	-----	DA3
13	Combine	1, 10, 11, 12	200.43	317.50	-----	-----	-----	-----	-----	-----	Large DA combined Pre
14	Combine	8, 9, 10, 11, 12,	199.65	317.00	-----	-----	-----	-----	-----	-----	Large DA Combined Post
Proj. file: Storm 190114_1.gpw										Wednesday, Jan 16, 2019	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	8.127	3	723	23,964	-----	-----	-----	Property
2	SCS Runoff	12.52	3	723	34,905	-----	-----	-----	Property Post
3	SCS Runoff	5.498	3	720	15,210	-----	-----	-----	Culvert
4	Reservoir	4.500	3	726	15,209	3	497.02	1,392	Culver
5	SCS Runoff	0.369	3	720	1,387	-----	-----	-----	Non Treated Remainder
6	SCS Runoff	7.927	3	723	22,419	-----	-----	-----	Non-Treated Area Post
7	SCS Runoff	6.968	3	717	16,129	-----	-----	-----	Treated Area Post
8	Reservoir	1.508	3	729	16,121	7	491.80	5,626	Total area needed
9	Combine	4.727	3	726	16,596	4, 5,	-----	-----	Post with Culvert at Drive
10	SCS Runoff	135.55	3	729	552,068	-----	-----	-----	DA1
11	SCS Runoff	30.84	3	726	104,955	-----	-----	-----	DA2
12	SCS Runoff	32.65	3	726	109,949	-----	-----	-----	DA3
13	Combine	200.43	3	726	790,937	1, 10, 11, 12	-----	-----	Large DA combined Pre
14	Combine	199.65	3	729	799,690	8, 9, 10, 11, 12,	-----	-----	Large DA Combined Post
Storm 190114_1.gpw					Return Period: 1 Year			Wednesday, Jan 16, 2019	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	12.56	3	723	35,616	-----	-----	-----	Property
2	SCS Runoff	17.80	3	720	48,896	-----	-----	-----	Property Post
3	SCS Runoff	7.702	3	720	21,009	-----	-----	-----	Culvert
4	Reservoir	6.279	3	726	21,007	3	497.59	2,192	Culver
5	SCS Runoff	0.887	3	720	2,450	-----	-----	-----	Non Treated Remainder
6	SCS Runoff	11.54	3	723	32,094	-----	-----	-----	Non-Treated Area Post
7	SCS Runoff	8.735	3	717	20,460	-----	-----	-----	Treated Area Post
8	Reservoir	3.557	3	726	20,452	7	492.51	6,958	Total area needed
9	Combine	6.721	3	726	23,458	4, 5,	-----	-----	Post with Culvert at Drive
10	SCS Runoff	217.87	3	729	829,931	-----	-----	-----	DA1
11	SCS Runoff	45.79	3	726	151,314	-----	-----	-----	DA2
12	SCS Runoff	47.81	3	726	157,128	-----	-----	-----	DA3
13	Combine	317.50	3	726	1,173,989	1, 10, 11, 12	-----	-----	Large DA combined Pre
14	Combine	317.00	3	726	1,182,283	8, 9, 10, 11, 12,	-----	-----	Large DA Combined Post
Storm 190114_1.gpw					Return Period: 2 Year			Wednesday, Jan 16, 2019	

Hydrograph Return Period Recap

Hydratlow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-----	-----	-----	-----	21.20	27.88	37.76	-----	53.66	Property
2	SCS Runoff	-----	-----	-----	-----	27.83	35.11	45.62	-----	62.11	Property Post
3	SCS Runoff	-----	-----	-----	-----	11.78	14.72	18.94	-----	25.51	Culvert
4	Reservoir	3	-----	-----	-----	8.476	9.702	11.07	-----	12.58	Culver
5	SCS Runoff	-----	-----	-----	-----	1.986	2.858	4.200	-----	6.481	Non Treated Remainder
6	SCS Runoff	-----	-----	-----	-----	18.62	23.86	31.47	-----	43.54	Non-Treated Area Post
7	SCS Runoff	-----	-----	-----	-----	11.81	13.94	16.92	-----	21.48	Treated Area Post
8	Reservoir	7	-----	-----	-----	8.983	10.27	12.00	-----	16.57	Total area needed
9	Combine	4, 5,	-----	-----	-----	9.623	11.35	13.82	-----	17.49	Post with Culvert at Drive
10	SCS Runoff	-----	-----	-----	-----	380.35	504.07	690.78	-----	993.25	DA1
11	SCS Runoff	-----	-----	-----	-----	74.51	96.16	127.84	-----	178.25	DA2
12	SCS Runoff	-----	-----	-----	-----	76.91	98.64	130.31	-----	180.52	DA3
13	Combine	1, 10, 11, 12	-----	-----	-----	547.46	720.32	976.06	-----	1387.88	Large DA combined Pre
14	Combine	8, 9, 10, 11, 12,	-----	-----	-----	547.05	717.45	968.99	-----	1372.66	Large DA Combined Post
Proj. file: Storm 190114_5.gpw										Wednesday, Jan 16, 2019	

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

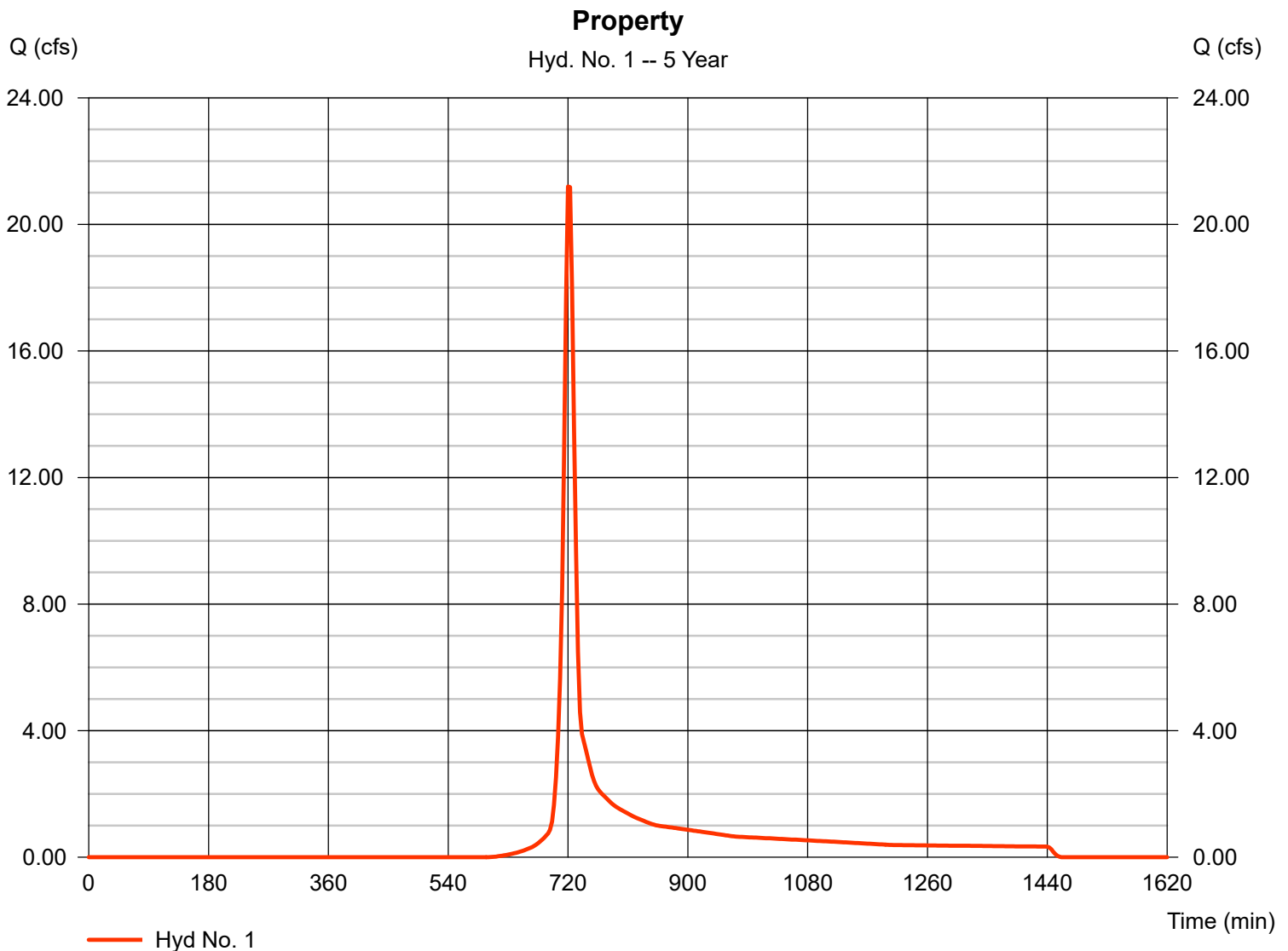
Wednesday, Jan 16, 2019

Hyd. No. 1

Property

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 21.20 cfs
Time to peak = 720 min
Hyd. volume = 58,729 cuft
Curve number = 70.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

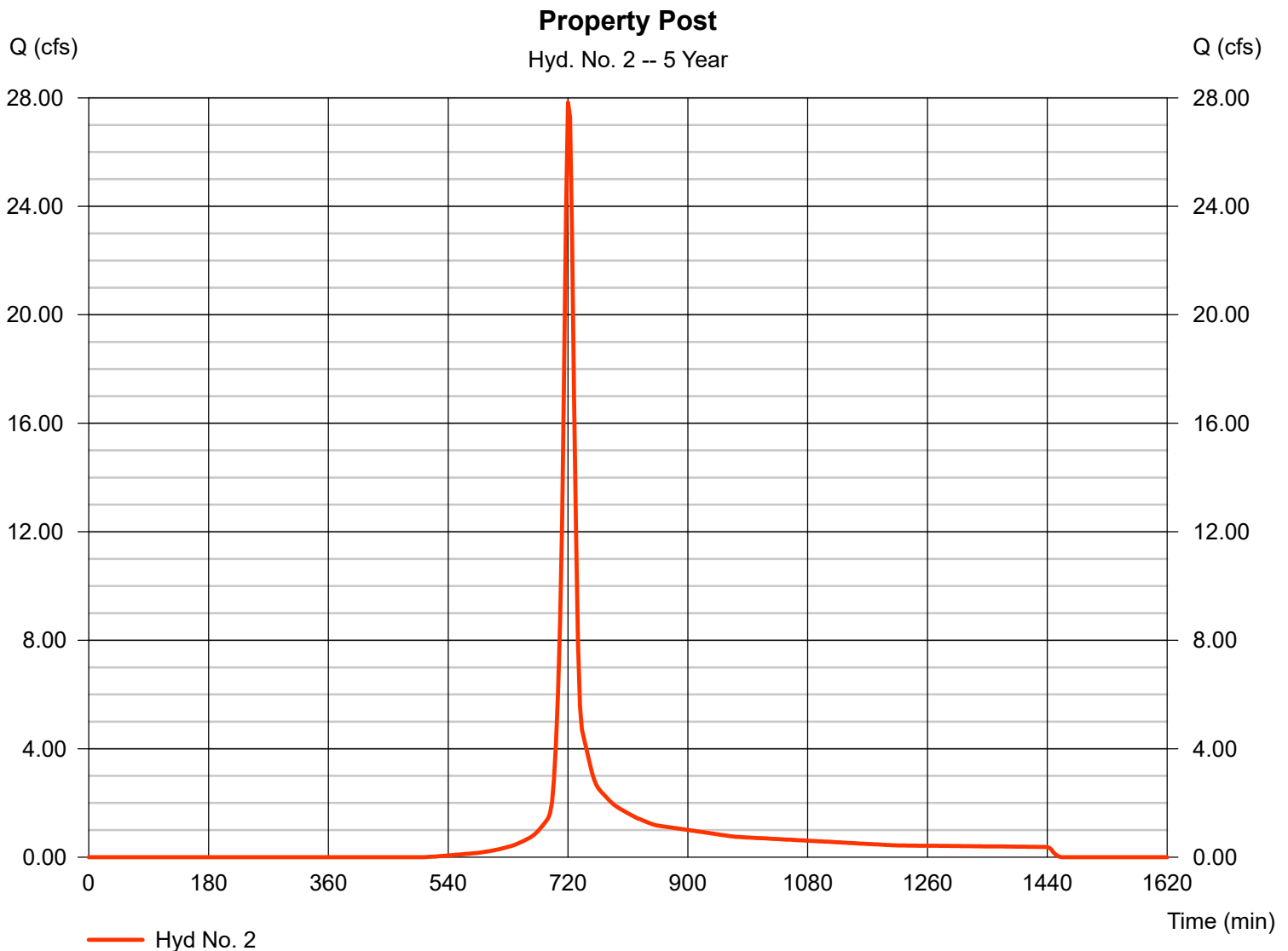
Wednesday, Jan 16, 2019

Hyd. No. 2

Property Post

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 27.83 cfs
Time to peak = 720 min
Hyd. volume = 75,511 cuft
Curve number = 77.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

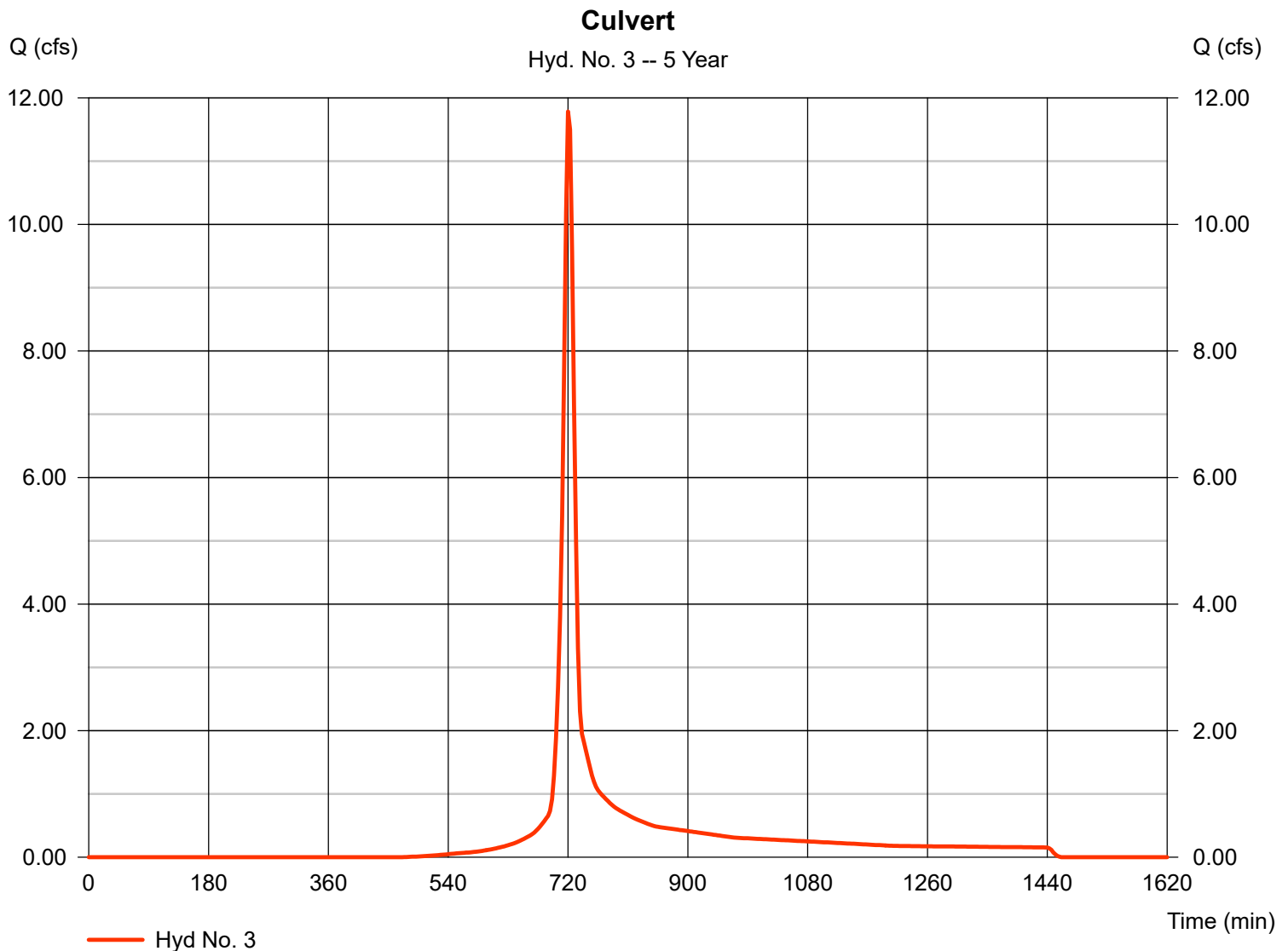
Wednesday, Jan 16, 2019

Hyd. No. 3

Culvert

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 3.490 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 11.78 cfs
Time to peak = 720 min
Hyd. volume = 31,927 cuft
Curve number = 79.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.80 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

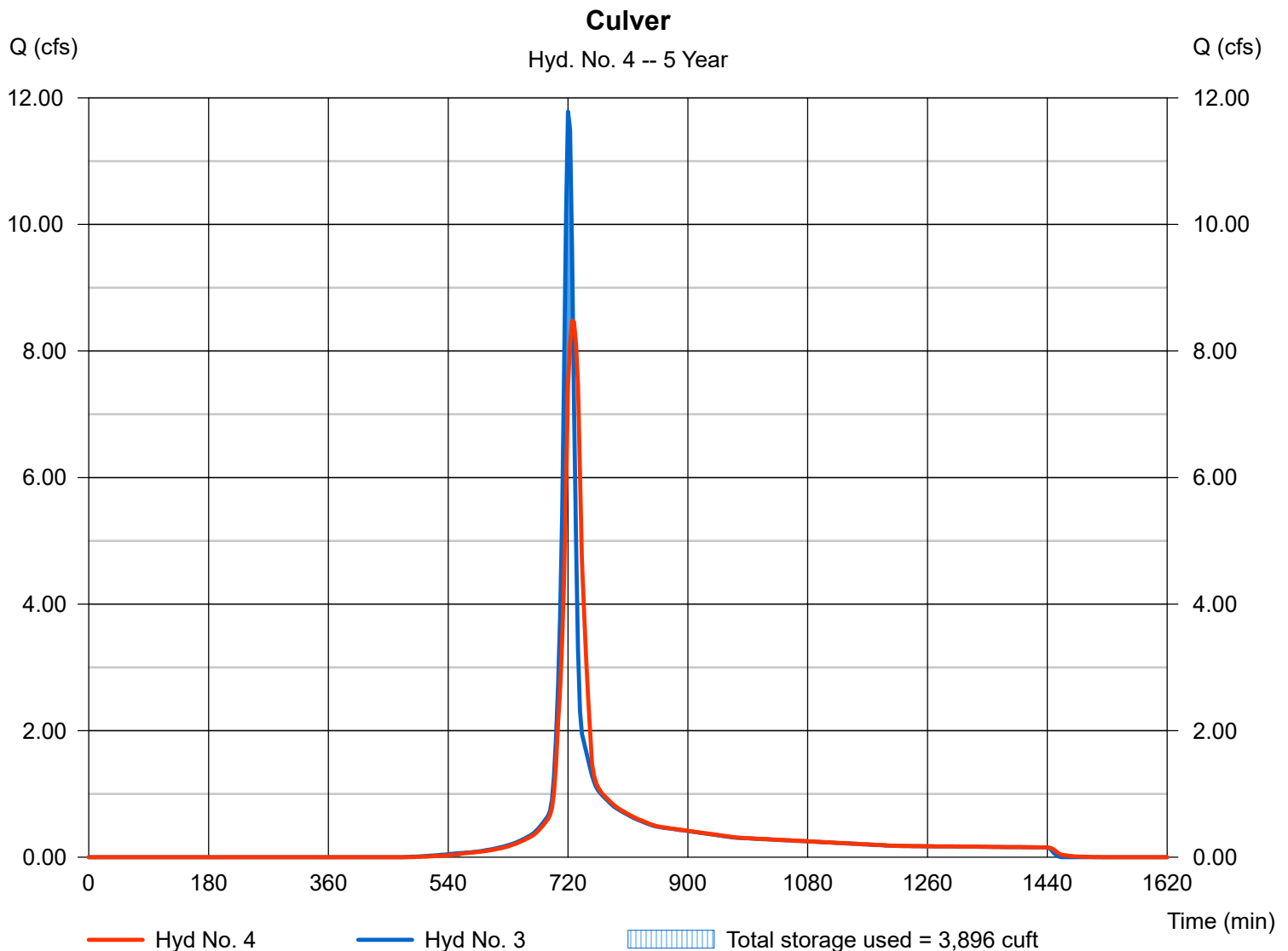
Hyd. No. 4

Culver

Hydrograph type = Reservoir
Storm frequency = 5 yrs
Time interval = 3 min
Inflow hyd. No. = 3 - Culvert
Reservoir name = Culvert

Peak discharge = 8.476 cfs
Time to peak = 726 min
Hyd. volume = 31,926 cuft
Max. Elevation = 498.52 ft
Max. Storage = 3,896 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

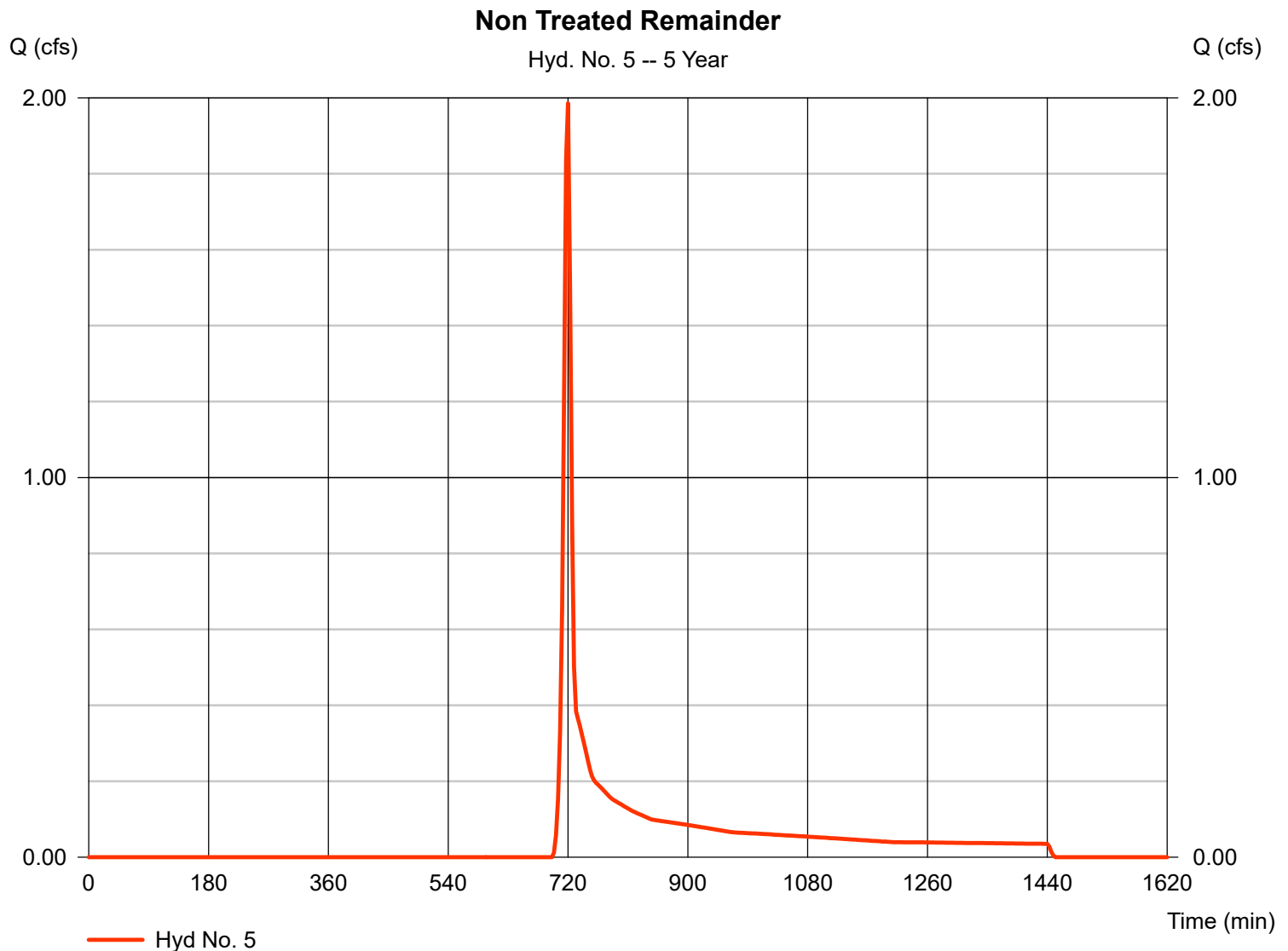
Wednesday, Jan 16, 2019

Hyd. No. 5

Non Treated Remainder

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 1.350 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 1.986 cfs
Time to peak = 720 min
Hyd. volume = 4,782 cuft
Curve number = 59
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

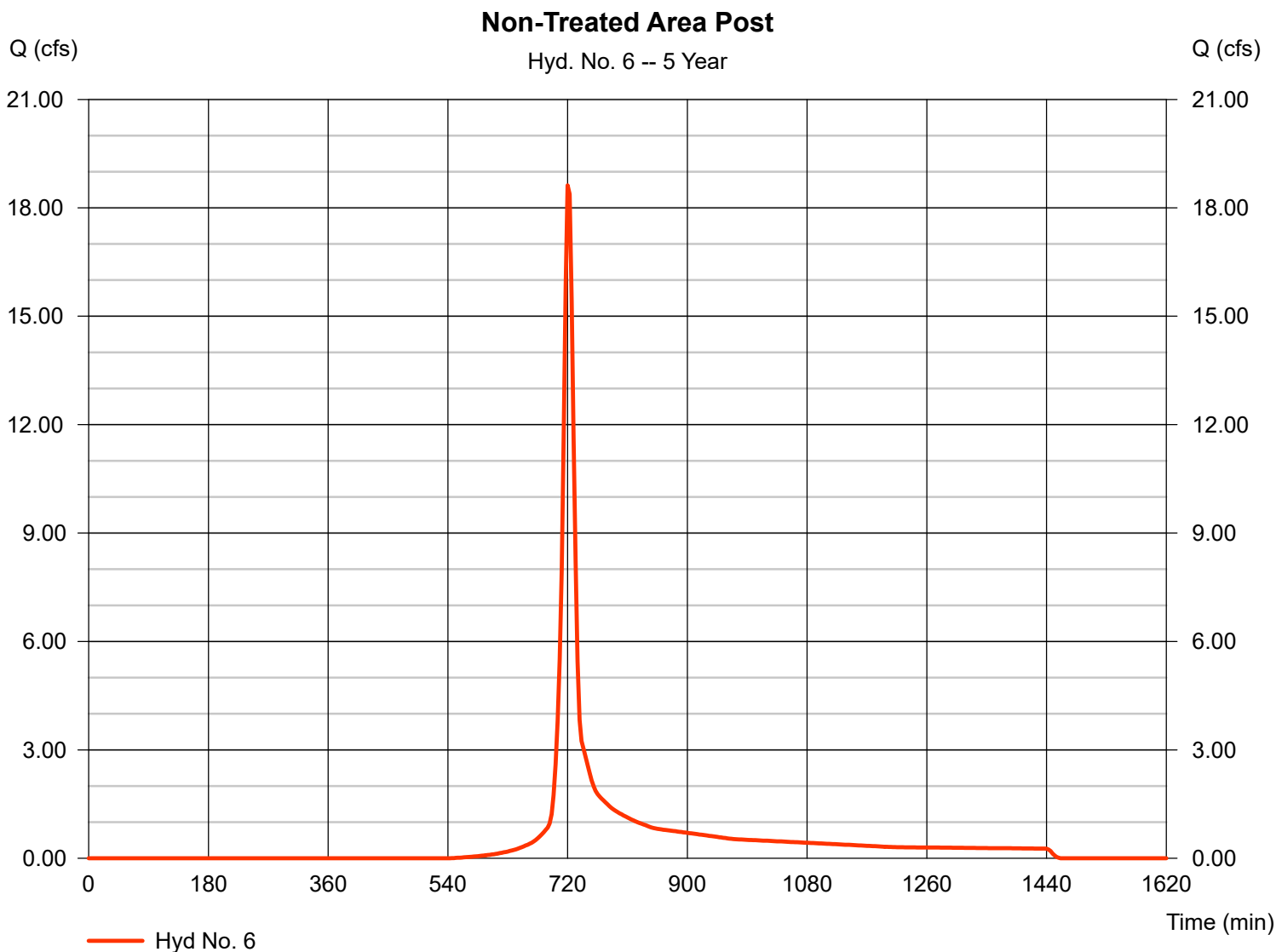
Wednesday, Jan 16, 2019

Hyd. No. 6

Non-Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 6.500 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 18.62 cfs
Time to peak = 720 min
Hyd. volume = 50,787 cuft
Curve number = 74.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

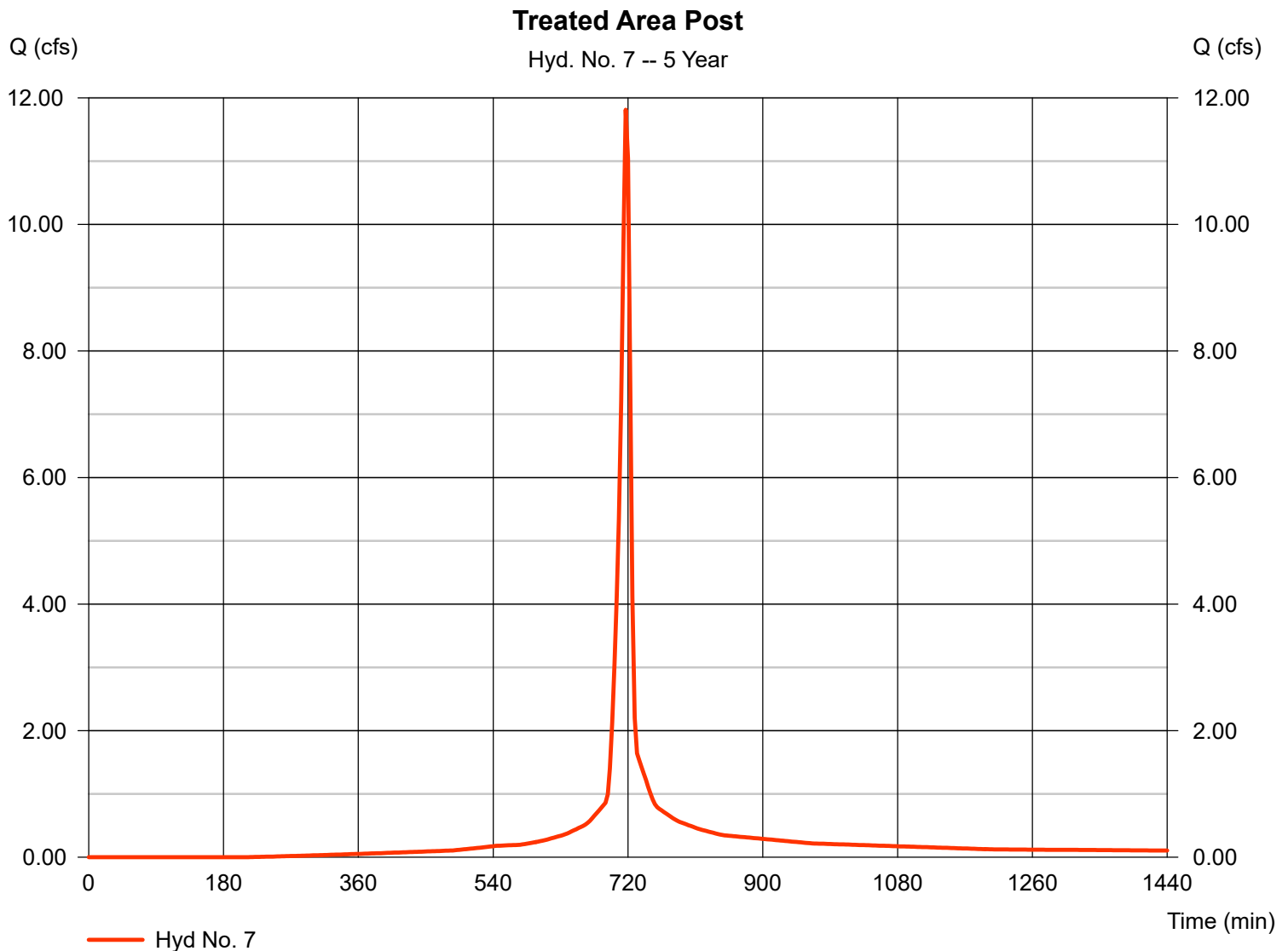
Wednesday, Jan 16, 2019

Hyd. No. 7

Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 2.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 11.81 cfs
Time to peak = 717 min
Hyd. volume = 28,169 cuft
Curve number = 91.5
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type II
Shape factor = 484



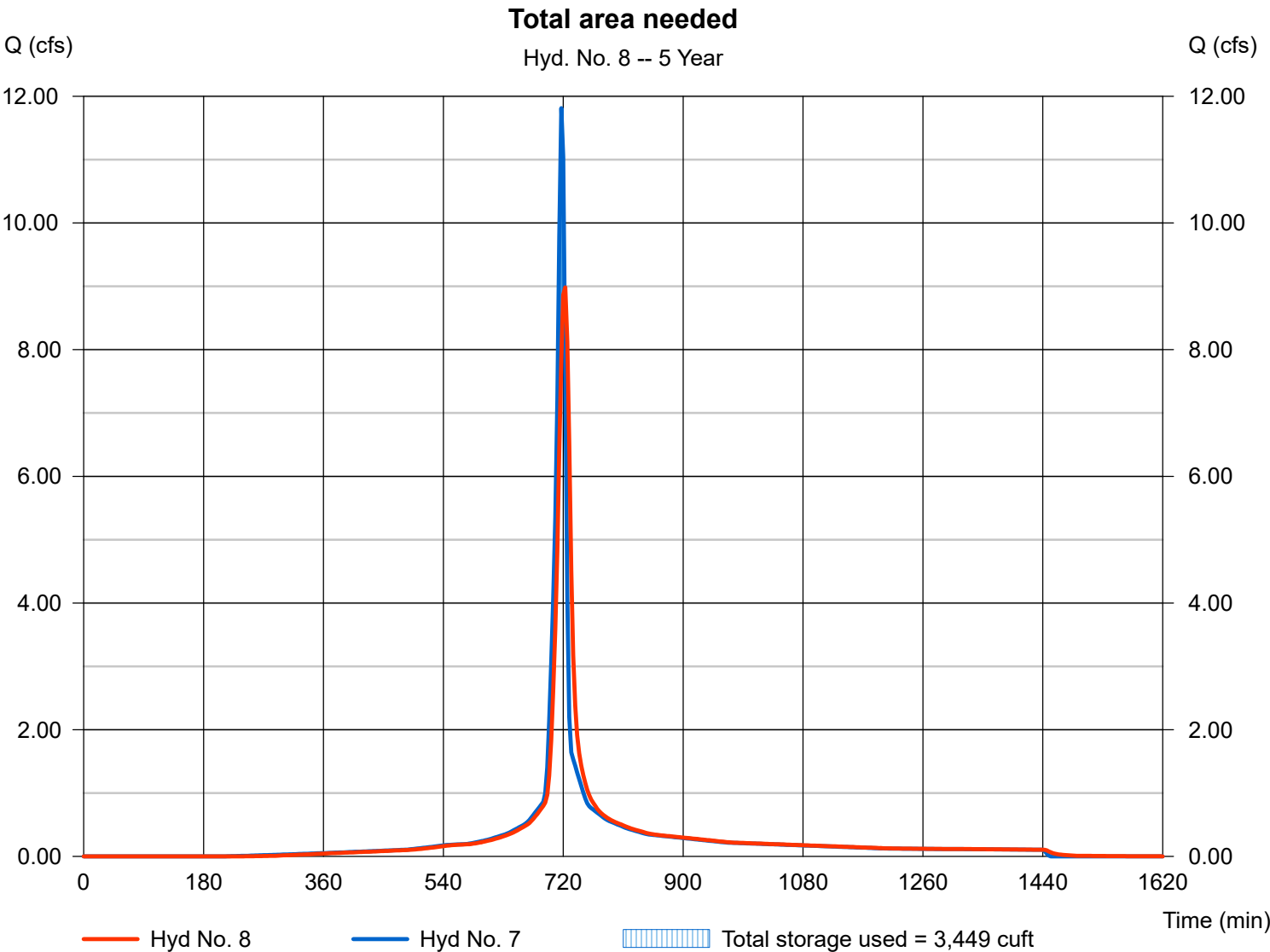
Hydrograph Report

Hyd. No. 8

Total area needed

Hydrograph type	= Reservoir	Peak discharge	= 8.983 cfs
Storm frequency	= 5 yrs	Time to peak	= 723 min
Time interval	= 3 min	Hyd. volume	= 28,165 cuft
Inflow hyd. No.	= 7 - Treated Area Post	Max. Elevation	= 490.92 ft
Reservoir name	= Pipe	Max. Storage	= 3,449 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

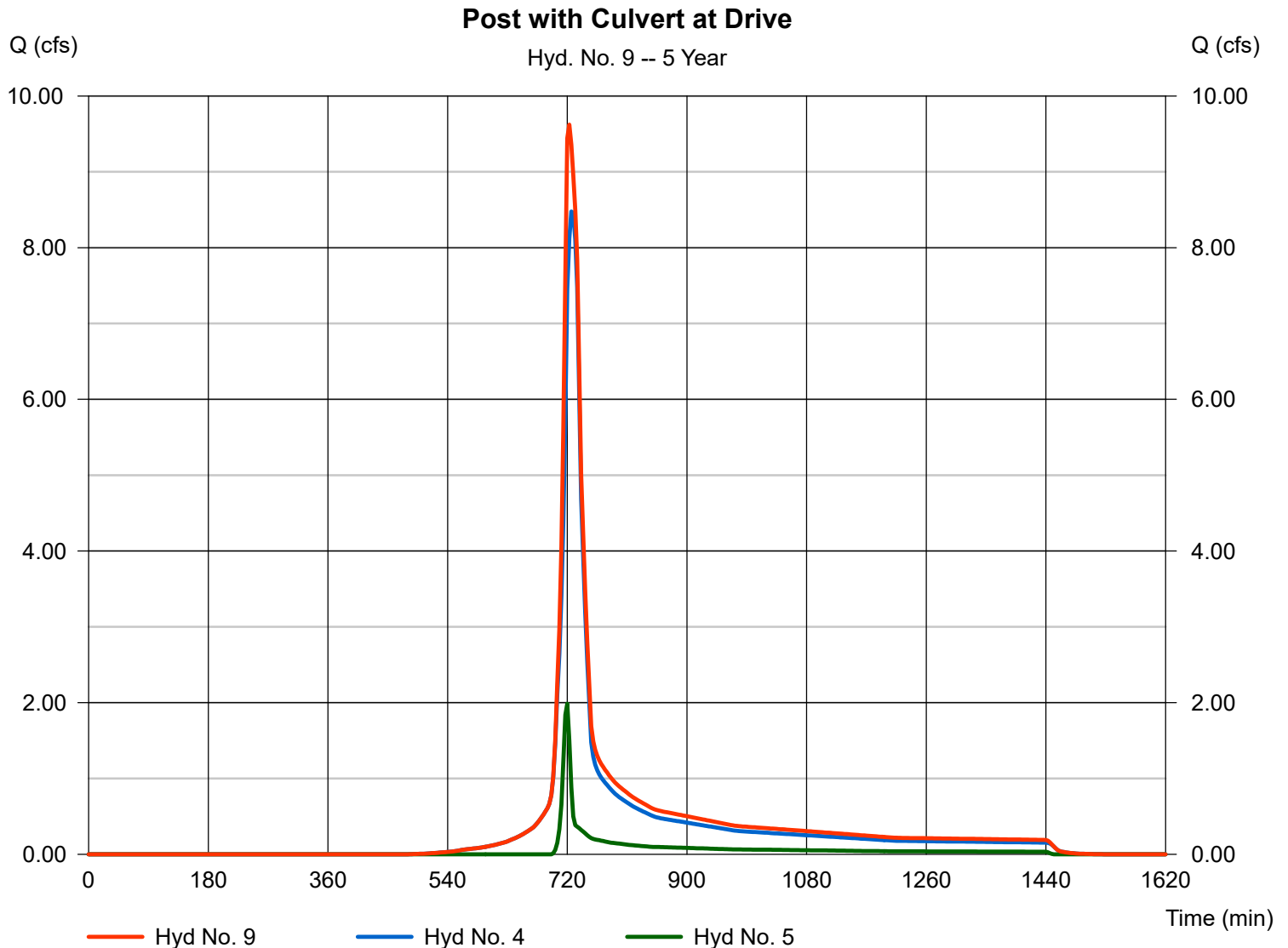
Wednesday, Jan 16, 2019

Hyd. No. 9

Post with Culvert at Drive

Hydrograph type = Combine
Storm frequency = 5 yrs
Time interval = 3 min
Inflow hyds. = 4, 5

Peak discharge = 9.623 cfs
Time to peak = 723 min
Hyd. volume = 36,708 cuft
Contrib. drain. area = 1.350 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

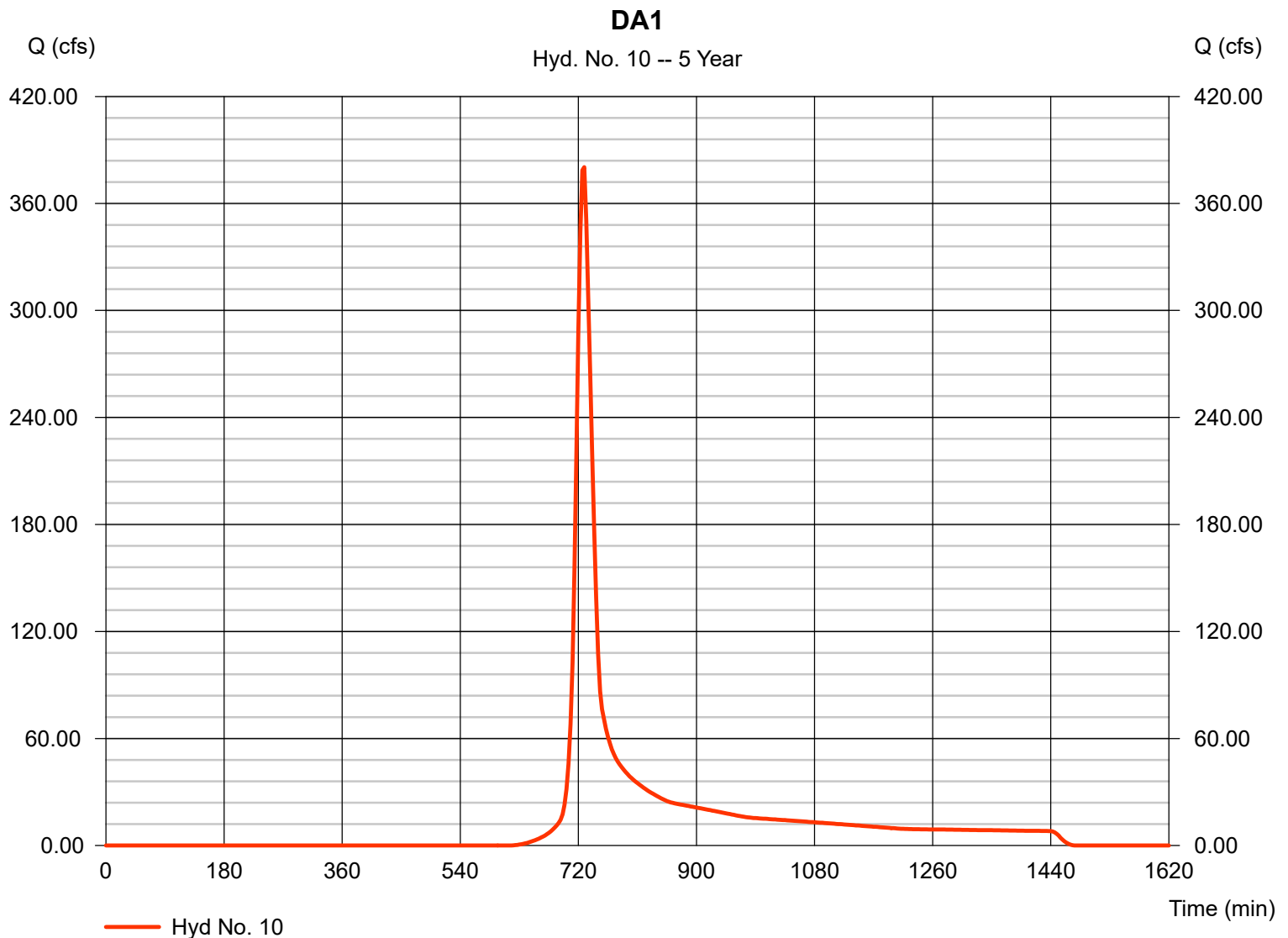
Wednesday, Jan 16, 2019

Hyd. No. 10

DA1

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 222.600 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 380.35 cfs
Time to peak = 729 min
Hyd. volume = 1,385,408 cuft
Curve number = 69.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 21.16 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

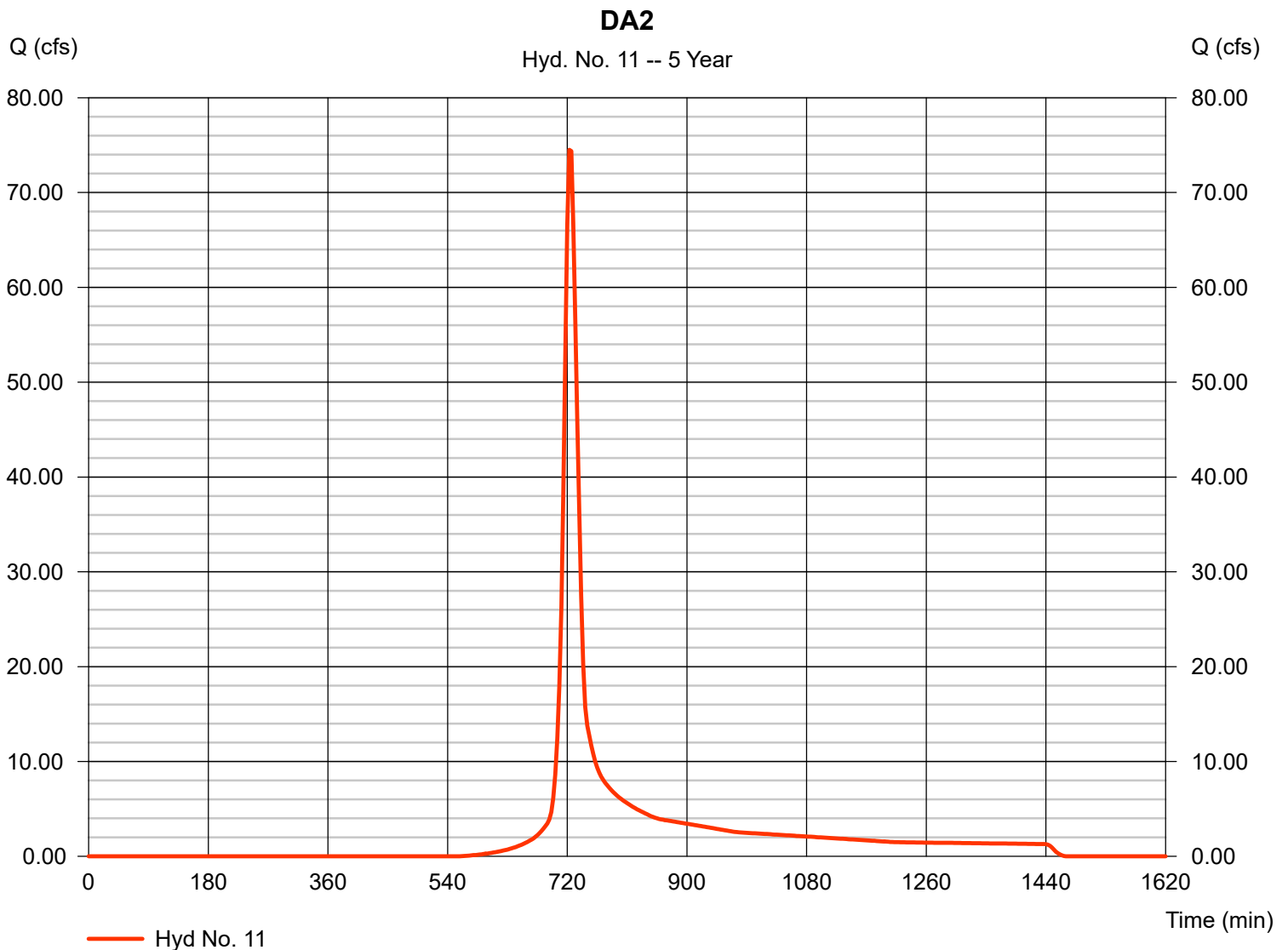
Wednesday, Jan 16, 2019

Hyd. No. 11

DA2

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 30.870 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 74.51 cfs
Time to peak = 723 min
Hyd. volume = 241,335 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 16.17 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

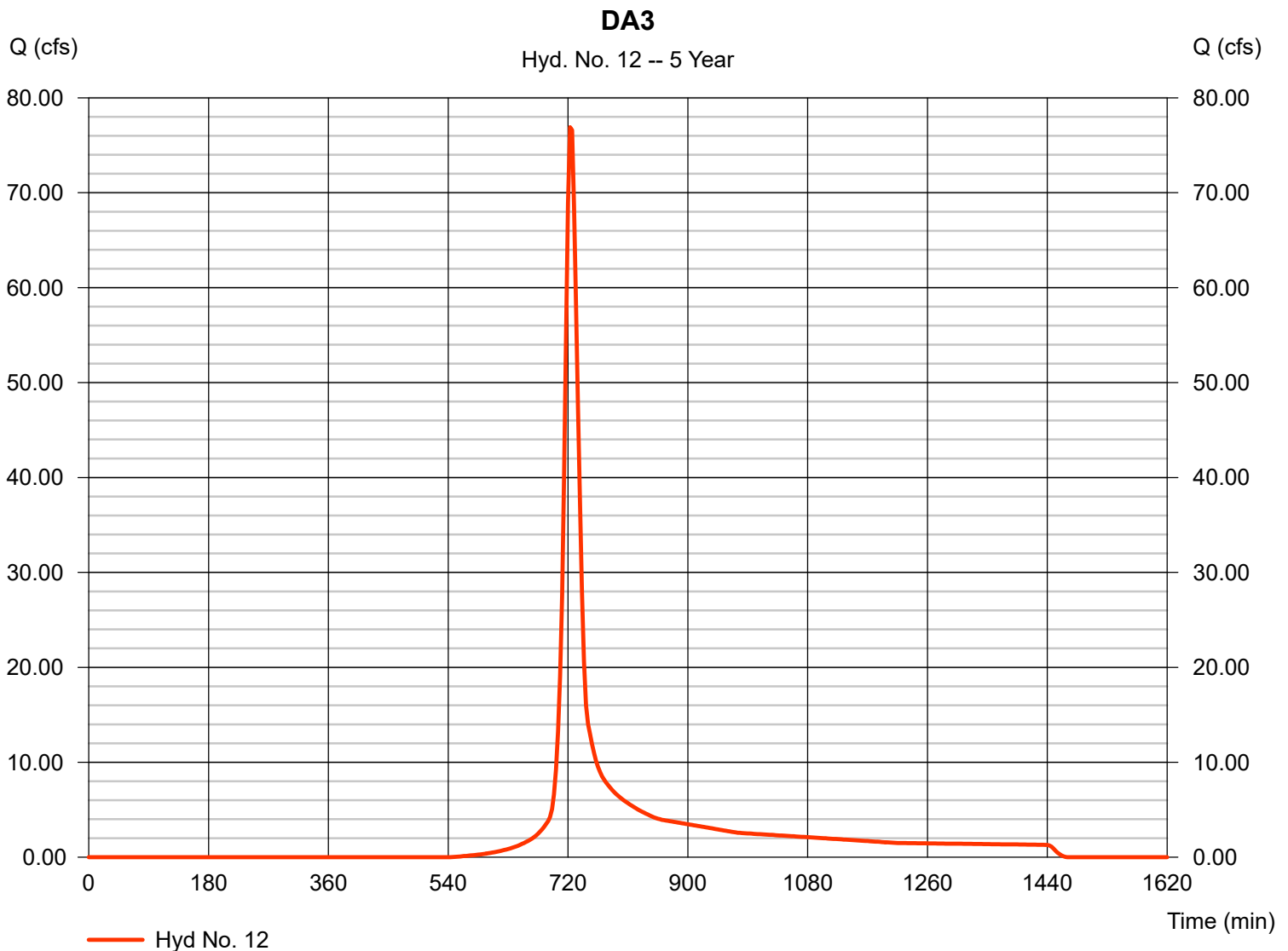
Wednesday, Jan 16, 2019

Hyd. No. 12

DA3

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Time interval = 3 min
Drainage area = 30.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.65 in
Storm duration = 24 hrs

Peak discharge = 76.91 cfs
Time to peak = 723 min
Hyd. volume = 248,168 cuft
Curve number = 75
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.95 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

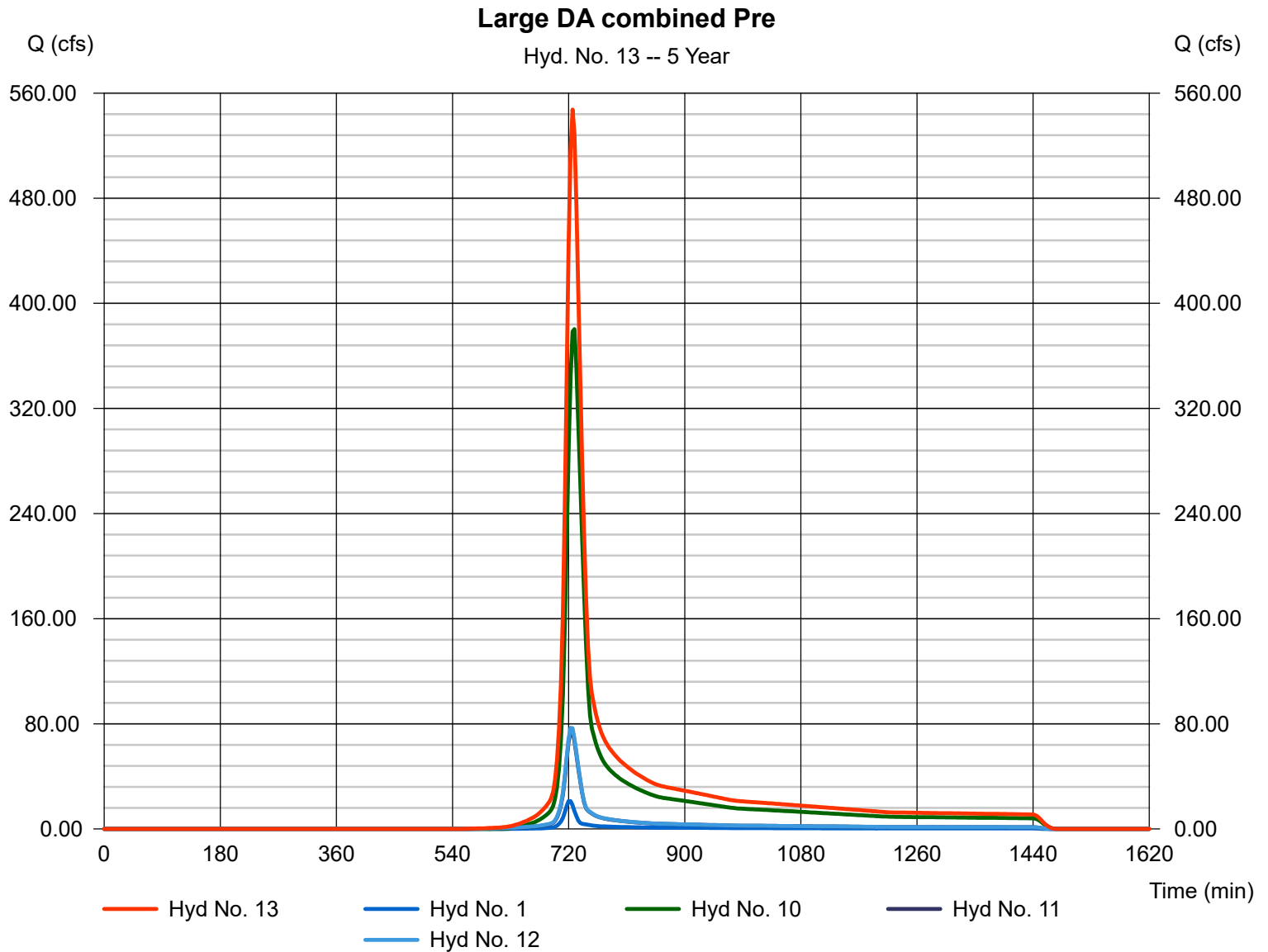
Wednesday, Jan 16, 2019

Hyd. No. 13

Large DA combined Pre

Hydrograph type = Combine
Storm frequency = 5 yrs
Time interval = 3 min
Inflow hyds. = 1, 10, 11, 12

Peak discharge = 547.46 cfs
Time to peak = 726 min
Hyd. volume = 1,933,640 cuft
Contrib. drain. area = 292.830 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

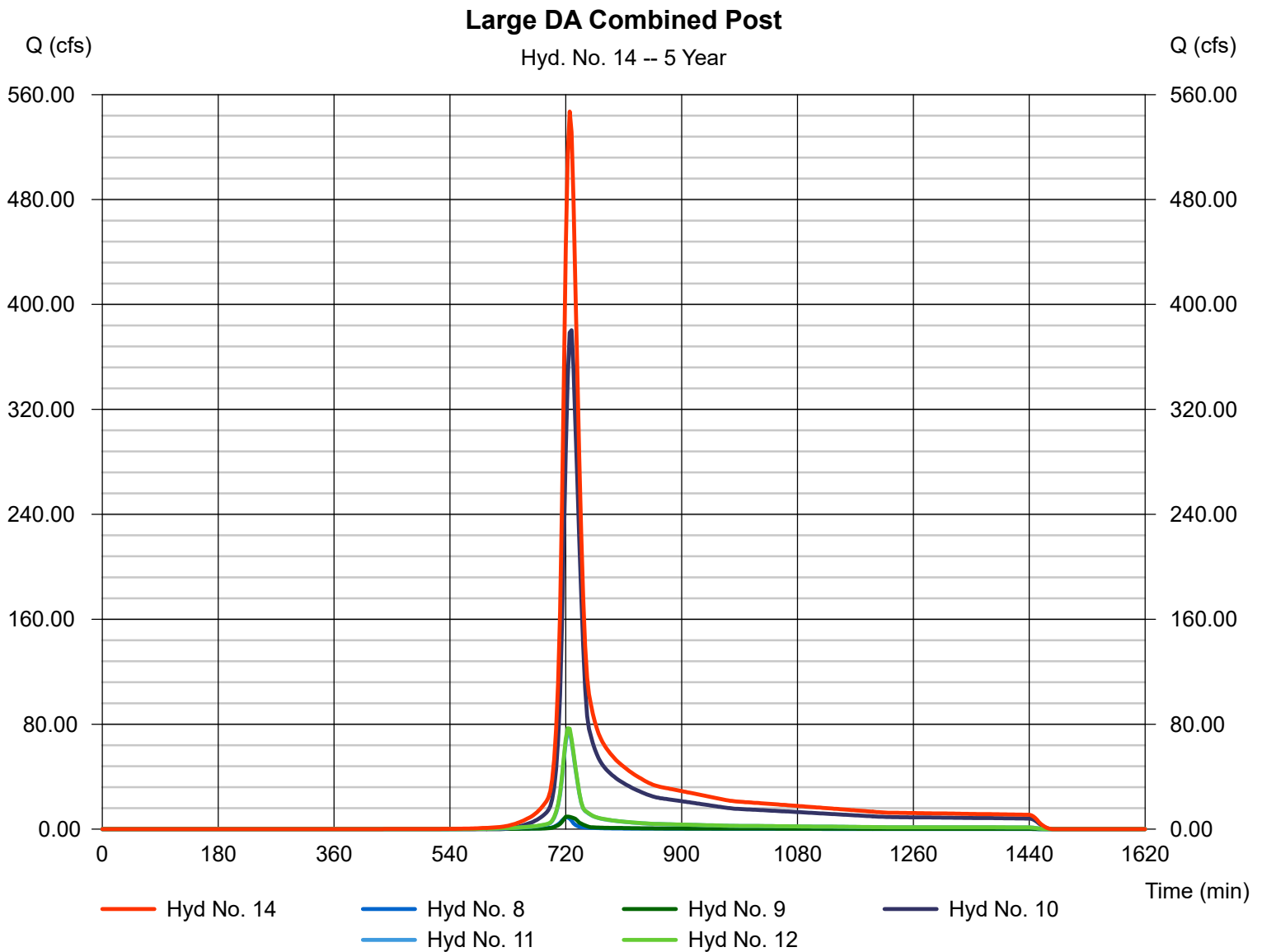
Wednesday, Jan 16, 2019

Hyd. No. 14

Large DA Combined Post

Hydrograph type = Combine
Storm frequency = 5 yrs
Time interval = 3 min
Inflow hyds. = 8, 9, 10, 11, 12

Peak discharge = 547.05 cfs
Time to peak = 726 min
Hyd. volume = 1,939,784 cuft
Contrib. drain. area = 284.040 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

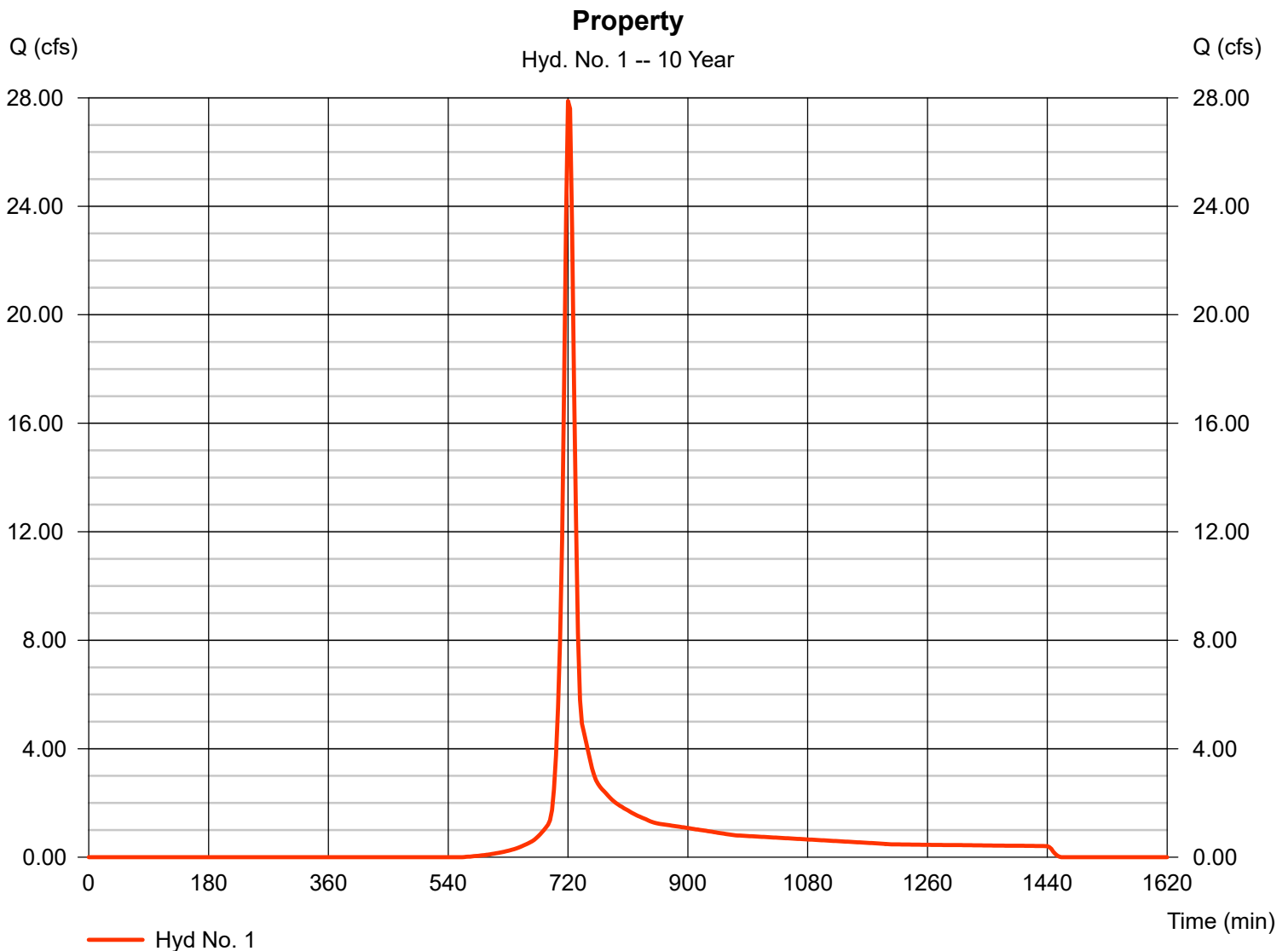
Wednesday, Jan 16, 2019

Hyd. No. 1

Property

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 27.88 cfs
Time to peak = 720 min
Hyd. volume = 76,279 cuft
Curve number = 70.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

Hyd. No. 2

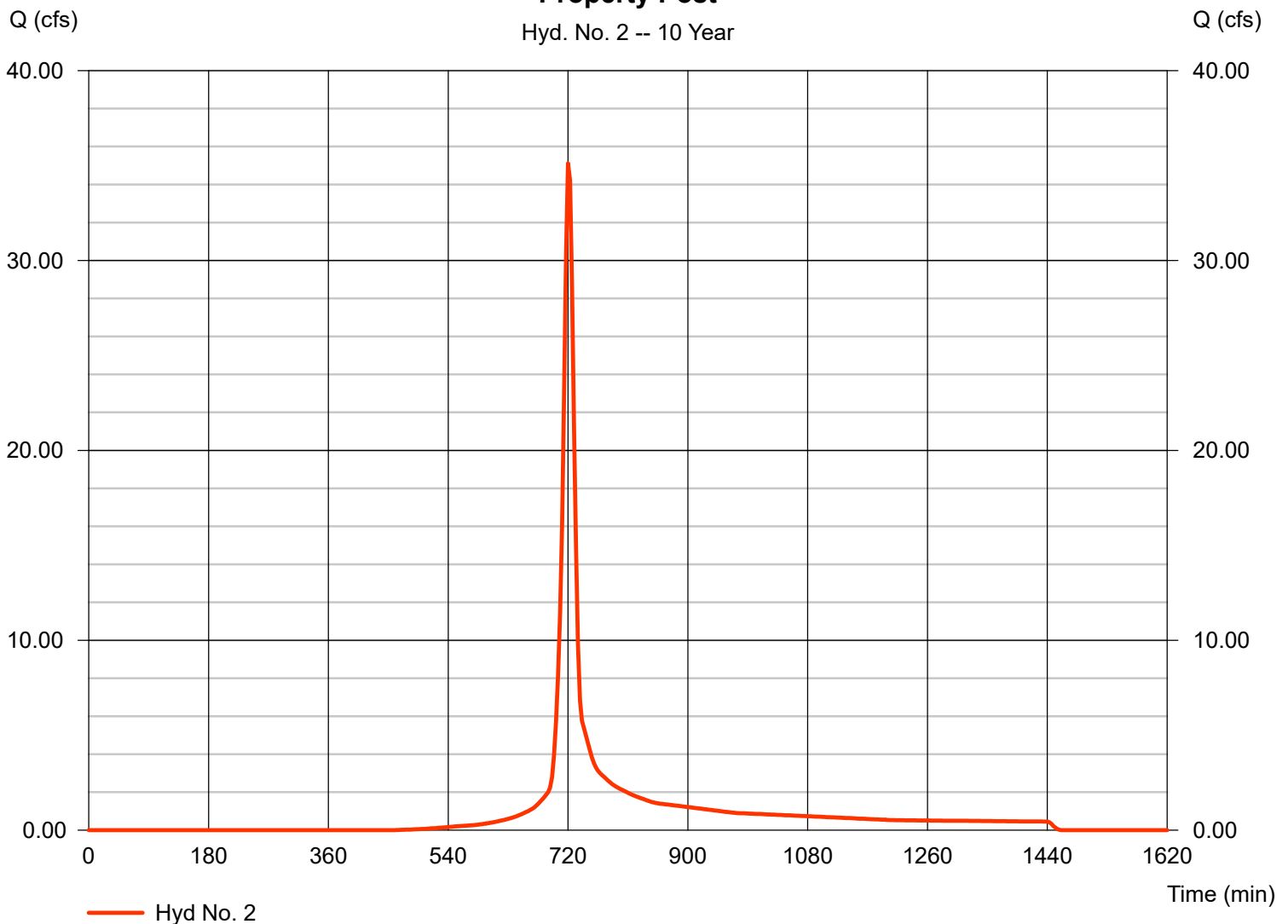
Property Post

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 35.11 cfs
Time to peak = 720 min
Hyd. volume = 95,120 cuft
Curve number = 77.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484

Property Post

Hyd. No. 2 -- 10 Year



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

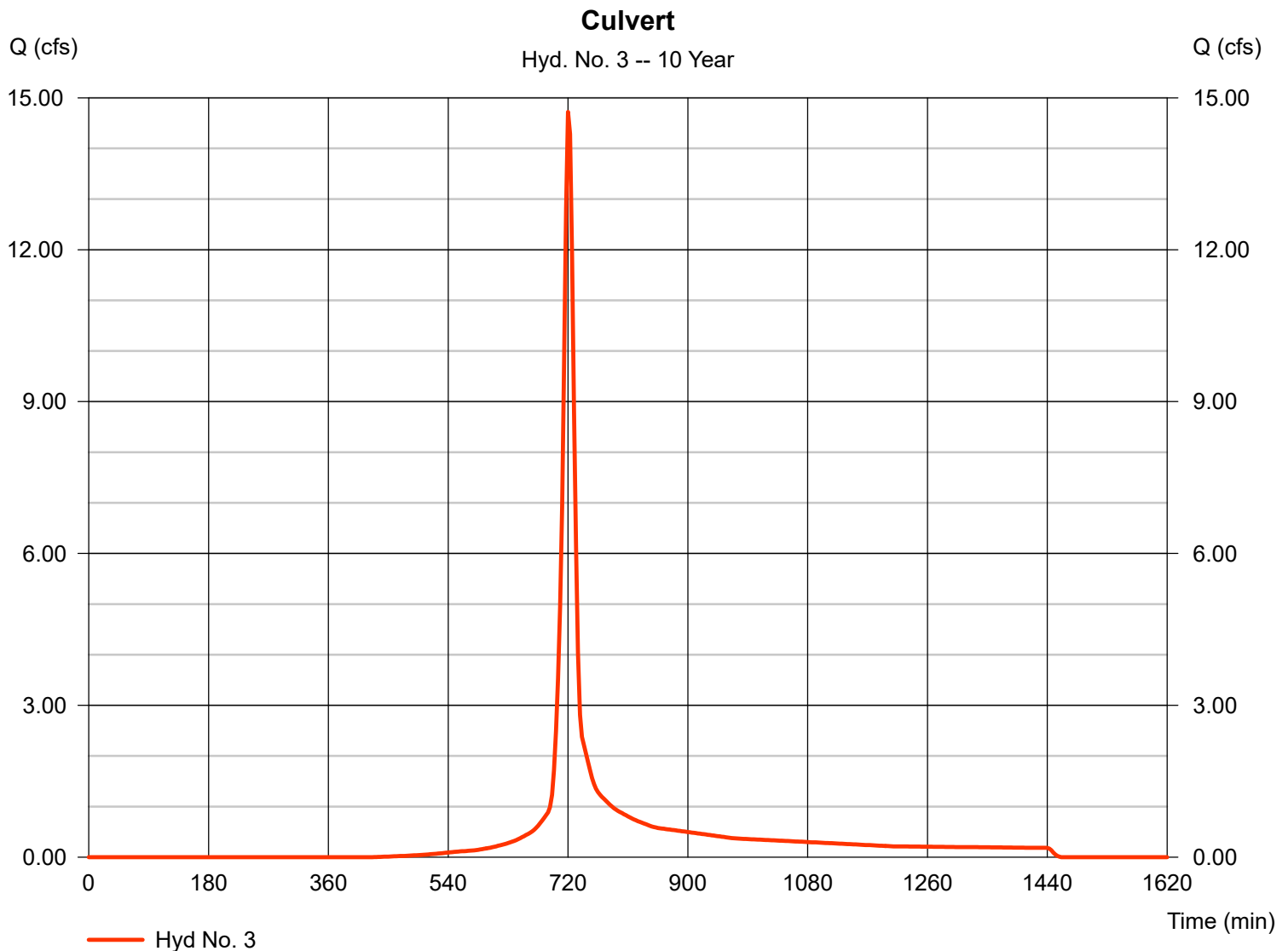
Wednesday, Jan 16, 2019

Hyd. No. 3

Culvert

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 3.490 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 14.72 cfs
Time to peak = 720 min
Hyd. volume = 39,912 cuft
Curve number = 79.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.80 min
Distribution = Type II
Shape factor = 484



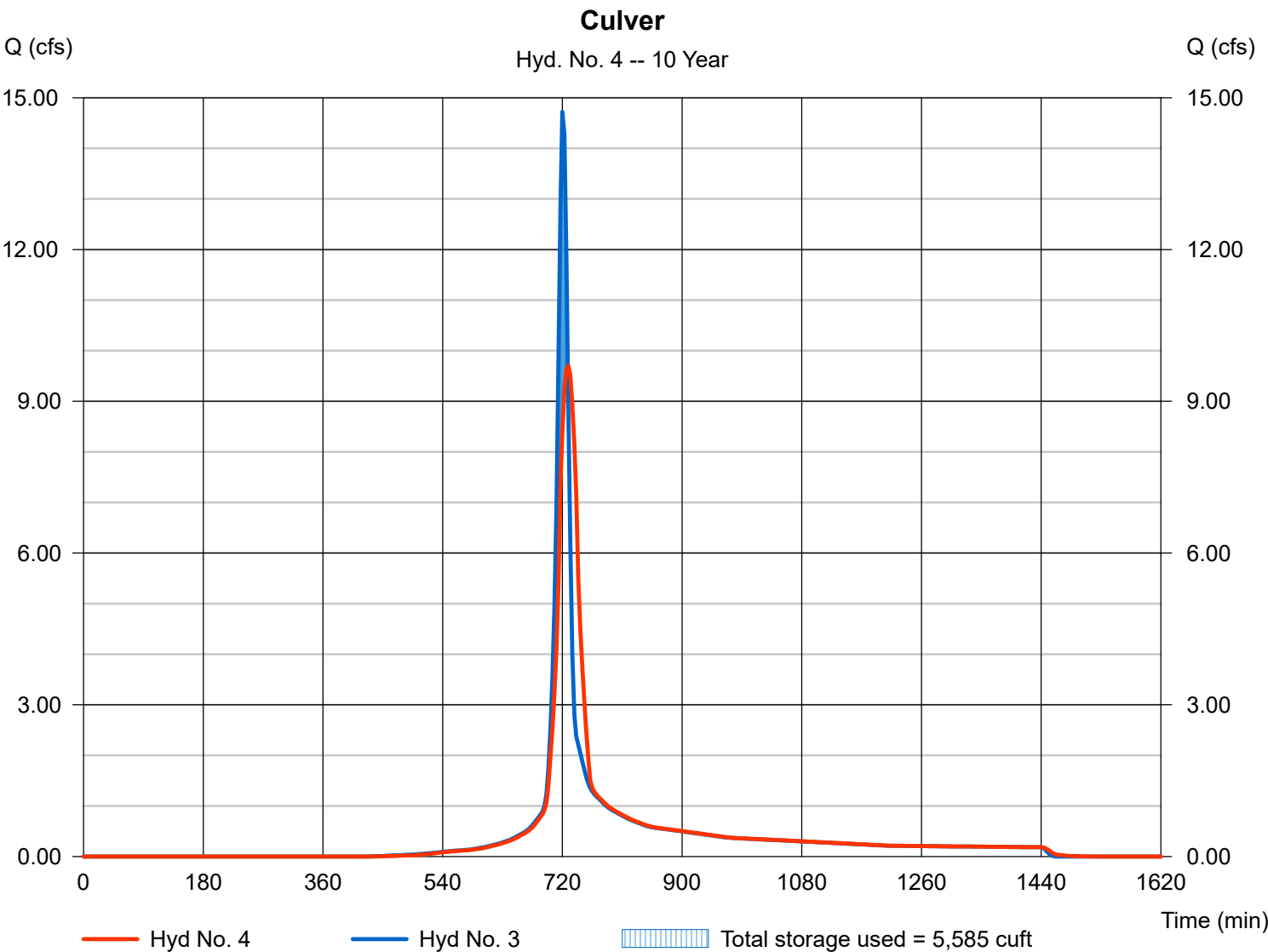
Hydrograph Report

Hyd. No. 4

Culver

Hydrograph type	= Reservoir	Peak discharge	= 9.702 cfs
Storm frequency	= 10 yrs	Time to peak	= 729 min
Time interval	= 3 min	Hyd. volume	= 39,911 cuft
Inflow hyd. No.	= 3 - Culvert	Max. Elevation	= 499.17 ft
Reservoir name	= Culvert	Max. Storage	= 5,585 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

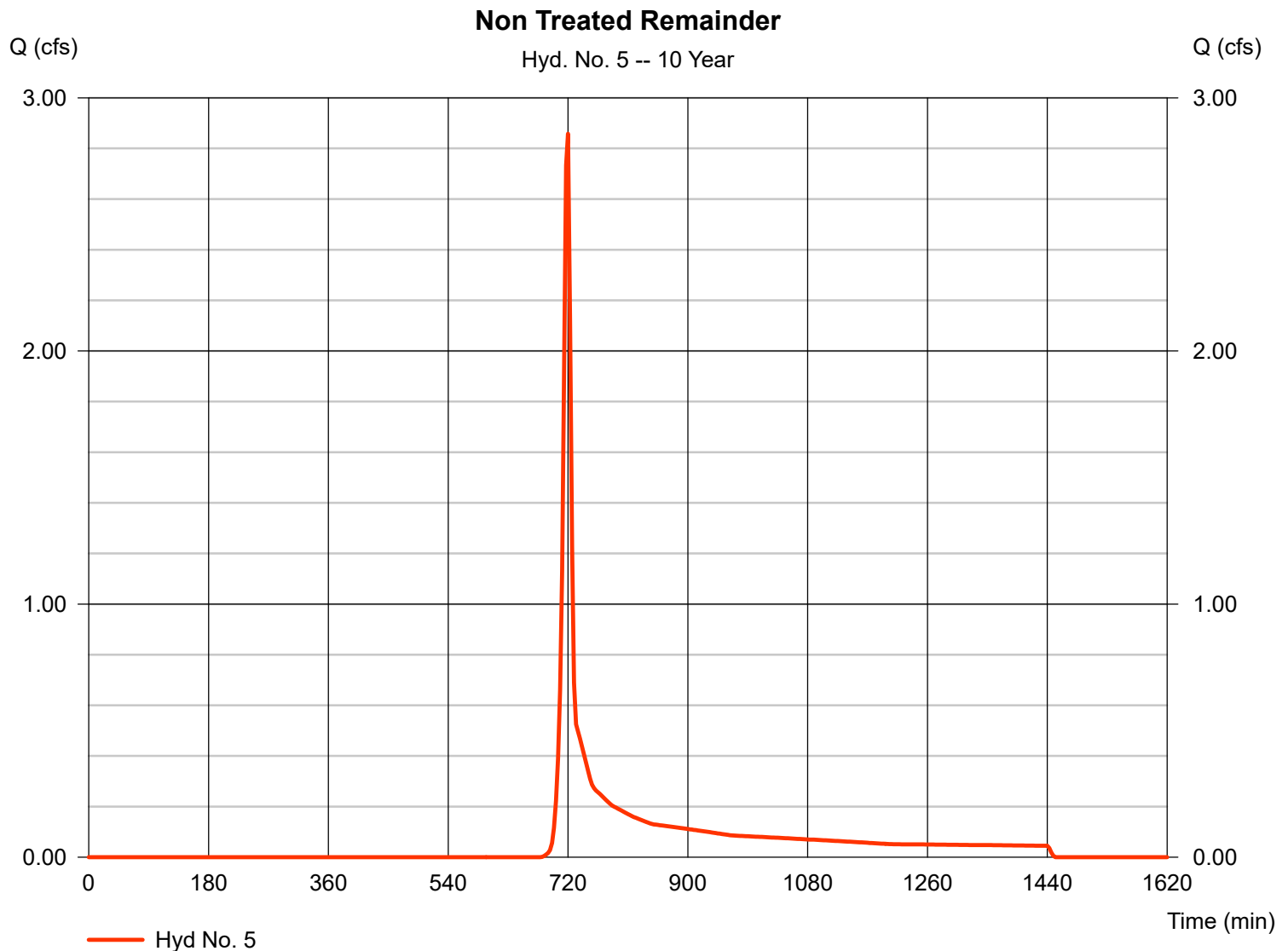
Wednesday, Jan 16, 2019

Hyd. No. 5

Non Treated Remainder

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 1.350 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 2.858 cfs
Time to peak = 720 min
Hyd. volume = 6,686 cuft
Curve number = 59
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

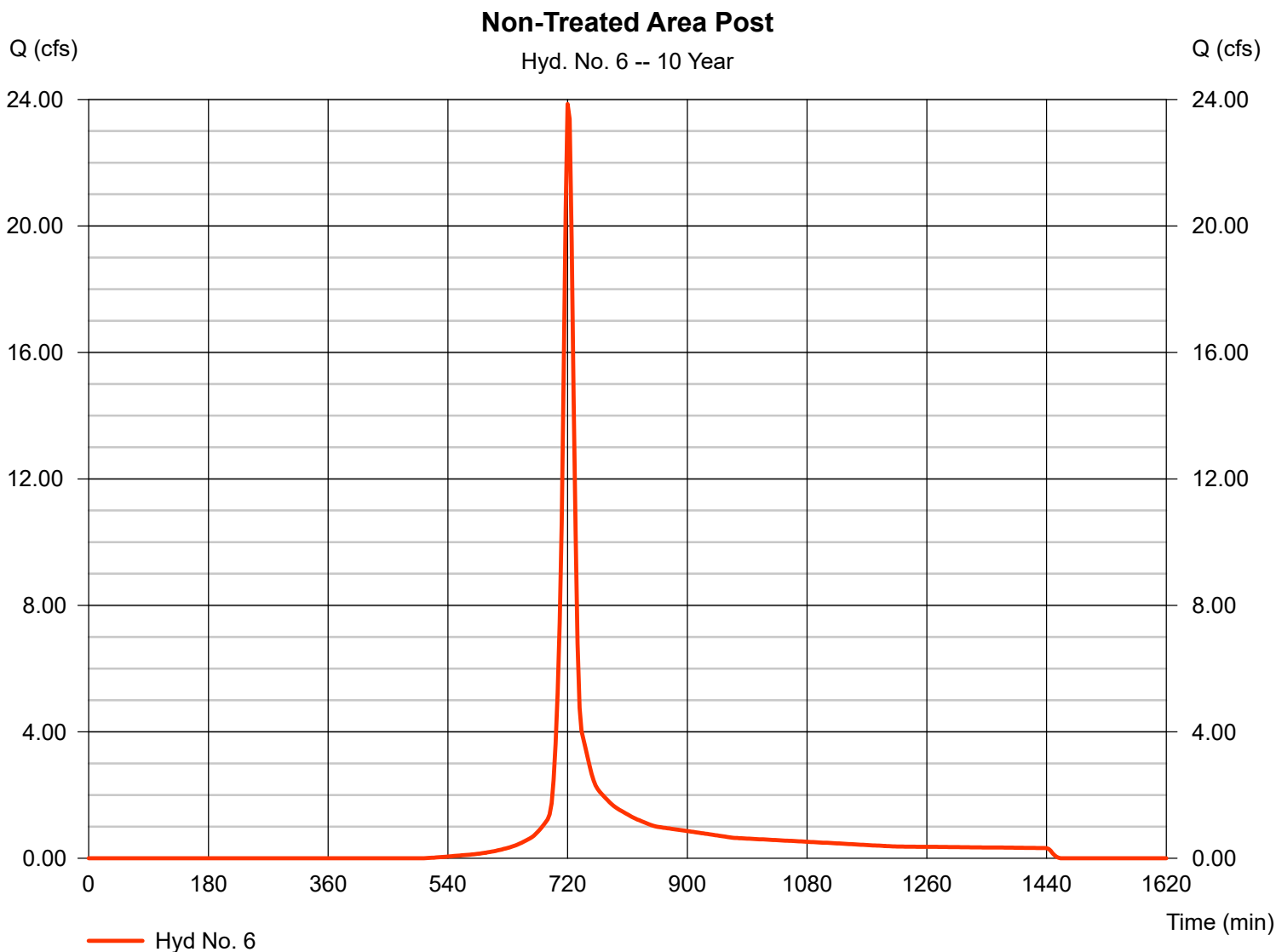
Wednesday, Jan 16, 2019

Hyd. No. 6

Non-Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 6.500 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 23.86 cfs
Time to peak = 720 min
Hyd. volume = 64,716 cuft
Curve number = 74.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

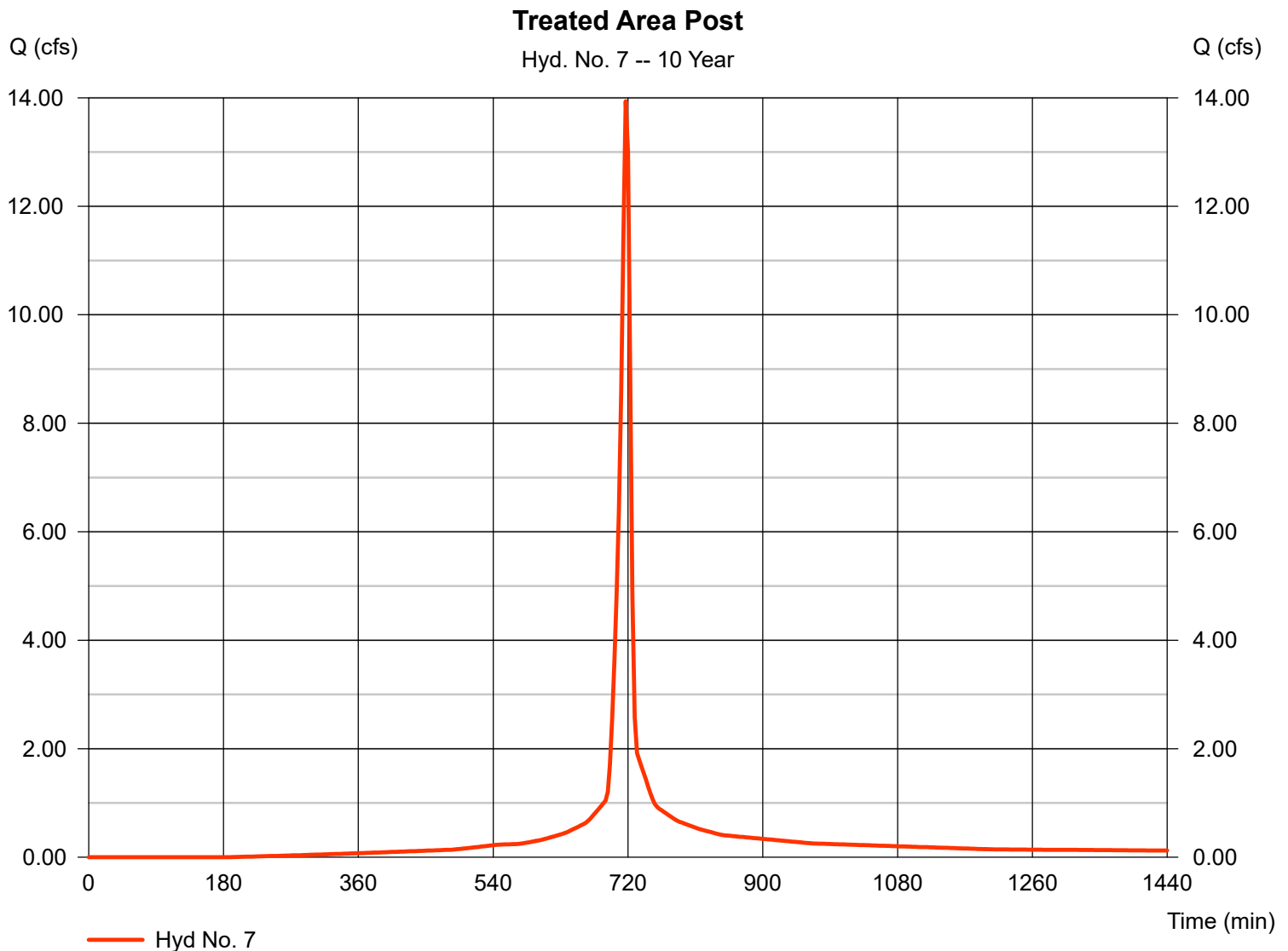
Wednesday, Jan 16, 2019

Hyd. No. 7

Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 2.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 13.94 cfs
Time to peak = 717 min
Hyd. volume = 33,588 cuft
Curve number = 91.5
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

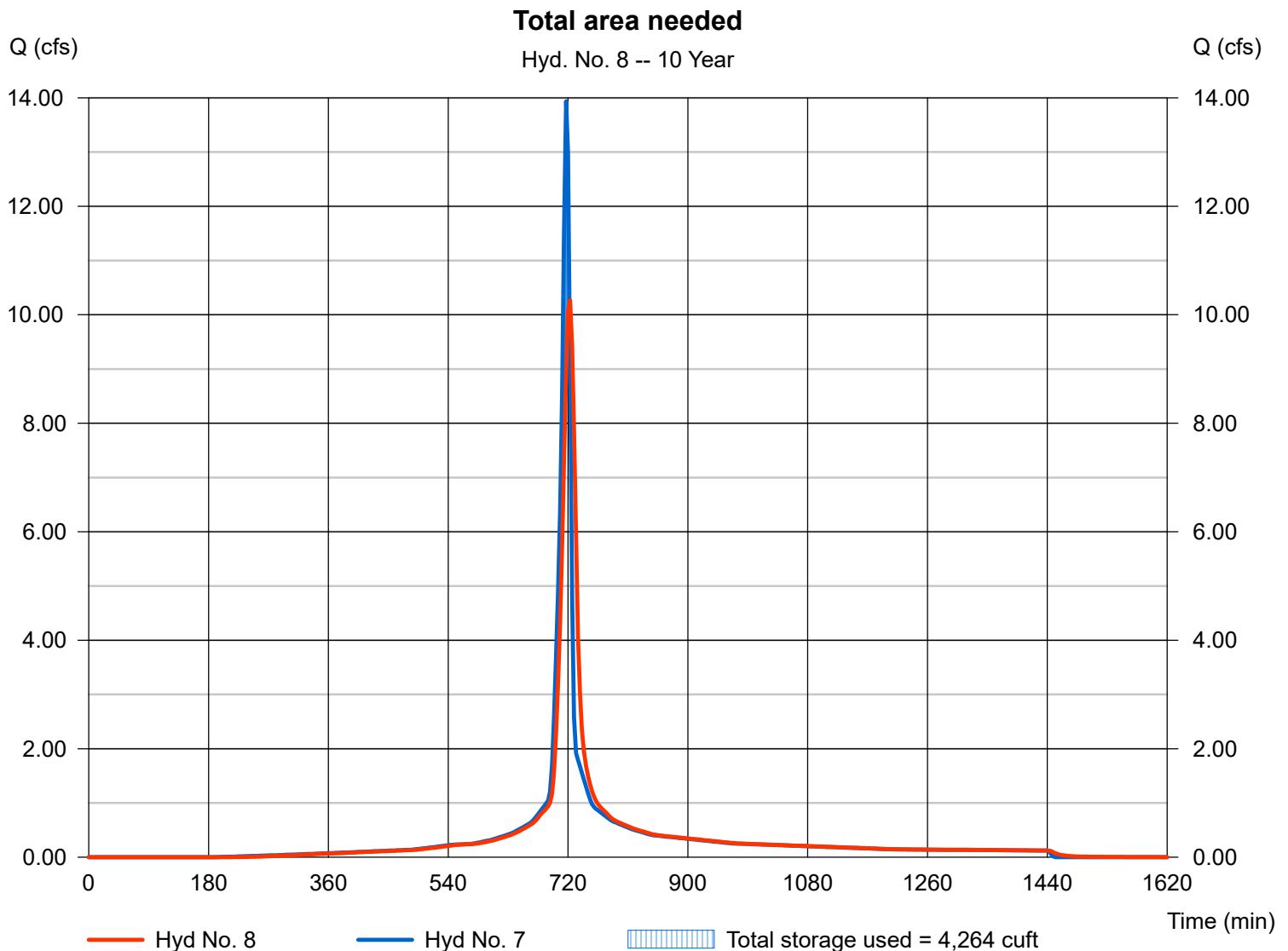
Hyd. No. 8

Total area needed

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 3 min
Inflow hyd. No. = 7 - Treated Area Post
Reservoir name = Pipe

Peak discharge = 10.27 cfs
Time to peak = 723 min
Hyd. volume = 33,584 cuft
Max. Elevation = 491.26 ft
Max. Storage = 4,264 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

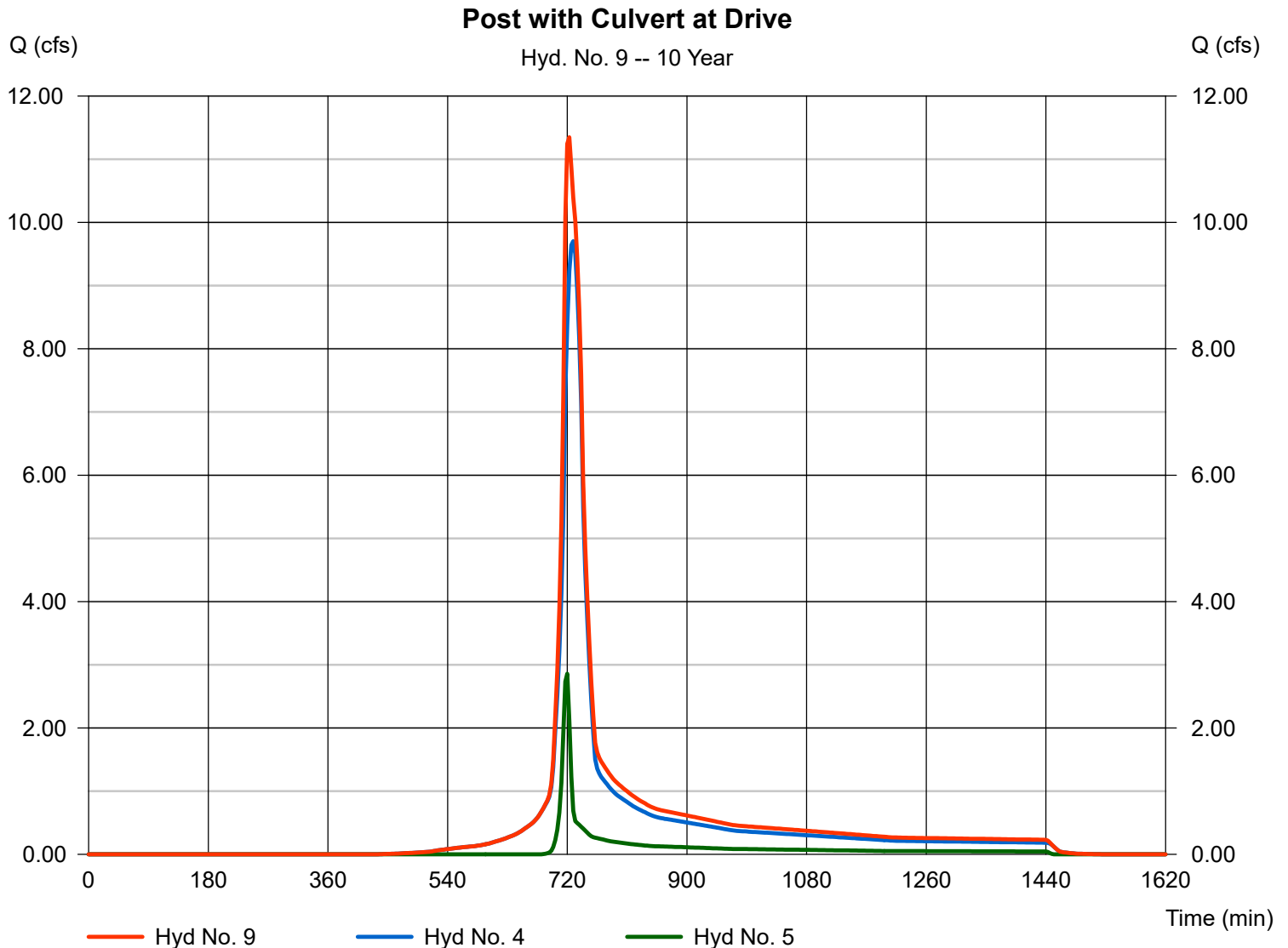
Wednesday, Jan 16, 2019

Hyd. No. 9

Post with Culvert at Drive

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 3 min
Inflow hyds. = 4, 5

Peak discharge = 11.35 cfs
Time to peak = 723 min
Hyd. volume = 46,598 cuft
Contrib. drain. area = 1.350 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

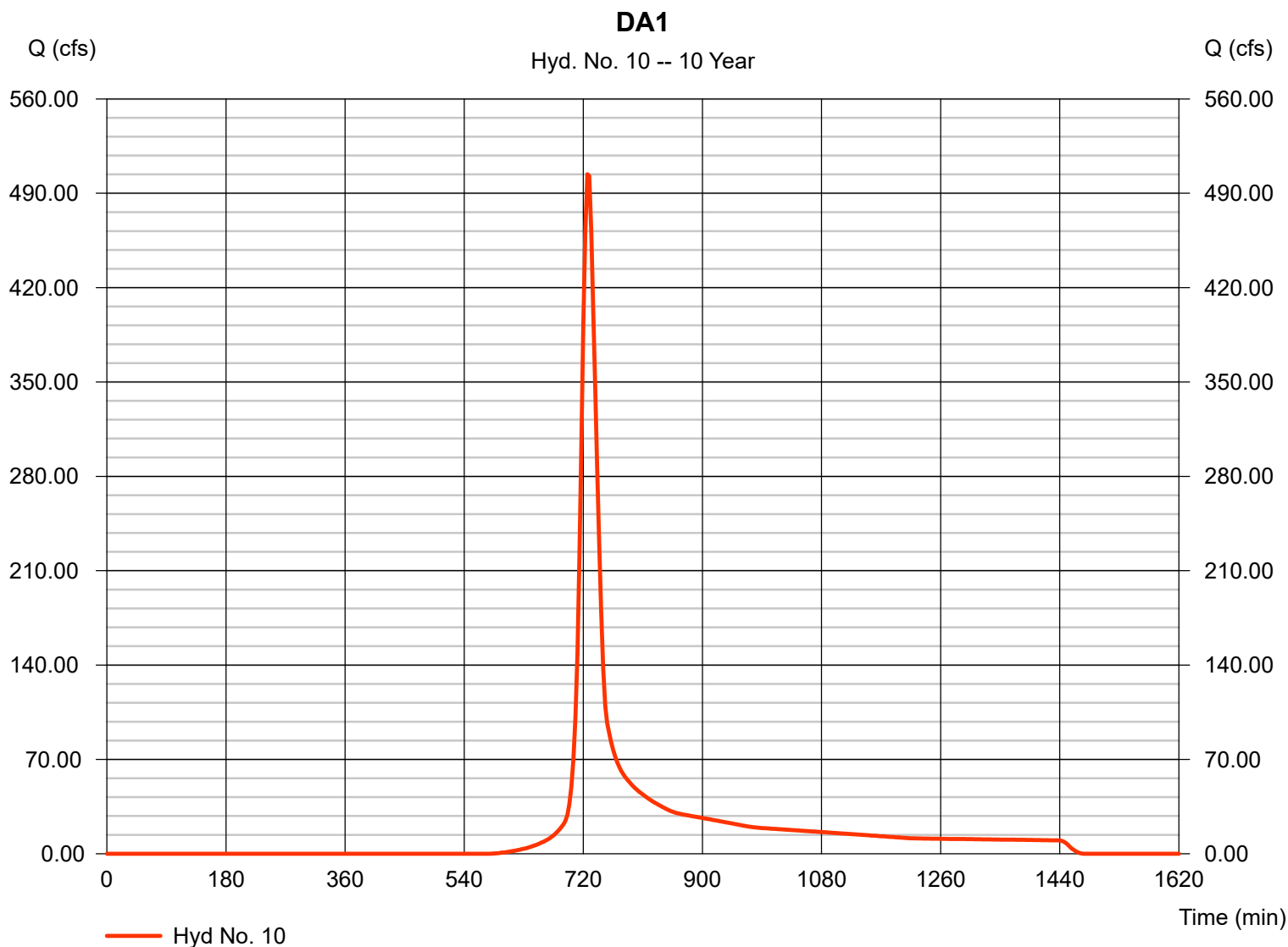
Wednesday, Jan 16, 2019

Hyd. No. 10

DA1

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 222.600 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 504.07 cfs
Time to peak = 726 min
Hyd. volume = 1,809,561 cuft
Curve number = 69.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 21.16 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

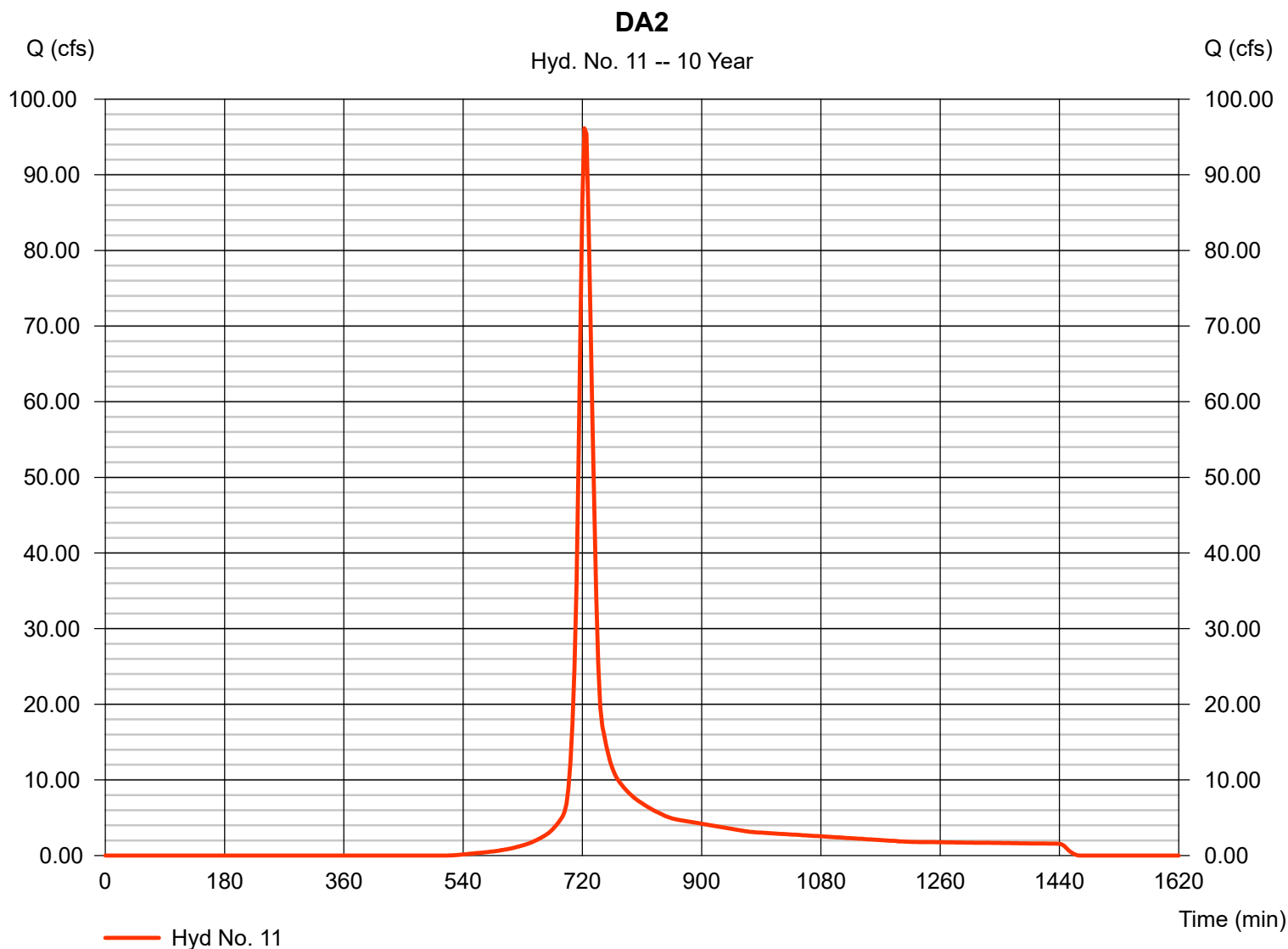
Wednesday, Jan 16, 2019

Hyd. No. 11

DA2

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 30.870 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 96.16 cfs
Time to peak = 723 min
Hyd. volume = 308,653 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 16.17 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

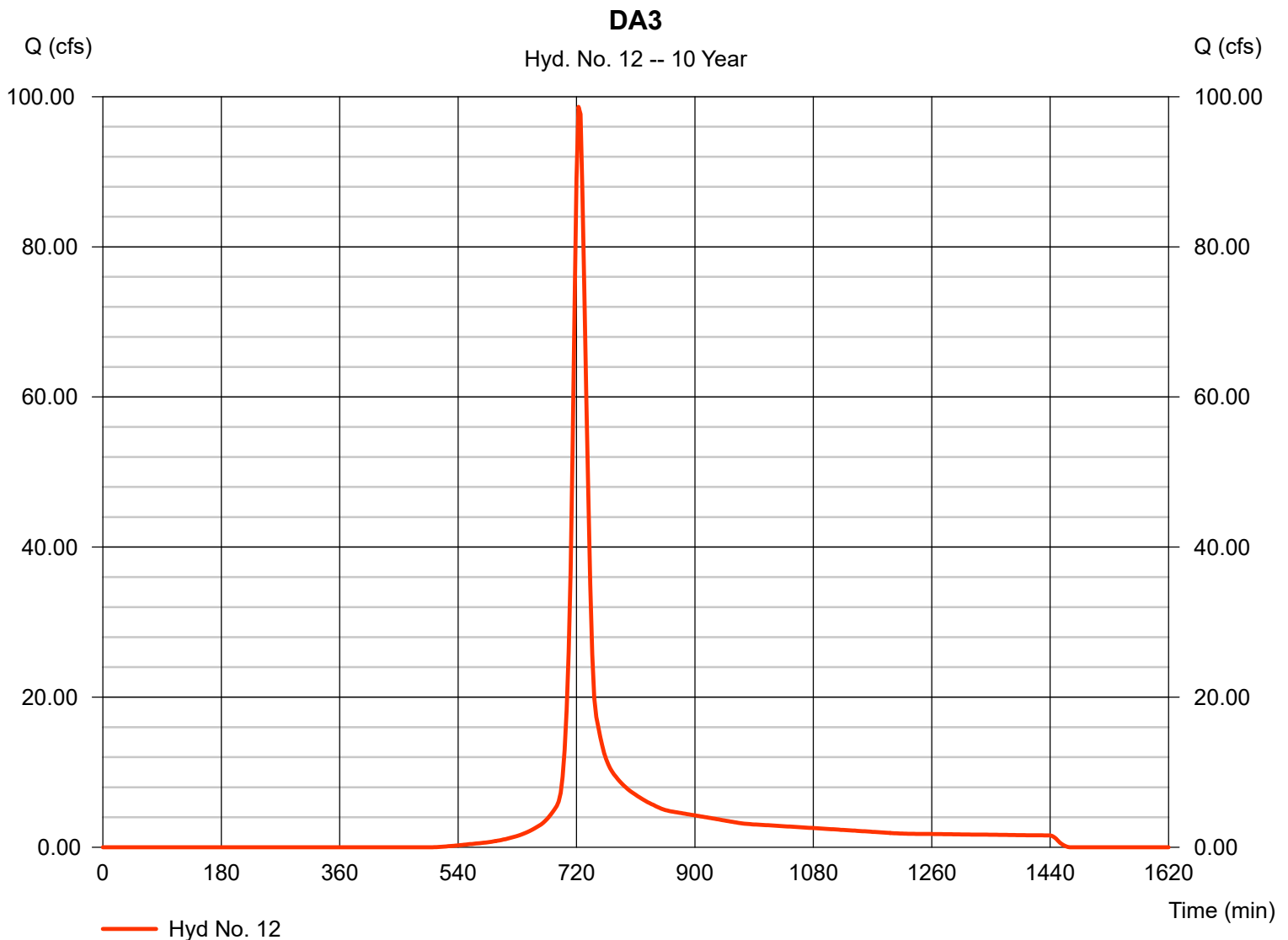
Wednesday, Jan 16, 2019

Hyd. No. 12

DA3

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 3 min
Drainage area = 30.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.38 in
Storm duration = 24 hrs

Peak discharge = 98.64 cfs
Time to peak = 723 min
Hyd. volume = 315,941 cuft
Curve number = 75
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.95 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

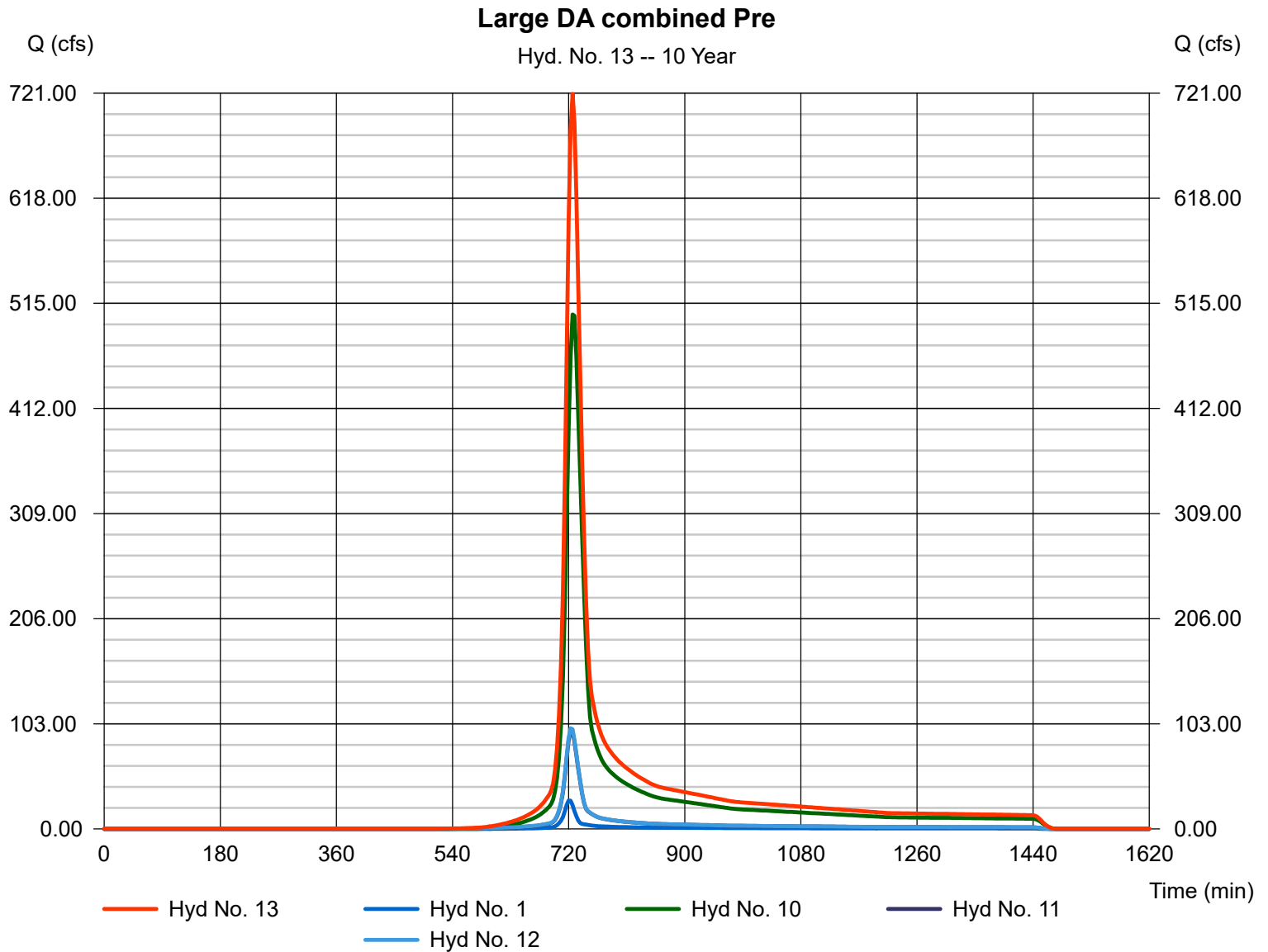
Wednesday, Jan 16, 2019

Hyd. No. 13

Large DA combined Pre

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 3 min
Inflow hyds. = 1, 10, 11, 12

Peak discharge = 720.32 cfs
Time to peak = 726 min
Hyd. volume = 2,510,434 cuft
Contrib. drain. area = 292.830 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

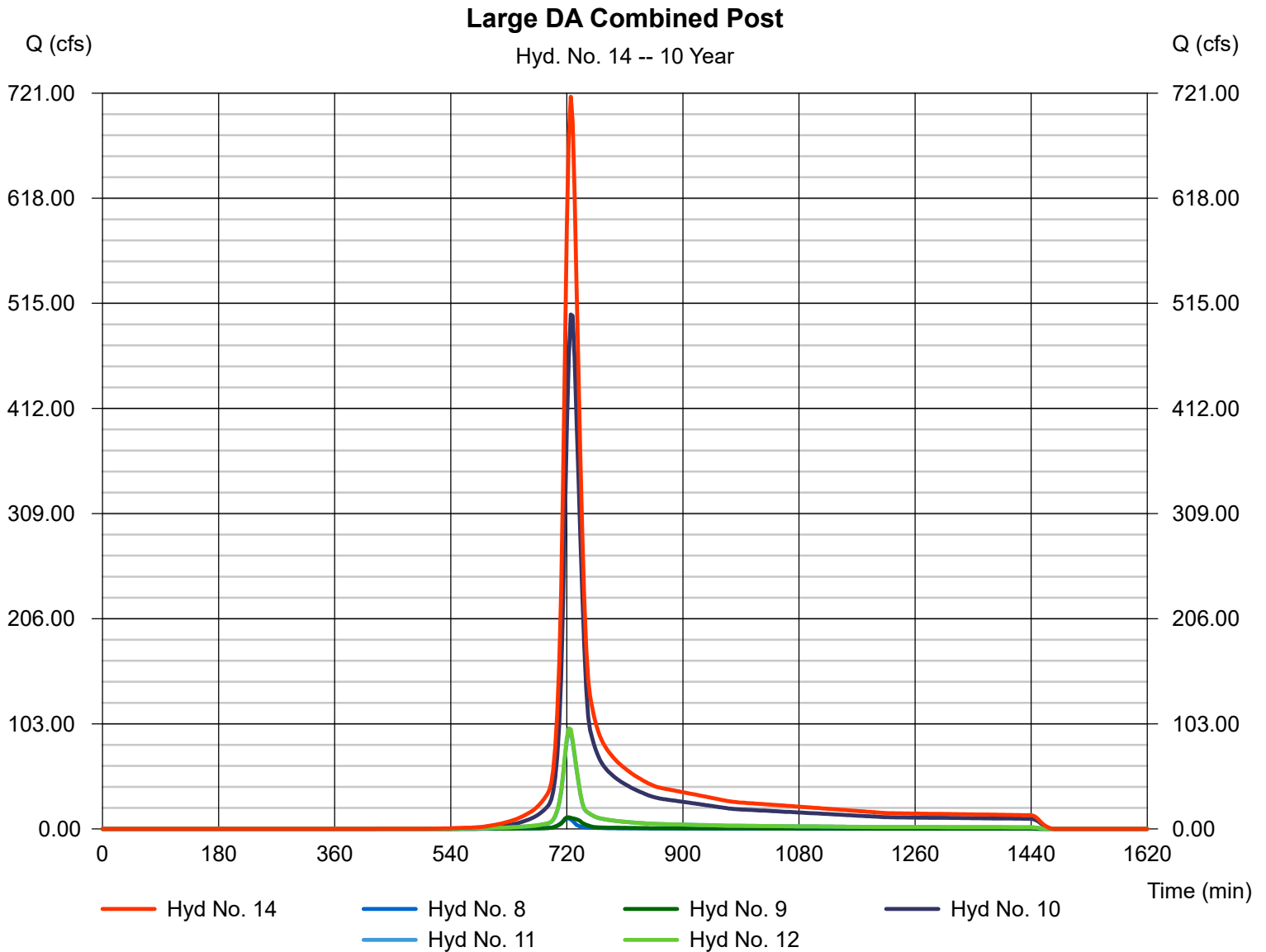
Wednesday, Jan 16, 2019

Hyd. No. 14

Large DA Combined Post

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 3 min
Inflow hyds. = 8, 9, 10, 11, 12

Peak discharge = 717.45 cfs
Time to peak = 726 min
Hyd. volume = 2,514,336 cuft
Contrib. drain. area = 284.040 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

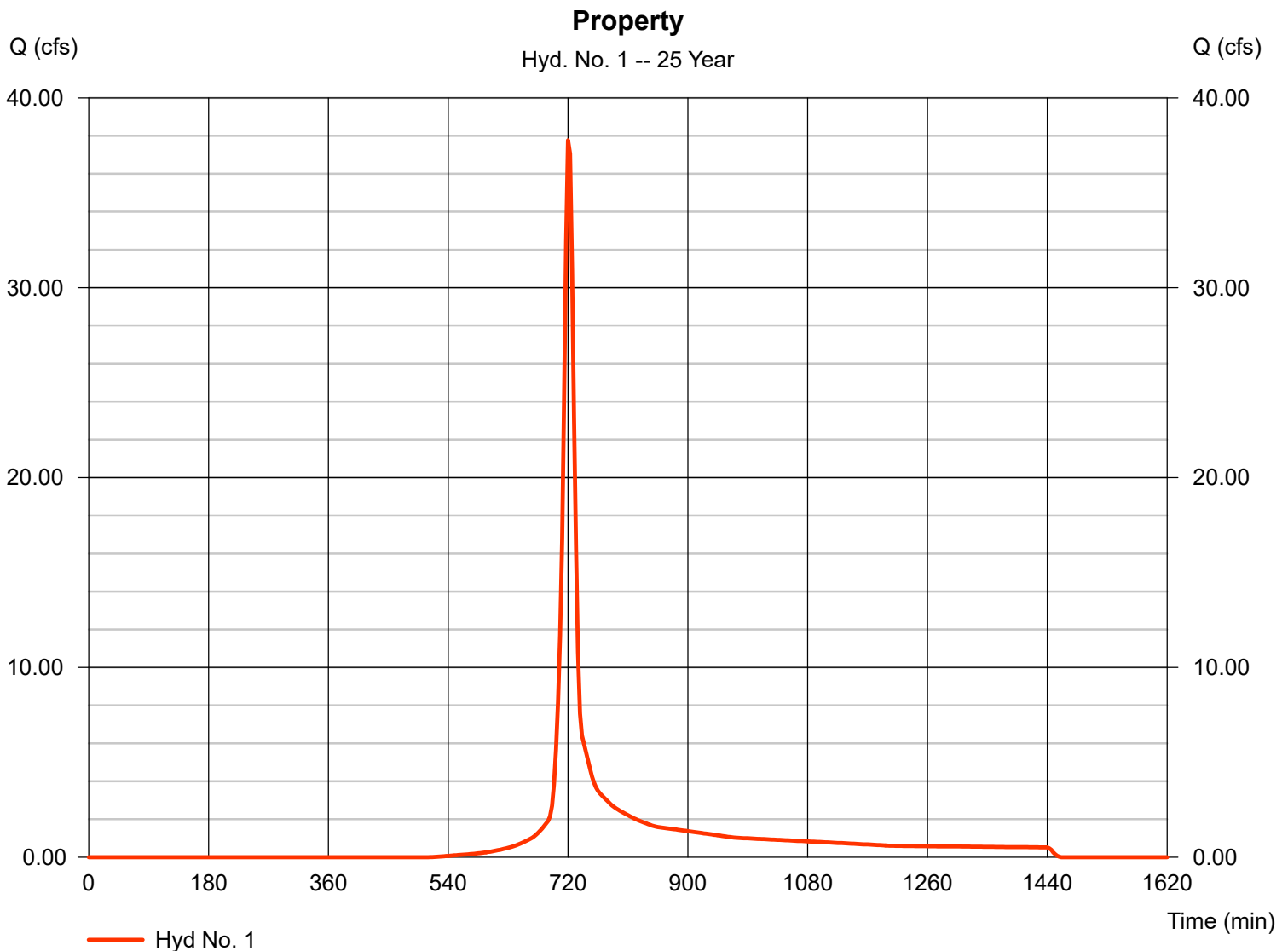
Wednesday, Jan 16, 2019

Hyd. No. 1

Property

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 37.76 cfs
Time to peak = 720 min
Hyd. volume = 102,511 cuft
Curve number = 70.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

Hyd. No. 2

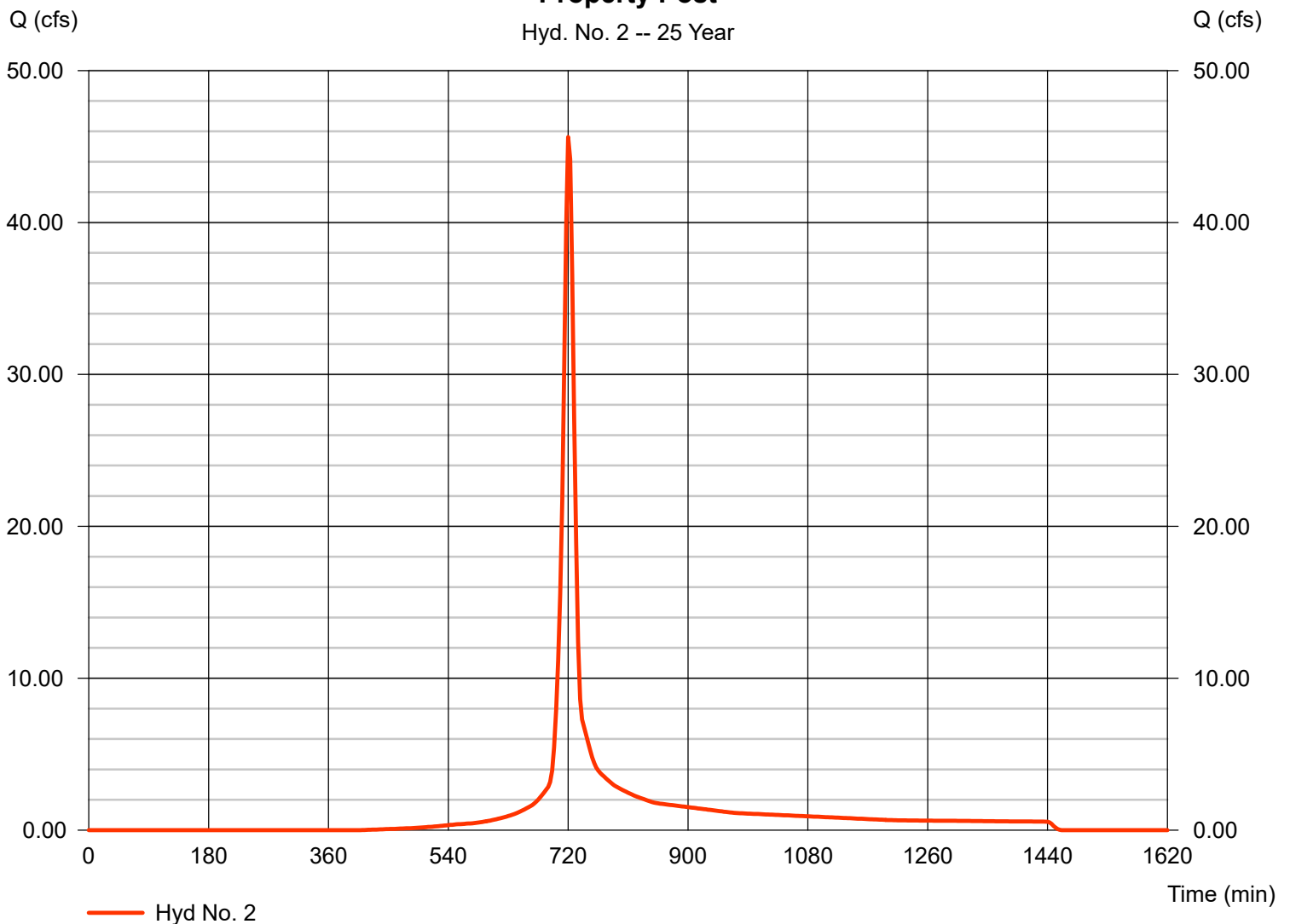
Property Post

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 45.62 cfs
Time to peak = 720 min
Hyd. volume = 123,832 cuft
Curve number = 77.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484

Property Post

Hyd. No. 2 -- 25 Year



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

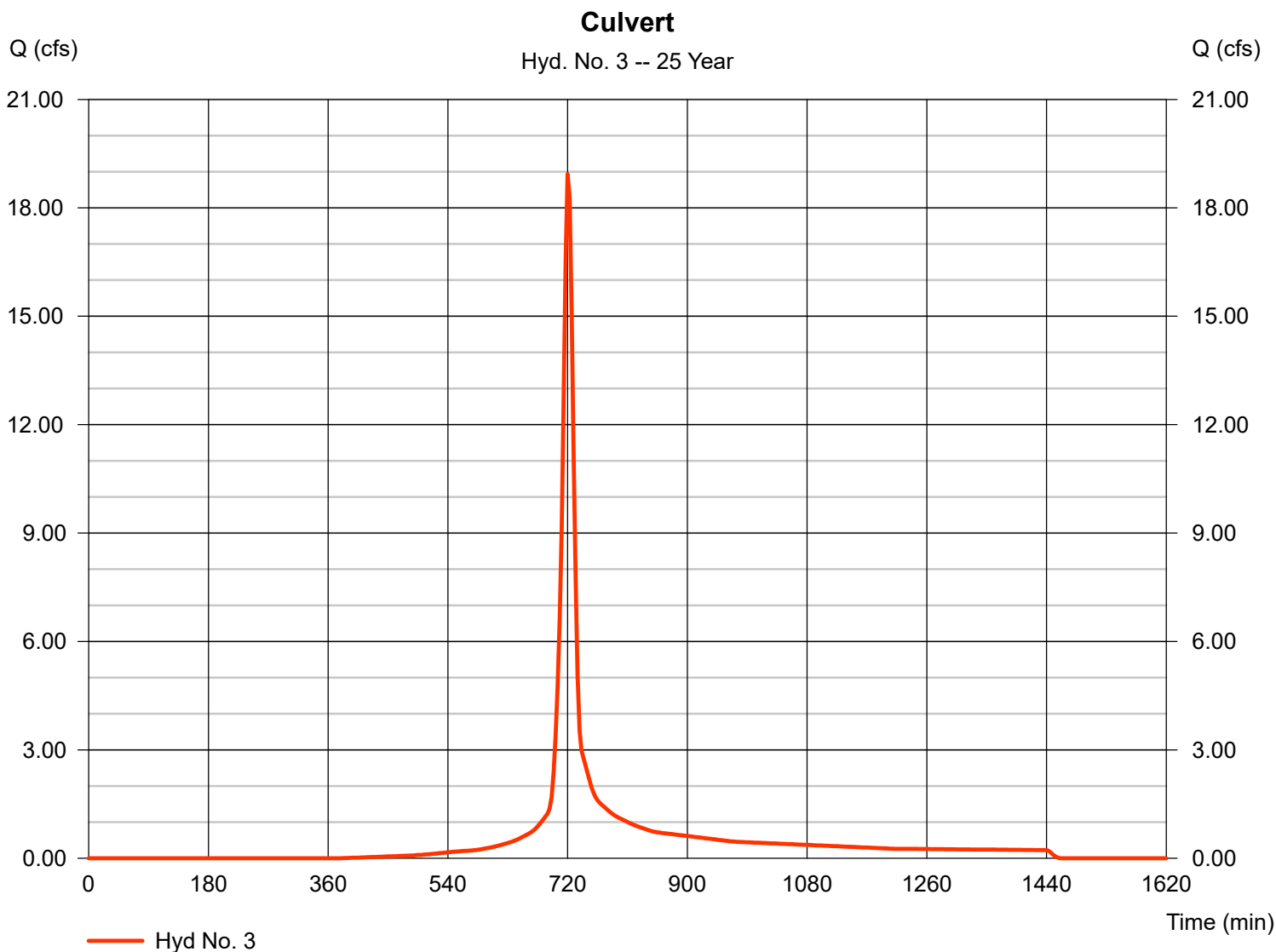
Wednesday, Jan 16, 2019

Hyd. No. 3

Culvert

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 3.490 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 18.94 cfs
Time to peak = 720 min
Hyd. volume = 51,547 cuft
Curve number = 79.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.80 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

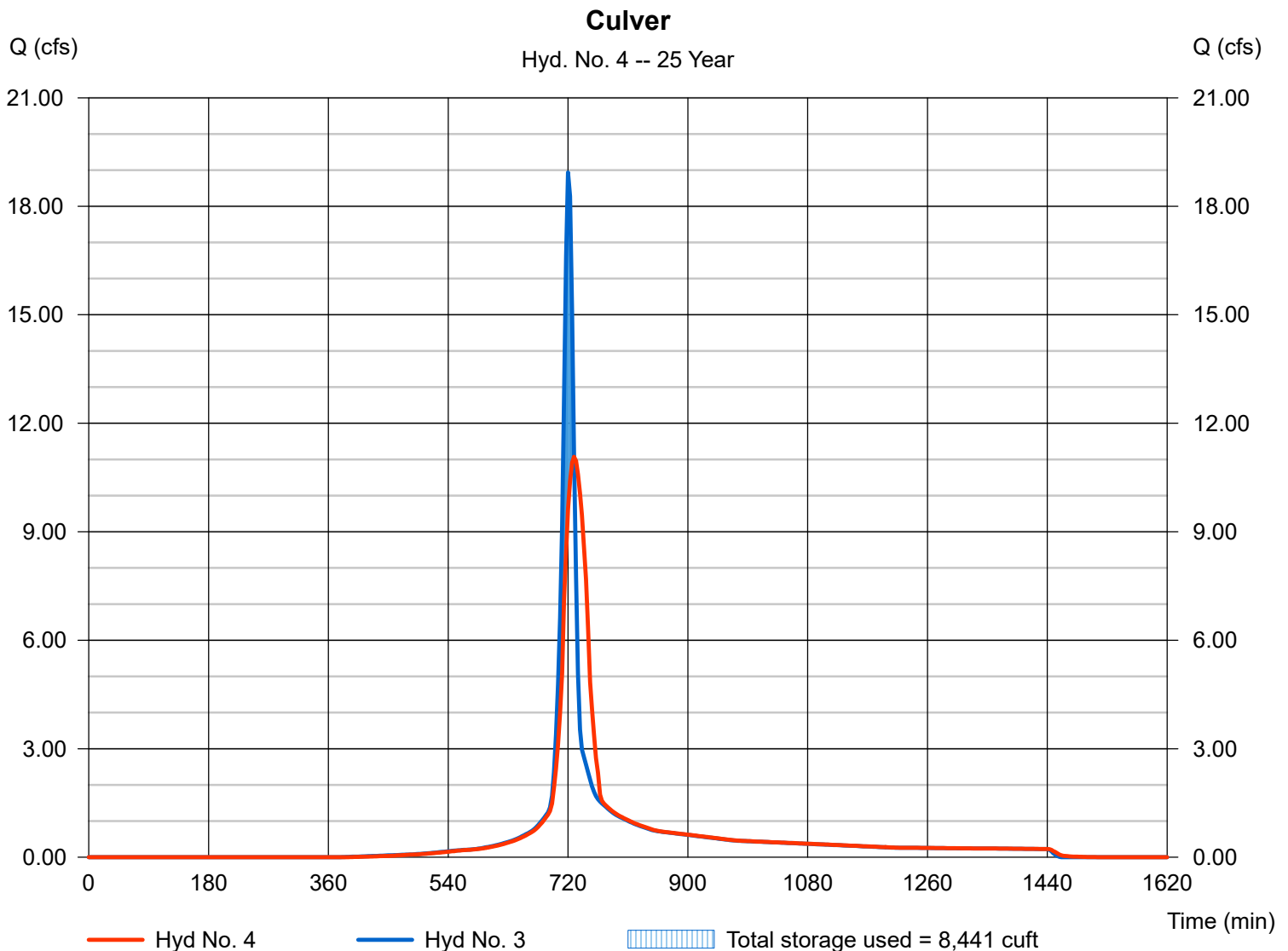
Hyd. No. 4

Culver

Hydrograph type = Reservoir
Storm frequency = 25 yrs
Time interval = 3 min
Inflow hyd. No. = 3 - Culvert
Reservoir name = Culvert

Peak discharge = 11.07 cfs
Time to peak = 729 min
Hyd. volume = 51,546 cuft
Max. Elevation = 500.02 ft
Max. Storage = 8,441 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

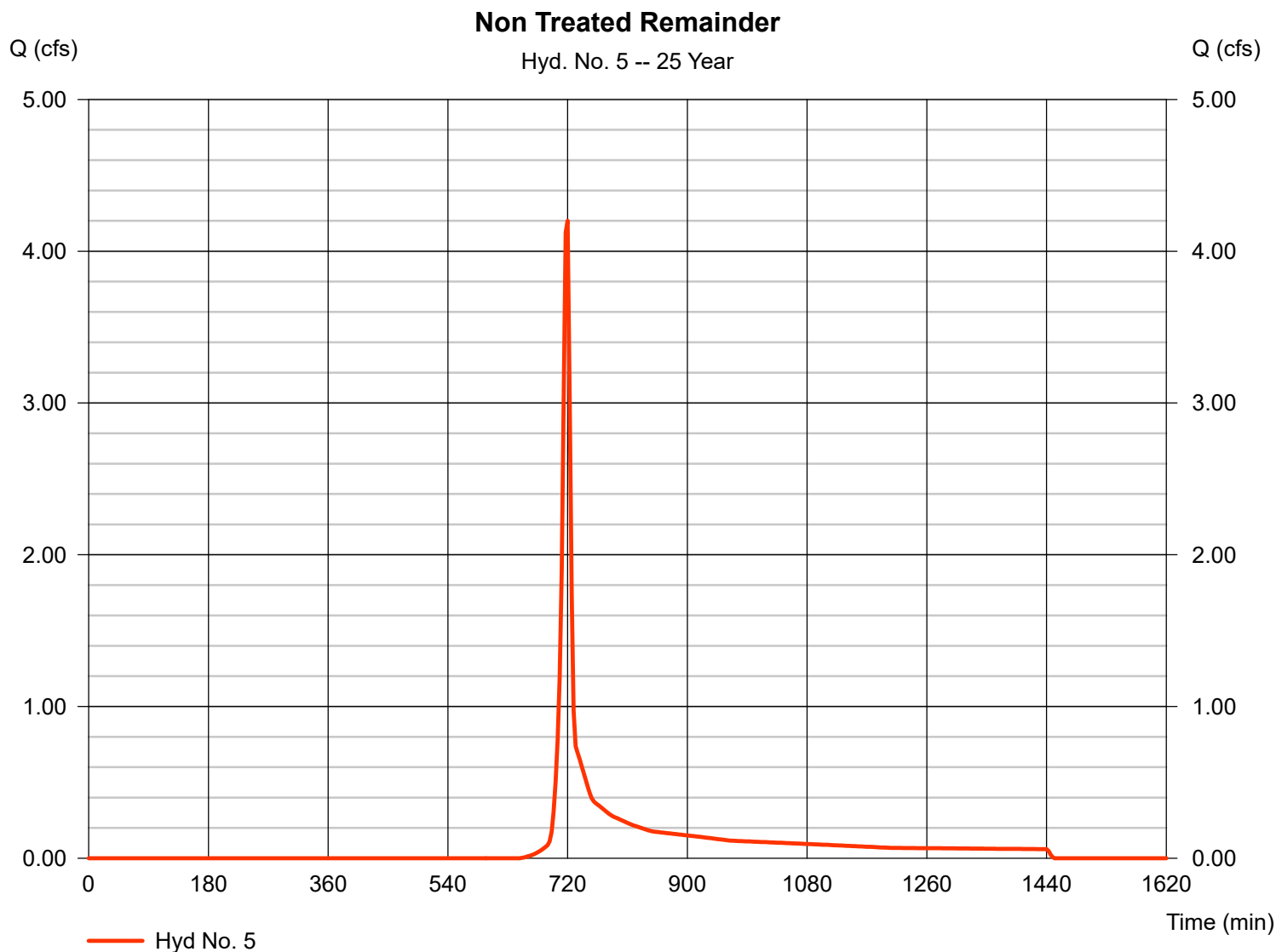
Wednesday, Jan 16, 2019

Hyd. No. 5

Non Treated Remainder

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 1.350 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 4.200 cfs
Time to peak = 720 min
Hyd. volume = 9,673 cuft
Curve number = 59
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

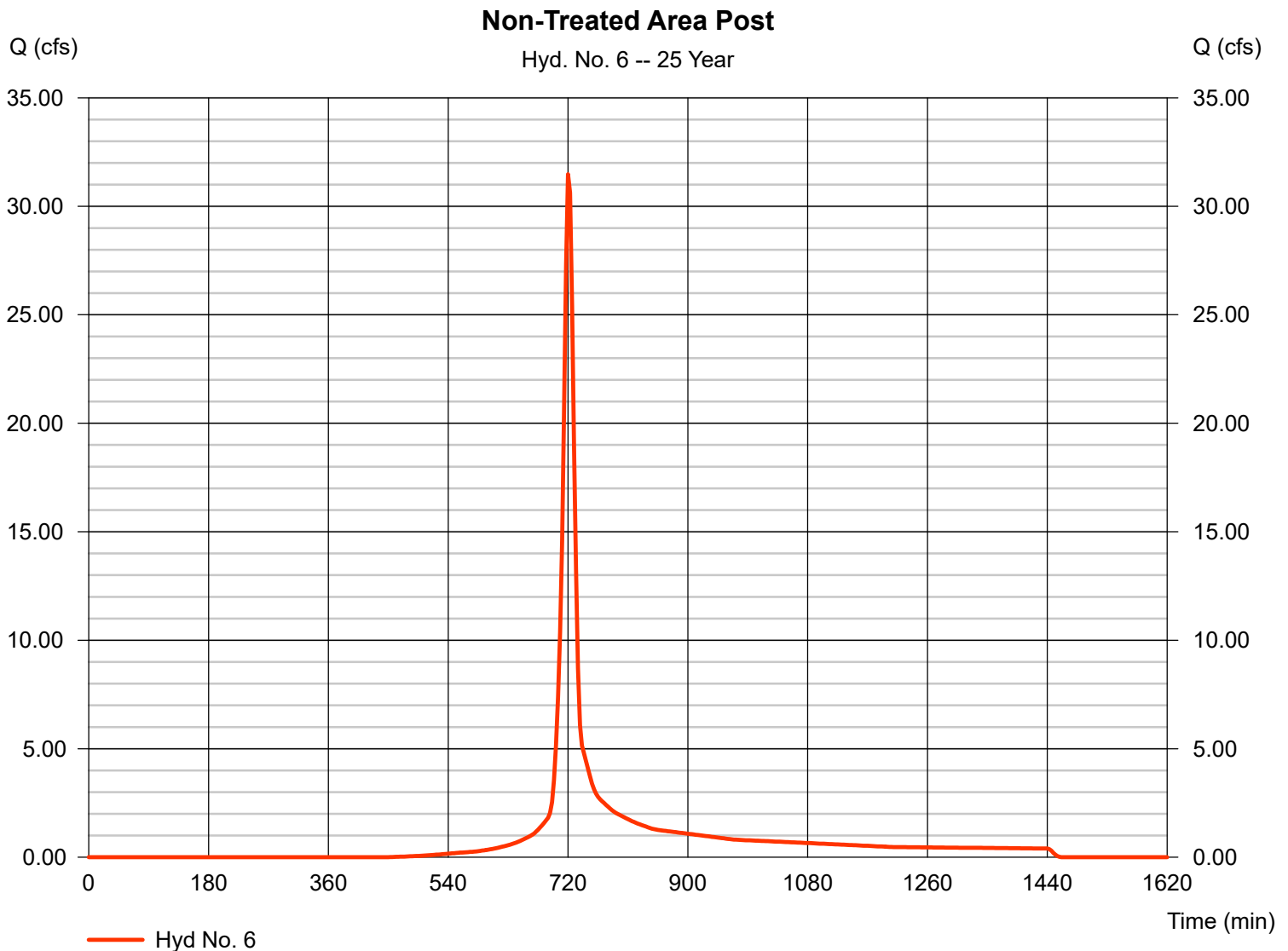
Wednesday, Jan 16, 2019

Hyd. No. 6

Non-Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 6.500 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 31.47 cfs
Time to peak = 720 min
Hyd. volume = 85,267 cuft
Curve number = 74.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

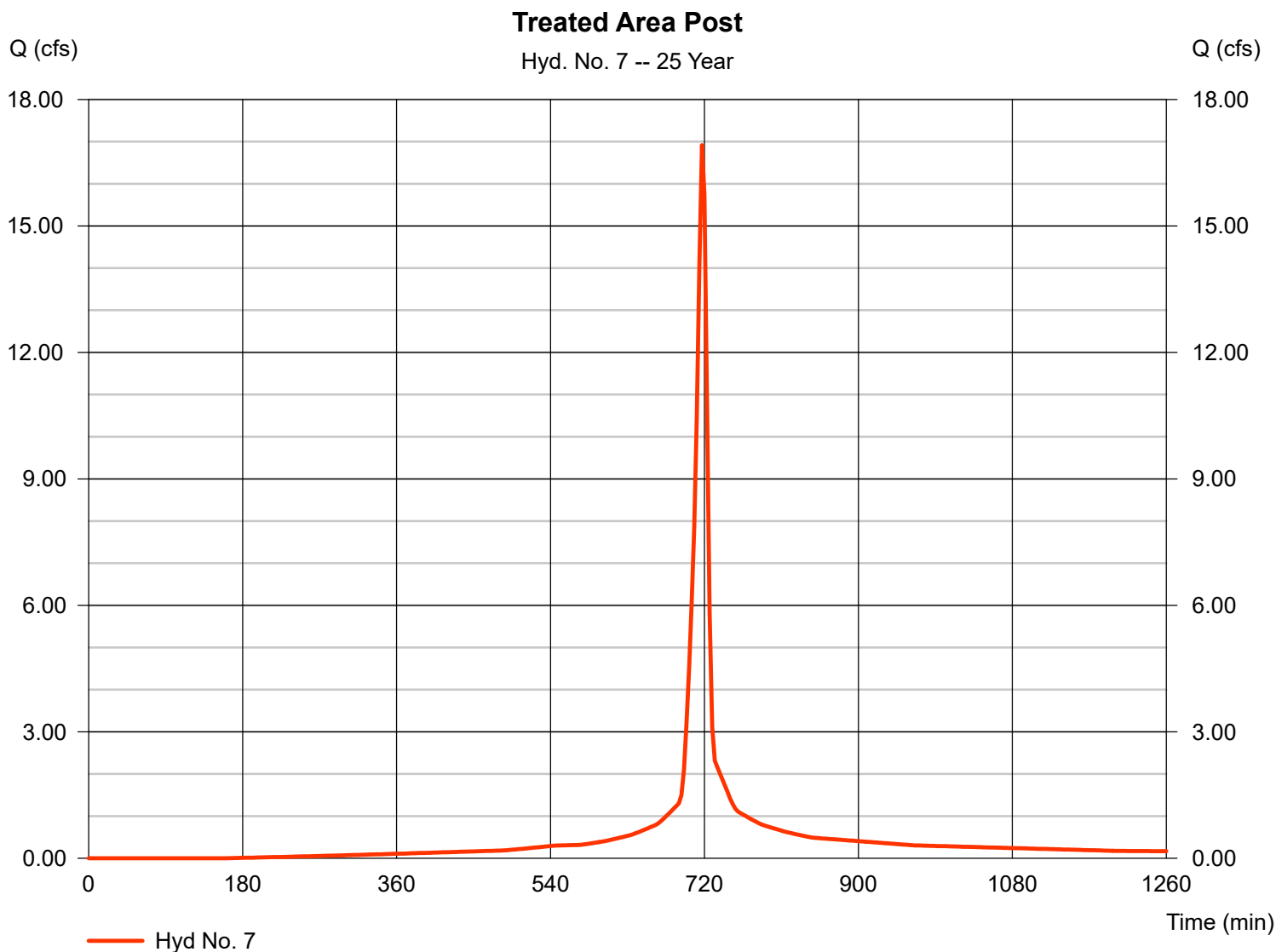
Wednesday, Jan 16, 2019

Hyd. No. 7

Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 2.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 16.92 cfs
Time to peak = 717 min
Hyd. volume = 41,285 cuft
Curve number = 91.5
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

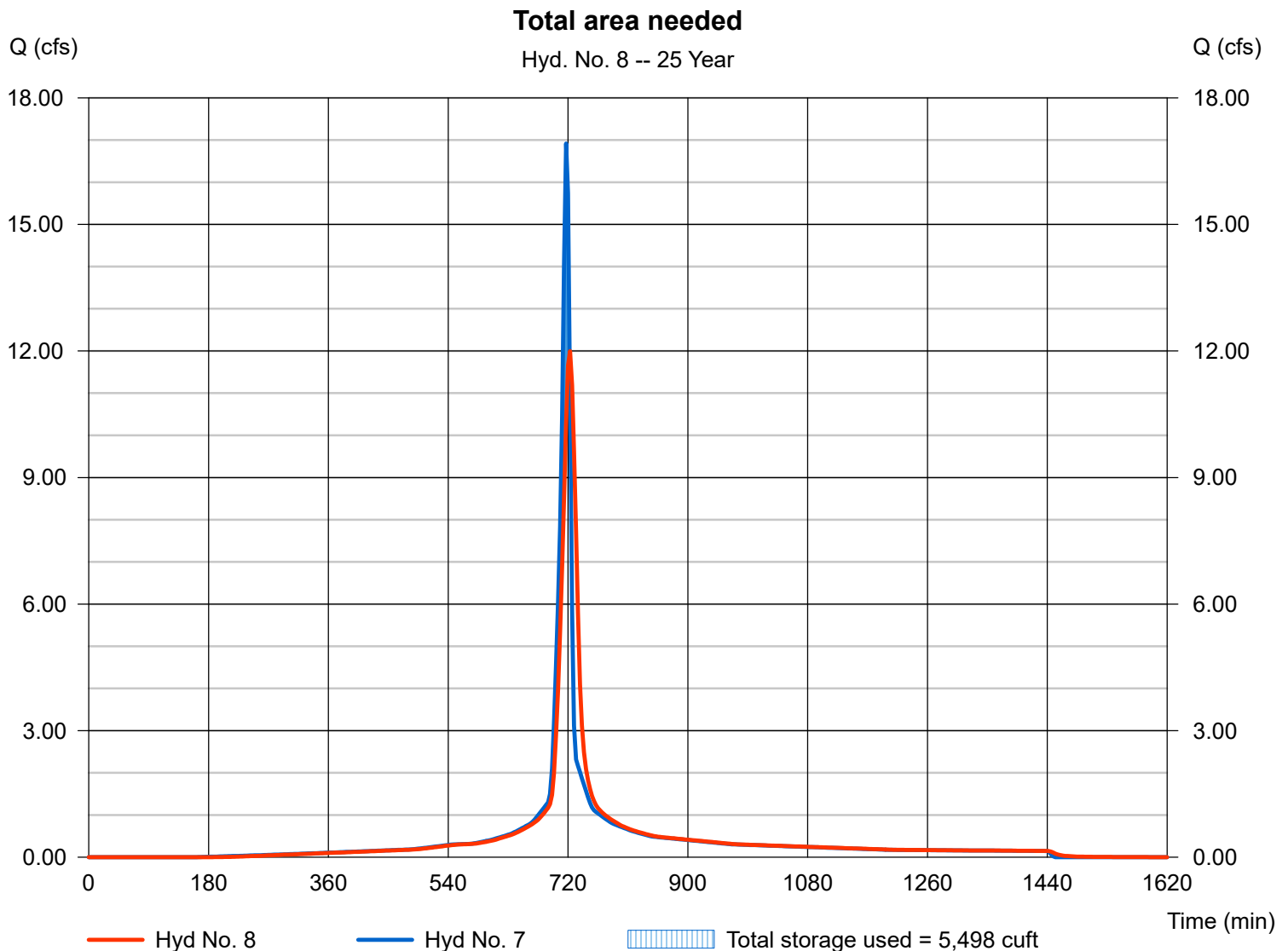
Hyd. No. 8

Total area needed

Hydrograph type = Reservoir
Storm frequency = 25 yrs
Time interval = 3 min
Inflow hyd. No. = 7 - Treated Area Post
Reservoir name = Pipe

Peak discharge = 12.00 cfs
Time to peak = 723 min
Hyd. volume = 41,281 cuft
Max. Elevation = 491.79 ft
Max. Storage = 5,498 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

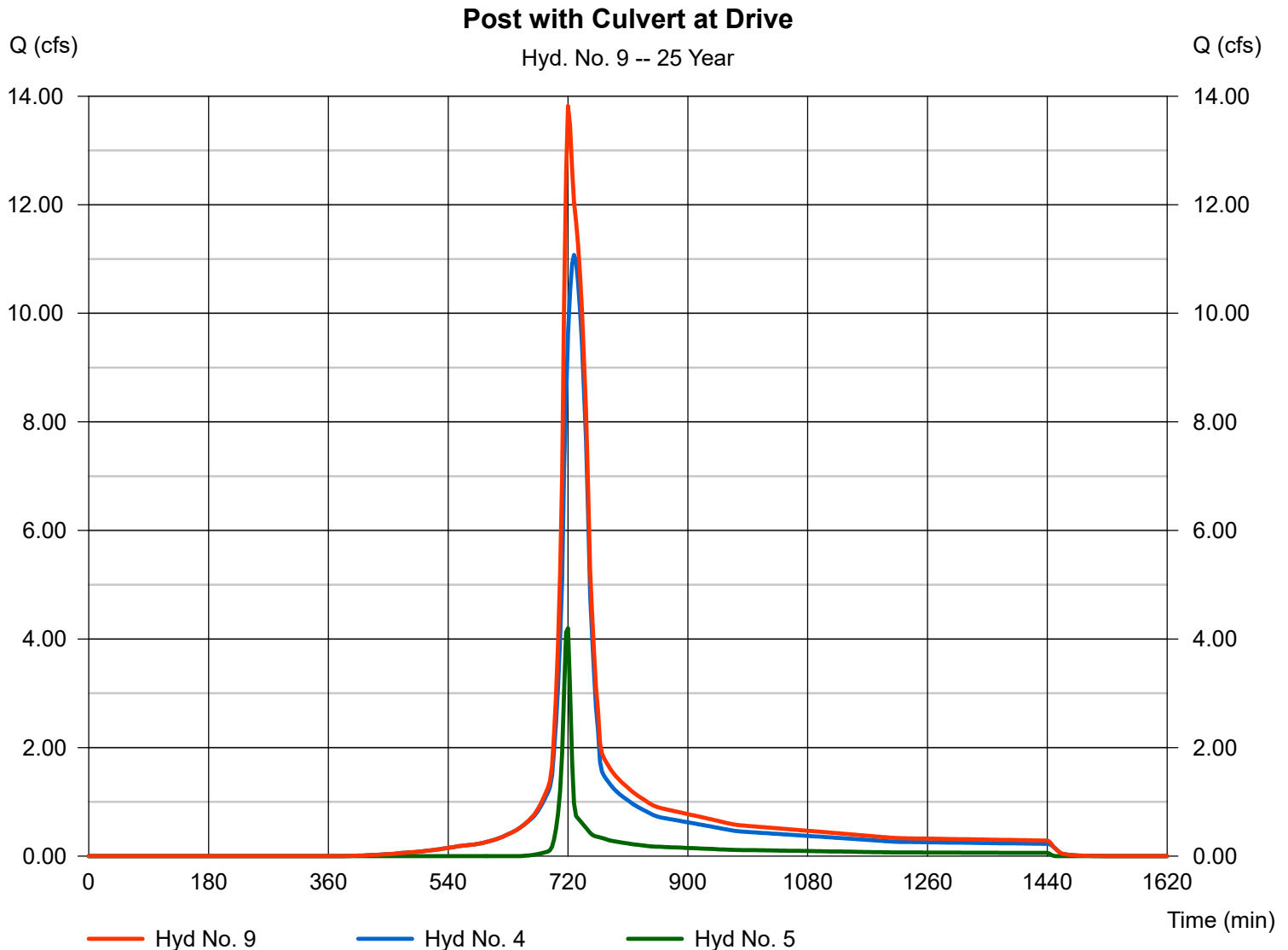
Wednesday, Jan 16, 2019

Hyd. No. 9

Post with Culvert at Drive

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 3 min
Inflow hyds. = 4, 5

Peak discharge = 13.82 cfs
Time to peak = 720 min
Hyd. volume = 61,220 cuft
Contrib. drain. area = 1.350 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

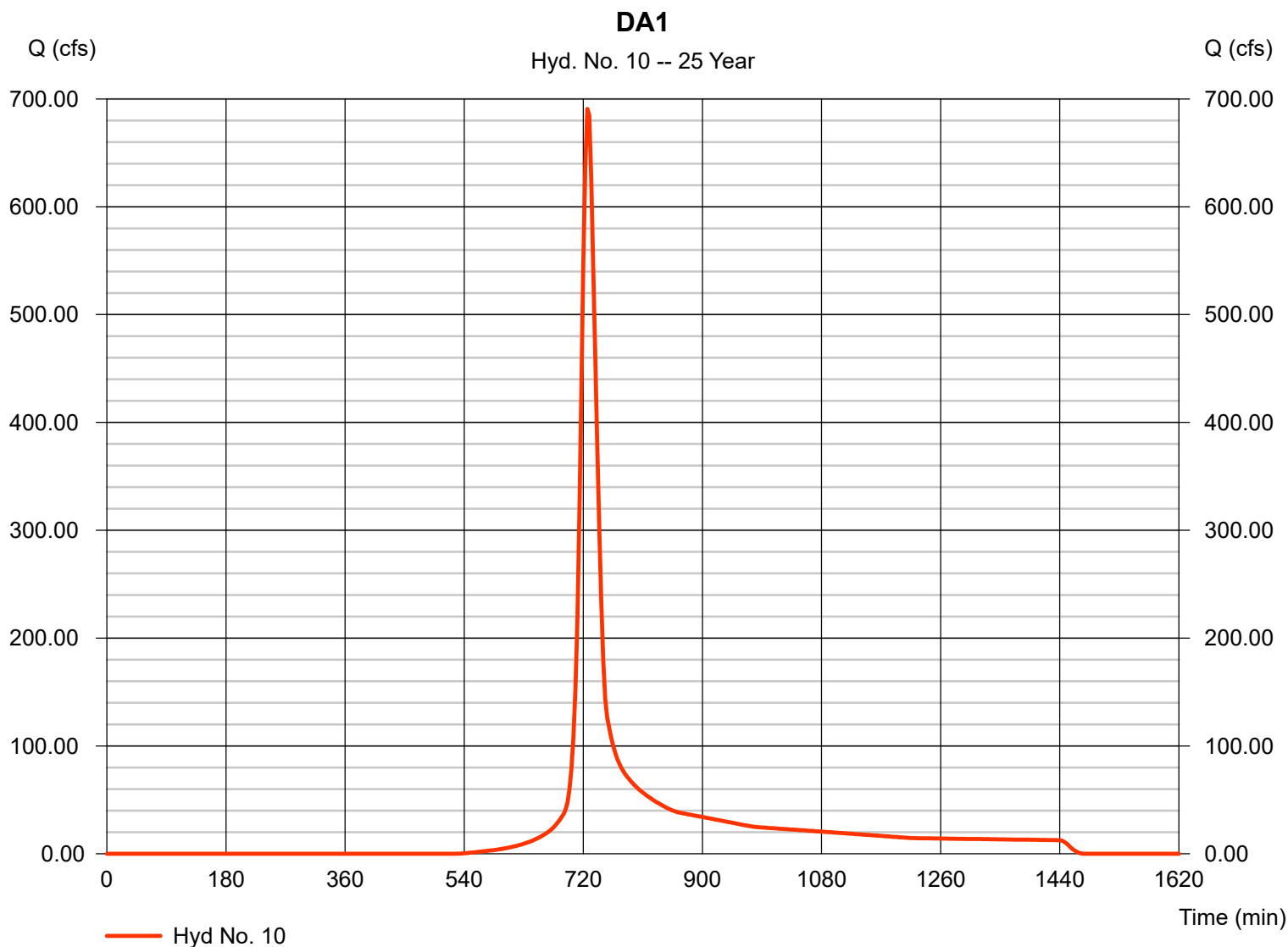
Wednesday, Jan 16, 2019

Hyd. No. 10

DA1

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 222.600 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 690.78 cfs
Time to peak = 726 min
Hyd. volume = 2,445,935 cuft
Curve number = 69.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 21.16 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

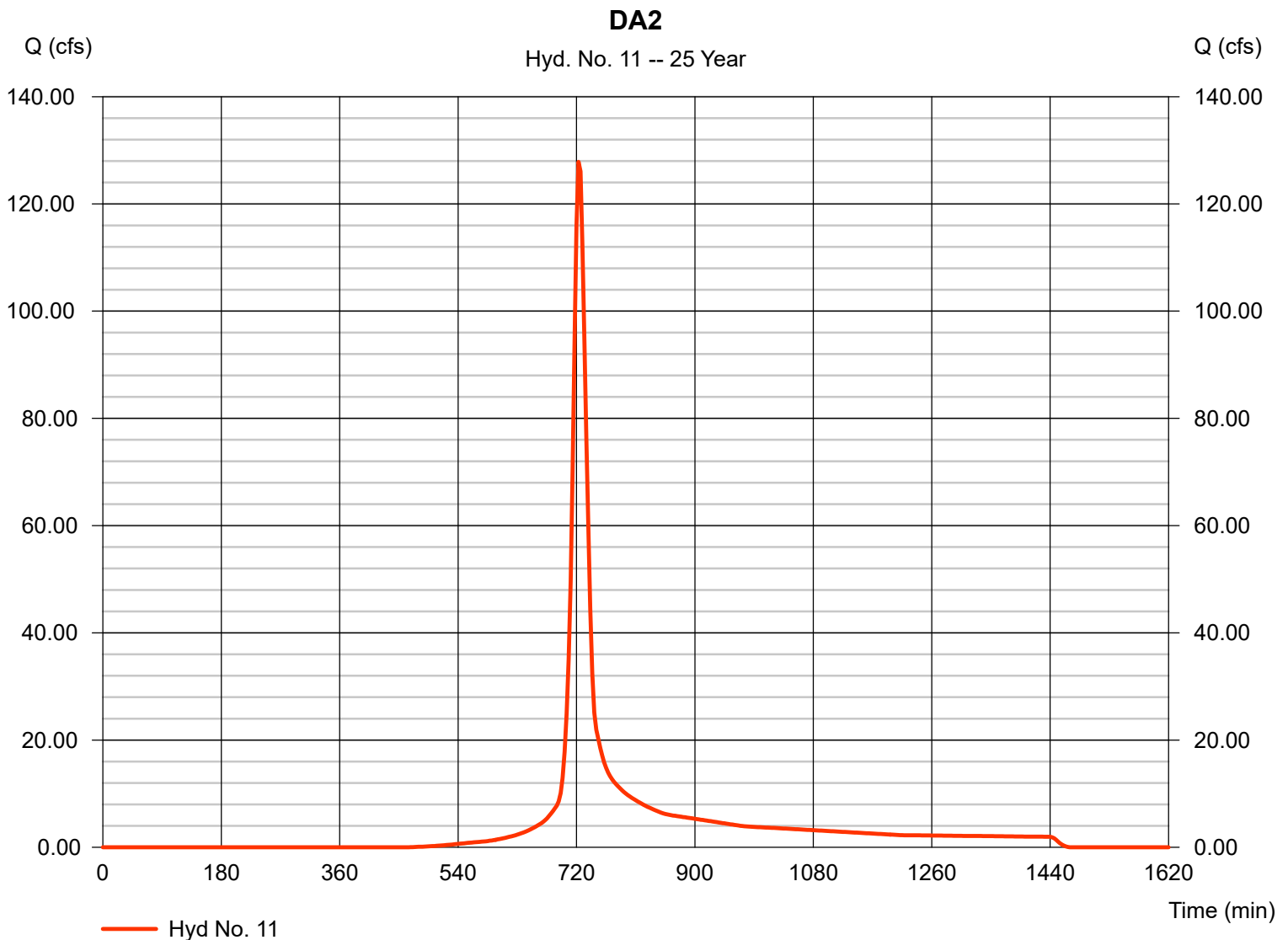
Wednesday, Jan 16, 2019

Hyd. No. 11

DA2

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 30.870 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 127.84 cfs
Time to peak = 723 min
Hyd. volume = 408,224 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 16.17 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

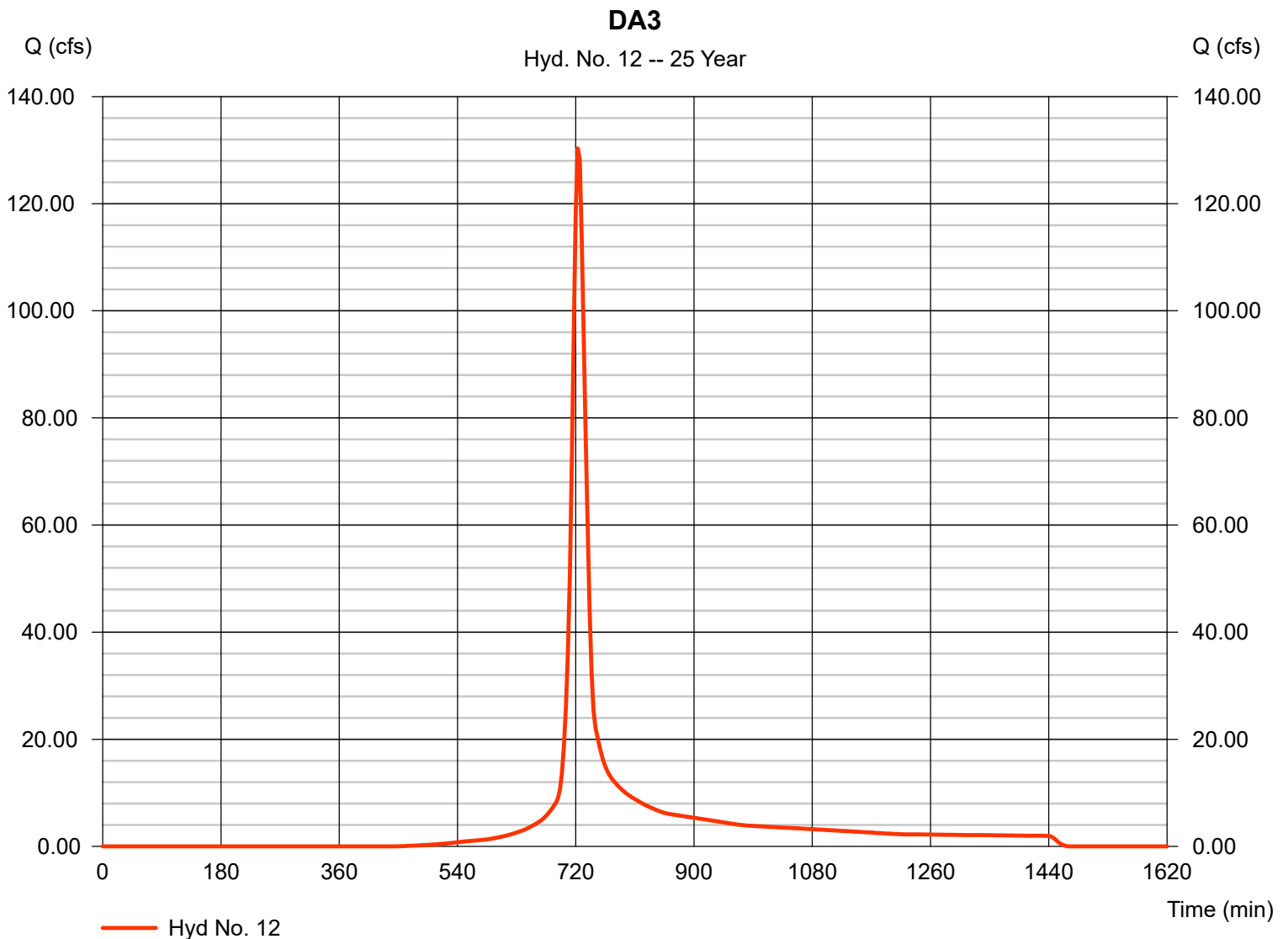
Wednesday, Jan 16, 2019

Hyd. No. 12

DA3

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 3 min
Drainage area = 30.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.41 in
Storm duration = 24 hrs

Peak discharge = 130.31 cfs
Time to peak = 723 min
Hyd. volume = 415,880 cuft
Curve number = 75
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.95 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

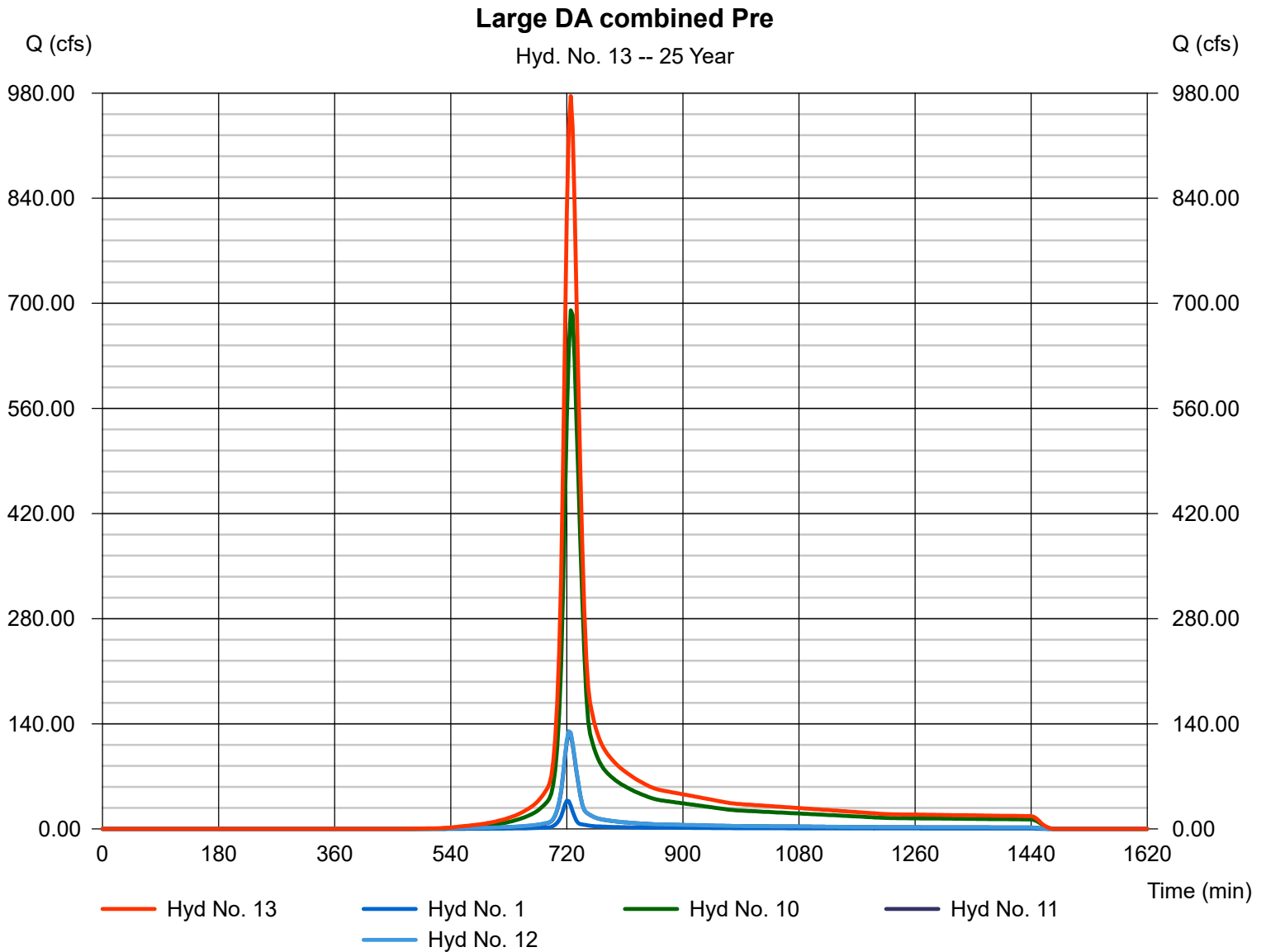
Wednesday, Jan 16, 2019

Hyd. No. 13

Large DA combined Pre

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 3 min
Inflow hyds. = 1, 10, 11, 12

Peak discharge = 976.06 cfs
Time to peak = 726 min
Hyd. volume = 3,372,551 cuft
Contrib. drain. area = 292.830 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

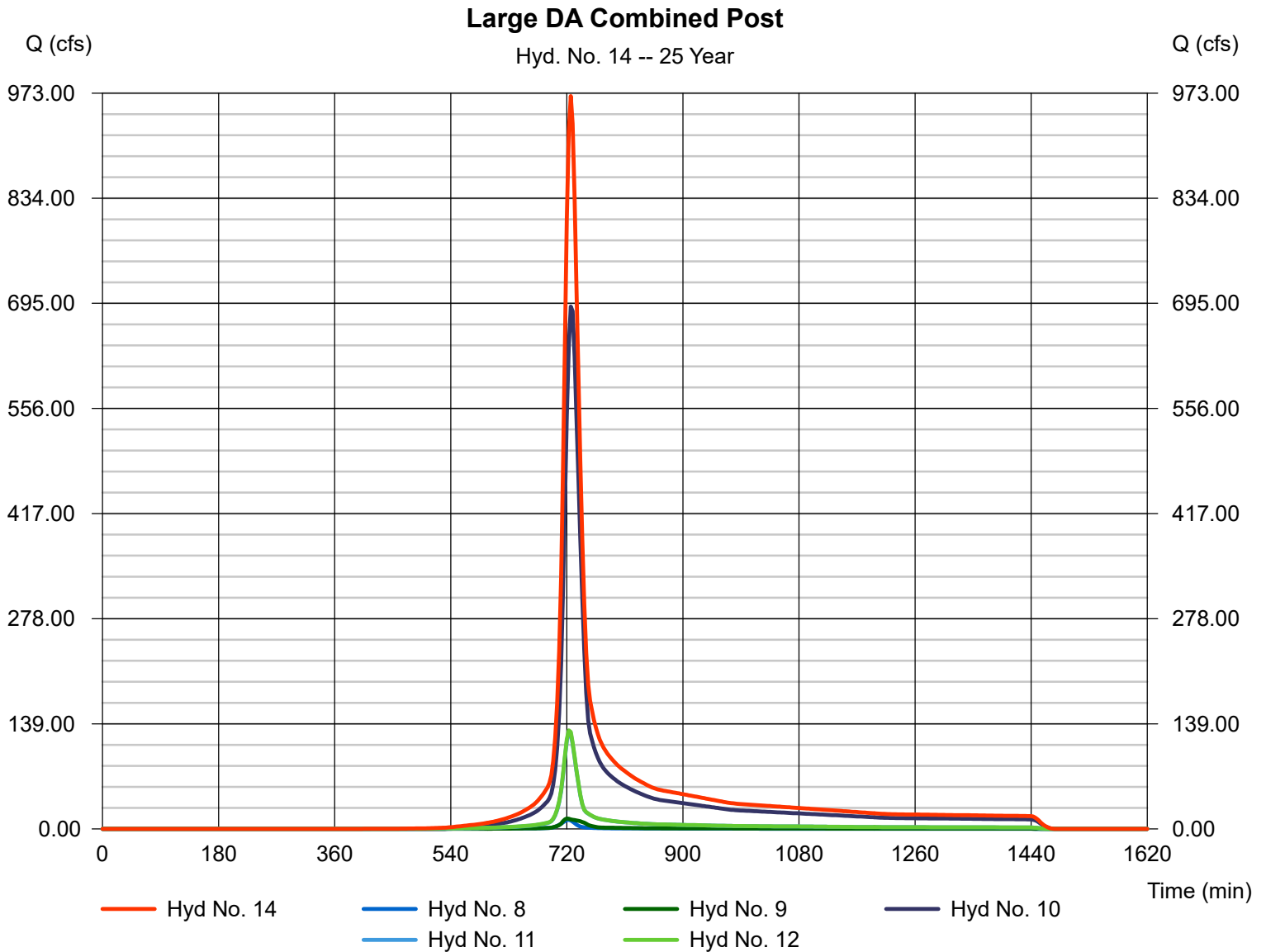
Wednesday, Jan 16, 2019

Hyd. No. 14

Large DA Combined Post

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 3 min
Inflow hyds. = 8, 9, 10, 11, 12

Peak discharge = 968.99 cfs
Time to peak = 726 min
Hyd. volume = 3,372,541 cuft
Contrib. drain. area = 284.040 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

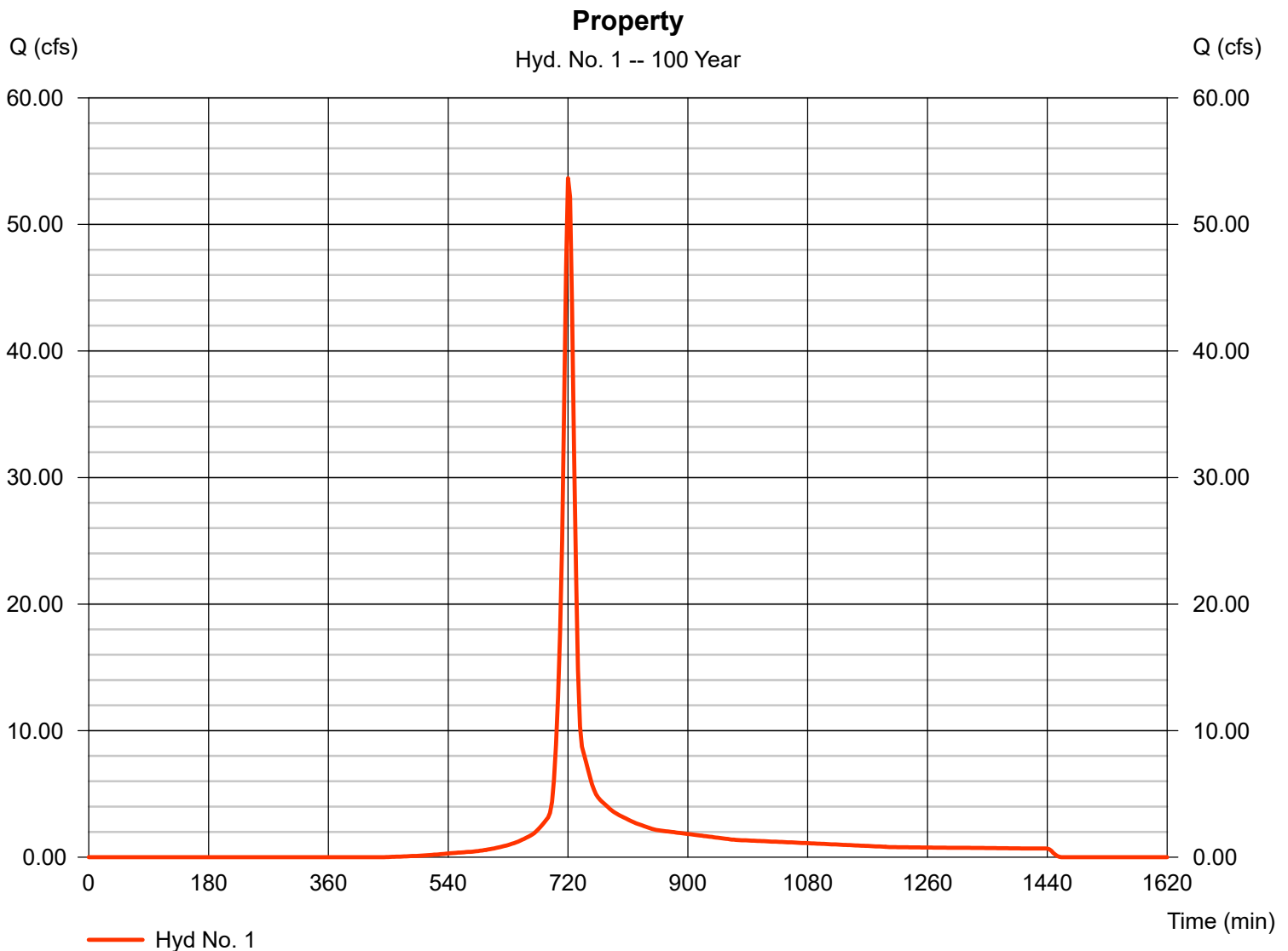
Wednesday, Jan 16, 2019

Hyd. No. 1

Property

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 53.66 cfs
Time to peak = 720 min
Hyd. volume = 145,378 cuft
Curve number = 70.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

Hyd. No. 2

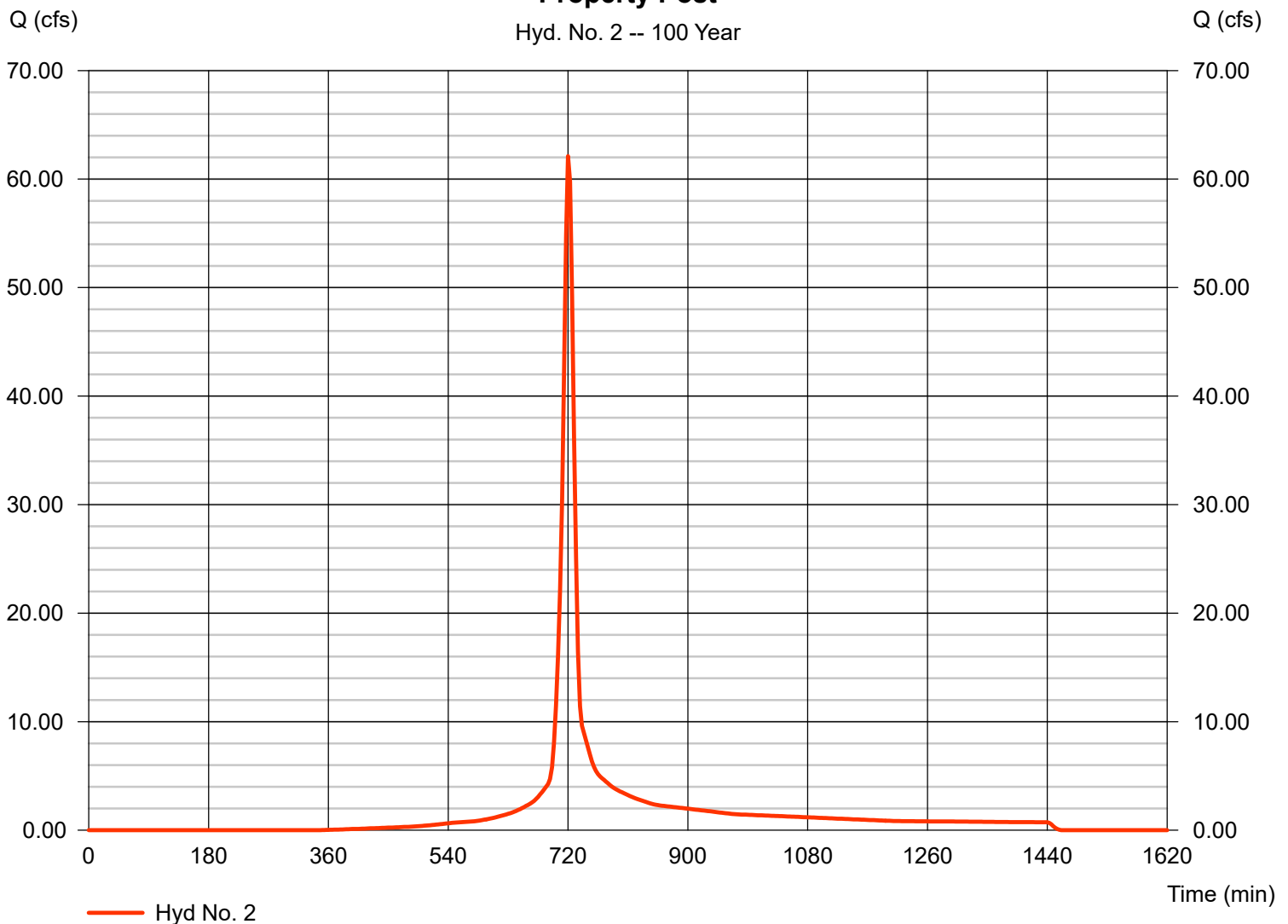
Property Post

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 62.11 cfs
Time to peak = 720 min
Hyd. volume = 169,781 cuft
Curve number = 77.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484

Property Post

Hyd. No. 2 -- 100 Year



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

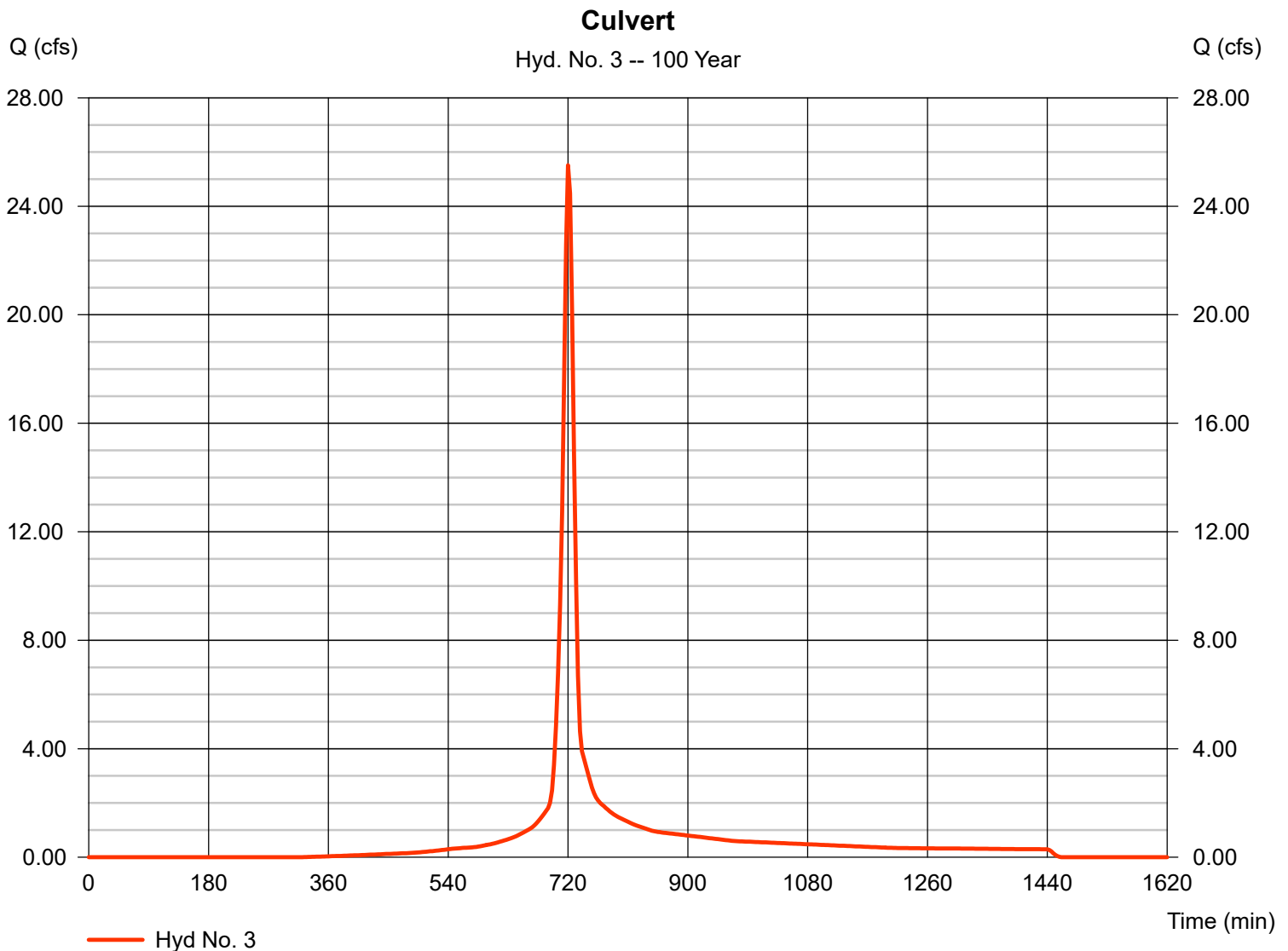
Wednesday, Jan 16, 2019

Hyd. No. 3

Culvert

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 3.490 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 25.51 cfs
Time to peak = 720 min
Hyd. volume = 70,075 cuft
Curve number = 79.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.80 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

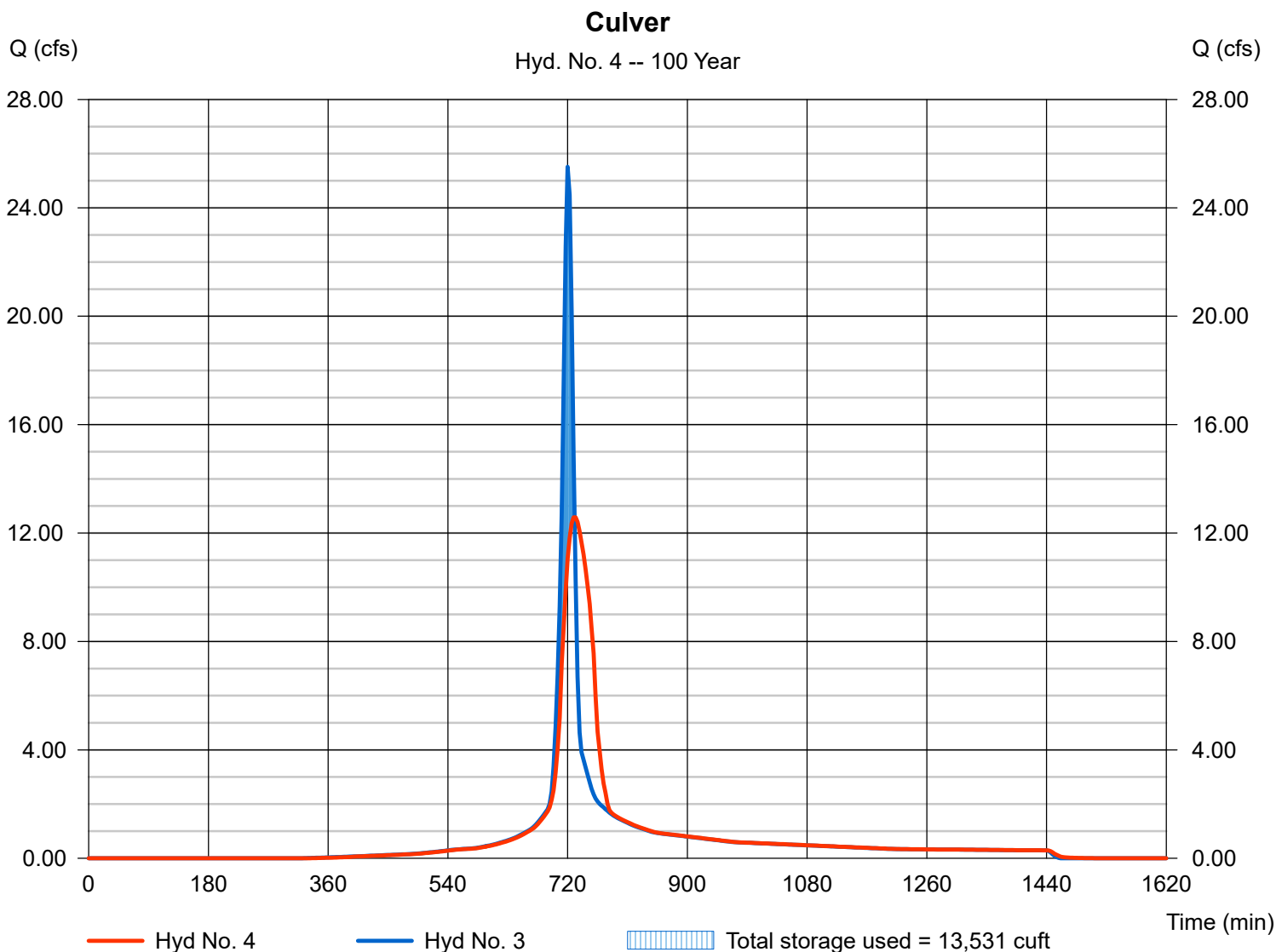
Hyd. No. 4

Culver

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 3 min
Inflow hyd. No. = 3 - Culvert
Reservoir name = Culvert

Peak discharge = 12.58 cfs
Time to peak = 729 min
Hyd. volume = 70,073 cuft
Max. Elevation = 501.14 ft
Max. Storage = 13,531 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

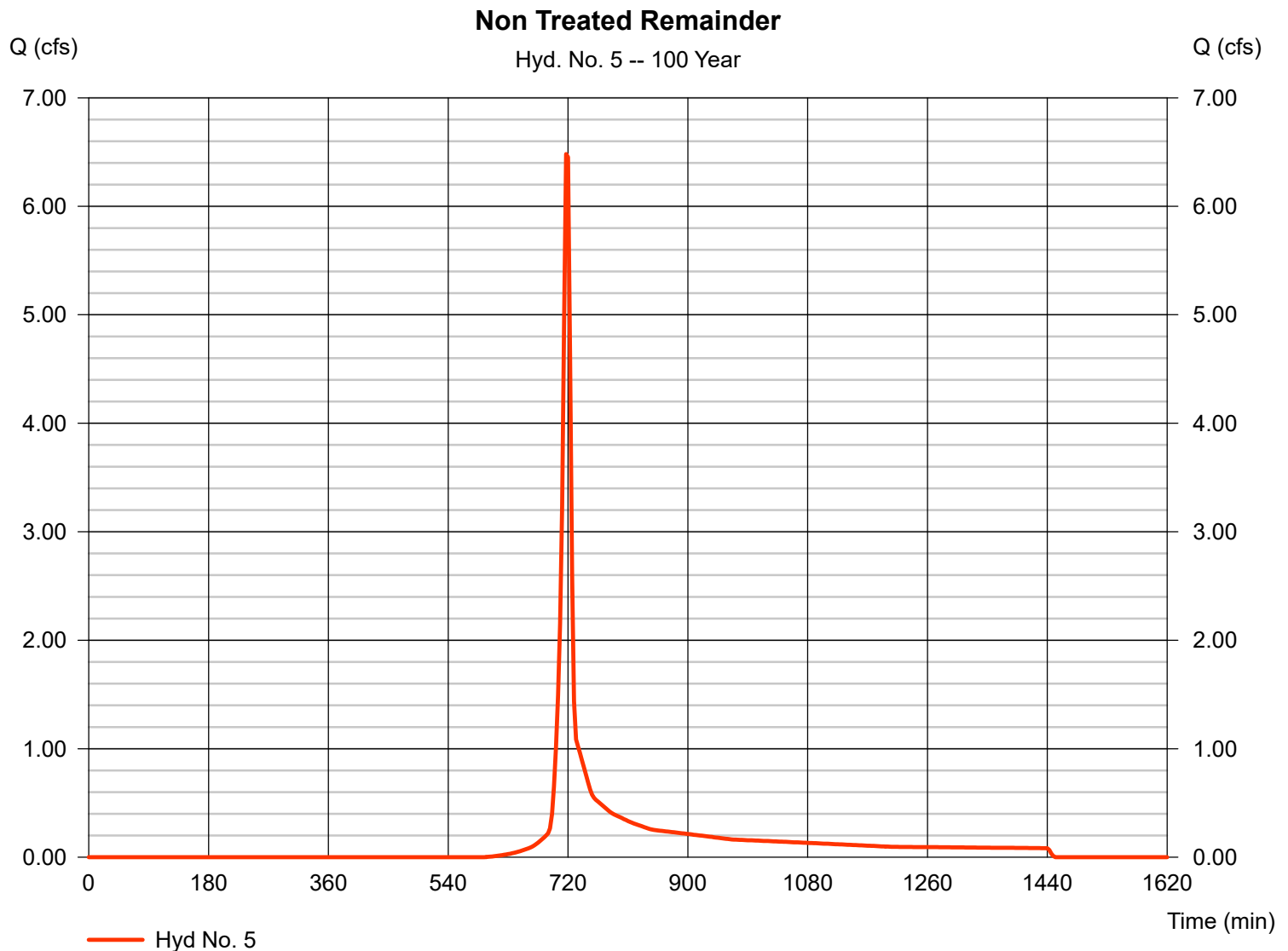
Wednesday, Jan 16, 2019

Hyd. No. 5

Non Treated Remainder

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 1.350 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 6.481 cfs
Time to peak = 717 min
Hyd. volume = 14,805 cuft
Curve number = 59
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

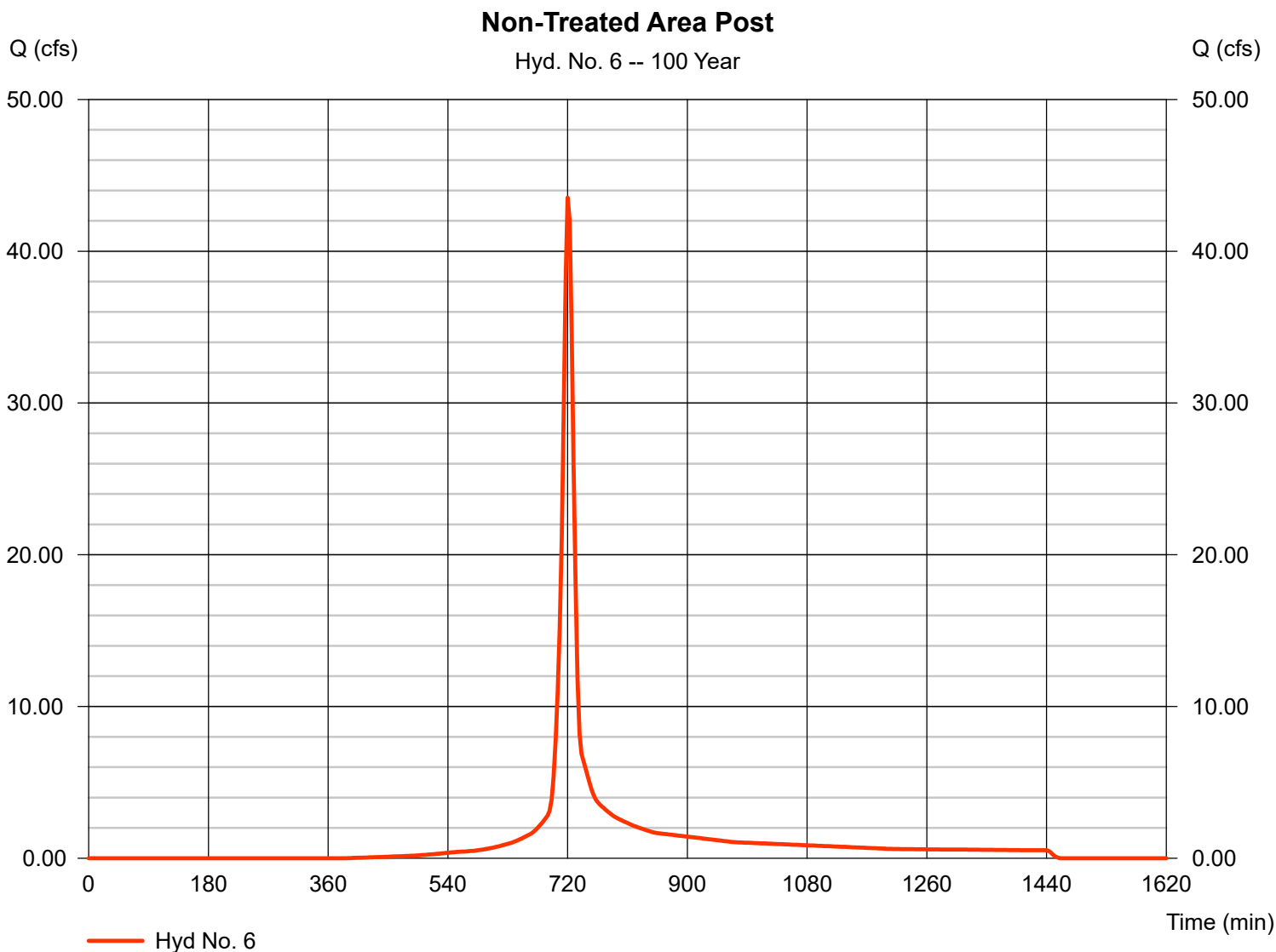
Wednesday, Jan 16, 2019

Hyd. No. 6

Non-Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 6.500 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 43.54 cfs
Time to peak = 720 min
Hyd. volume = 118,410 cuft
Curve number = 74.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

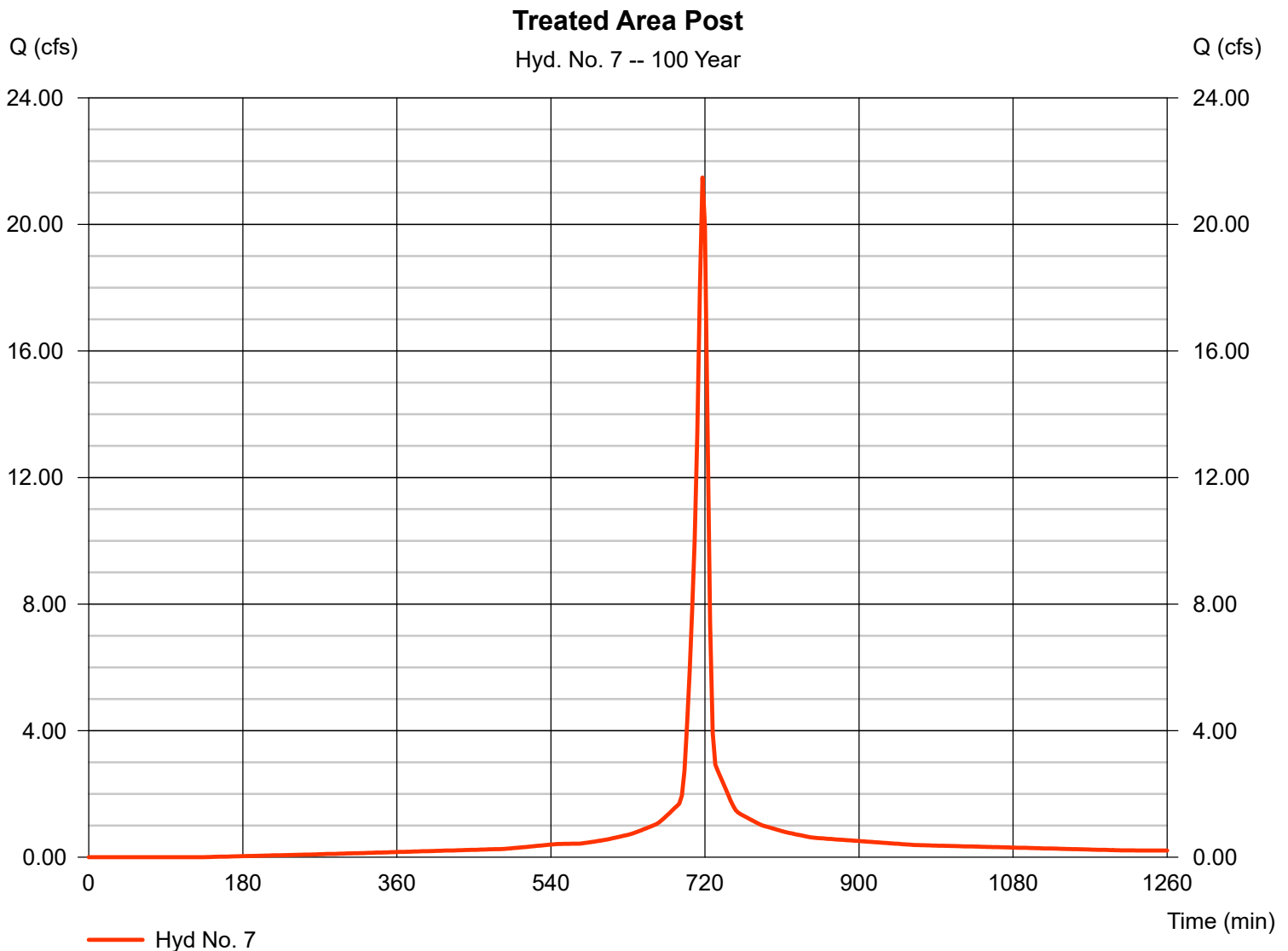
Wednesday, Jan 16, 2019

Hyd. No. 7

Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 2.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 21.48 cfs
Time to peak = 717 min
Hyd. volume = 53,239 cuft
Curve number = 91.5
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

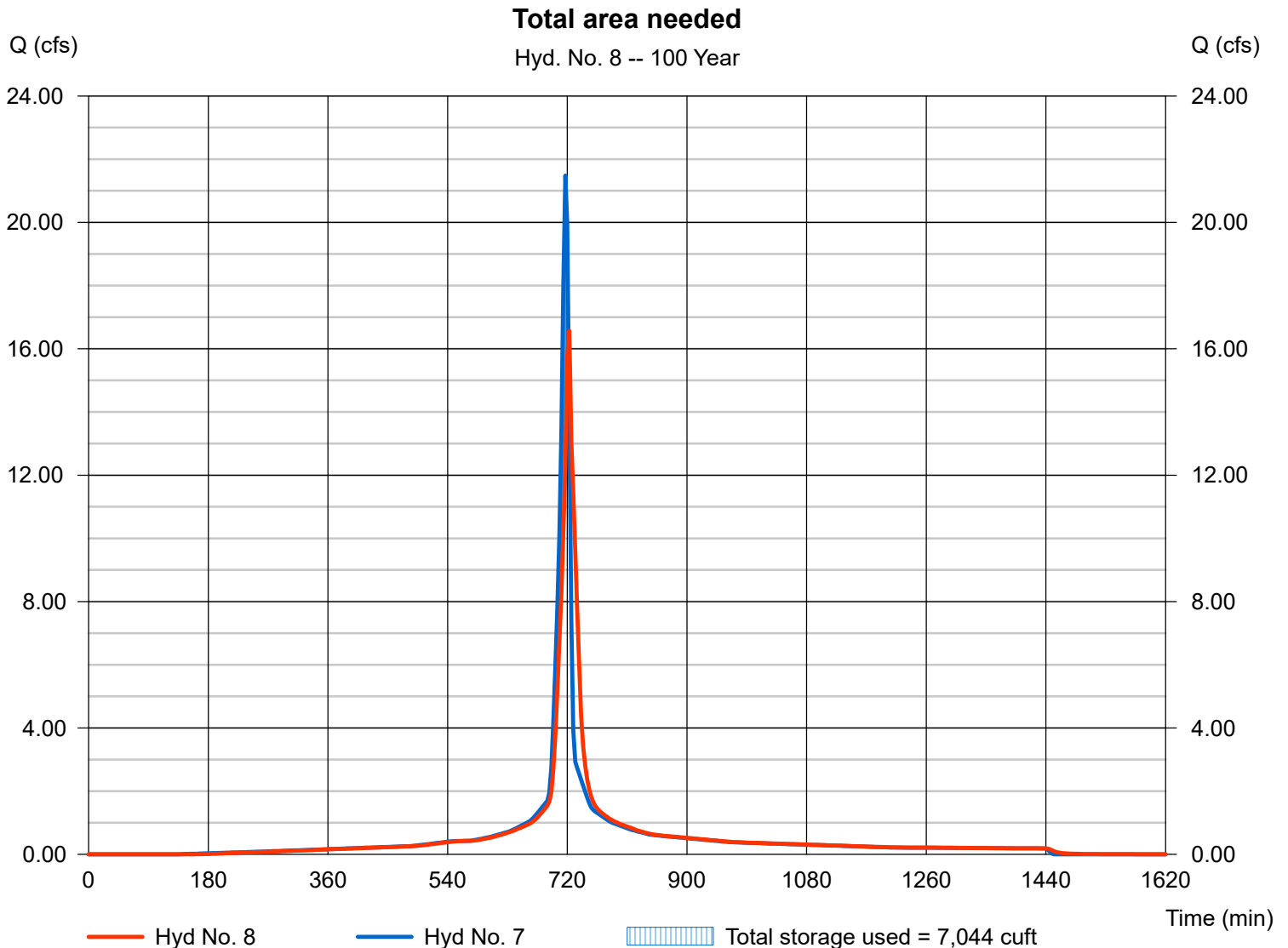
Hyd. No. 8

Total area needed

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 3 min
Inflow hyd. No. = 7 - Treated Area Post
Reservoir name = Pipe

Peak discharge = 16.57 cfs
Time to peak = 723 min
Hyd. volume = 53,234 cuft
Max. Elevation = 492.76 ft
Max. Storage = 7,044 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

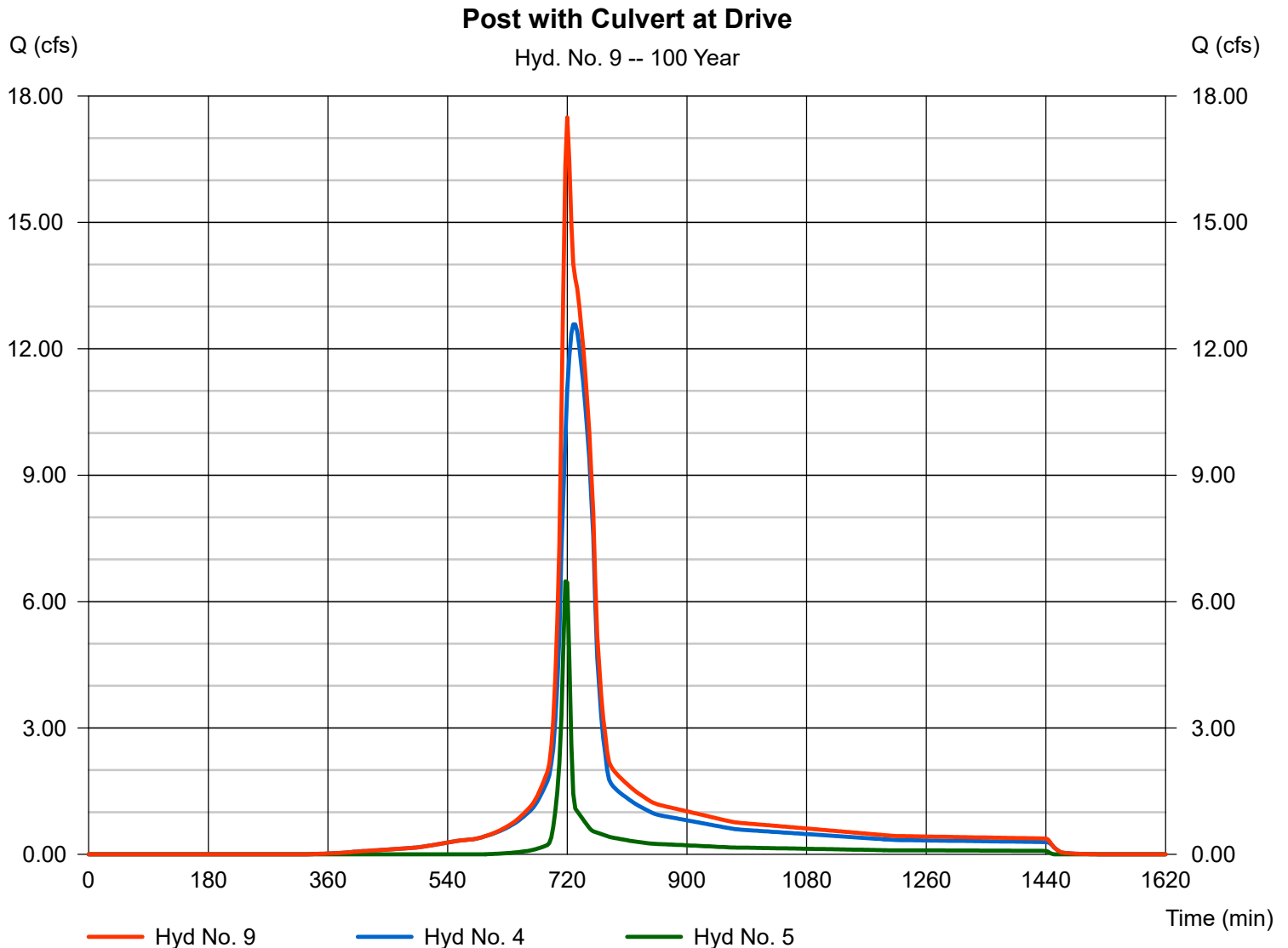
Wednesday, Jan 16, 2019

Hyd. No. 9

Post with Culvert at Drive

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 3 min
Inflow hyds. = 4, 5

Peak discharge = 17.49 cfs
Time to peak = 720 min
Hyd. volume = 84,878 cuft
Contrib. drain. area = 1.350 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

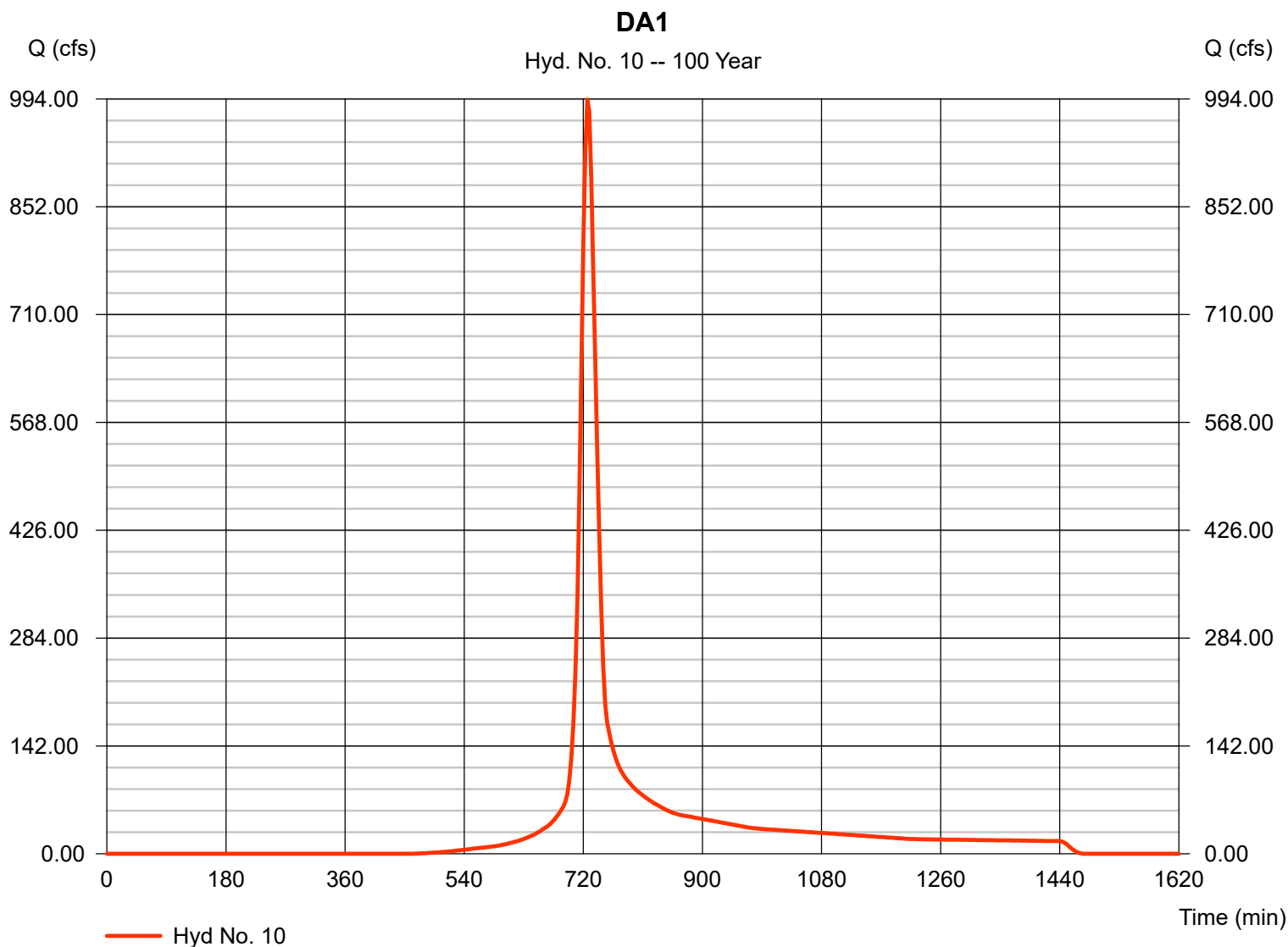
Wednesday, Jan 16, 2019

Hyd. No. 10

DA1

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 222.600 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 993.25 cfs
Time to peak = 726 min
Hyd. volume = 3,490,007 cuft
Curve number = 69.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 21.16 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

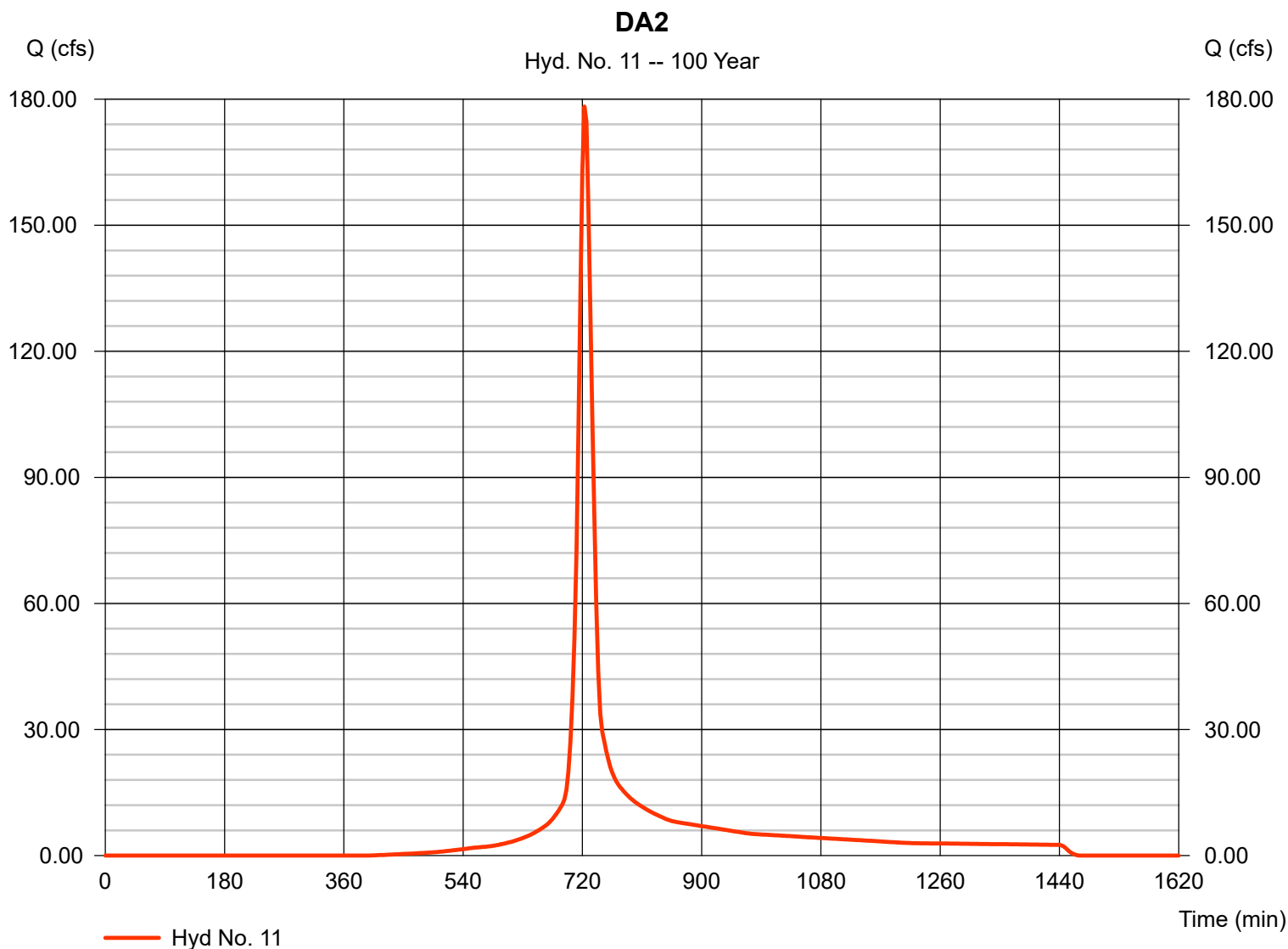
Wednesday, Jan 16, 2019

Hyd. No. 11

DA2

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 30.870 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 178.25 cfs
Time to peak = 723 min
Hyd. volume = 569,210 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 16.17 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

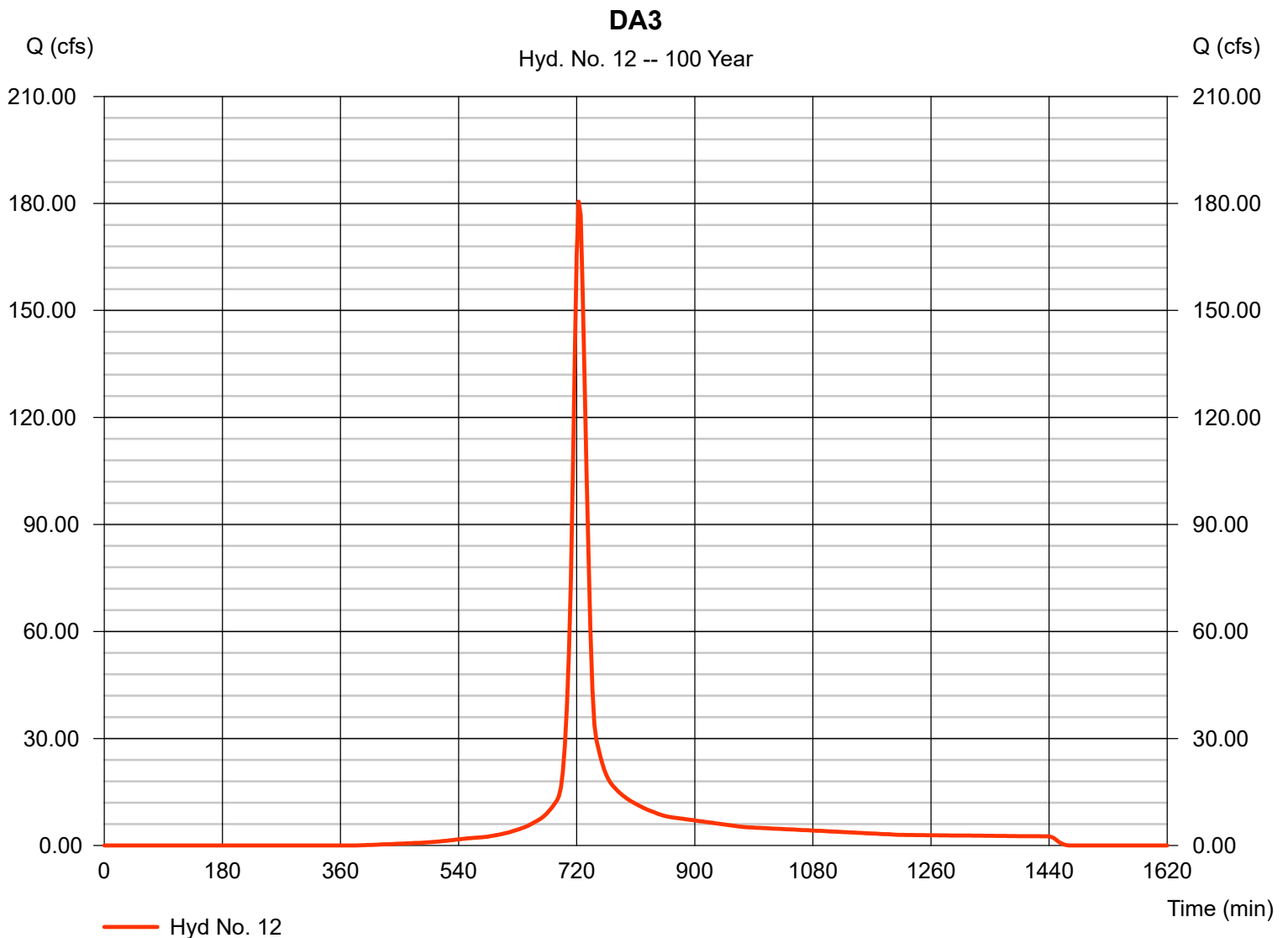
Wednesday, Jan 16, 2019

Hyd. No. 12

DA3

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 3 min
Drainage area = 30.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 8.00 in
Storm duration = 24 hrs

Peak discharge = 180.52 cfs
Time to peak = 723 min
Hyd. volume = 576,953 cuft
Curve number = 75
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.95 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

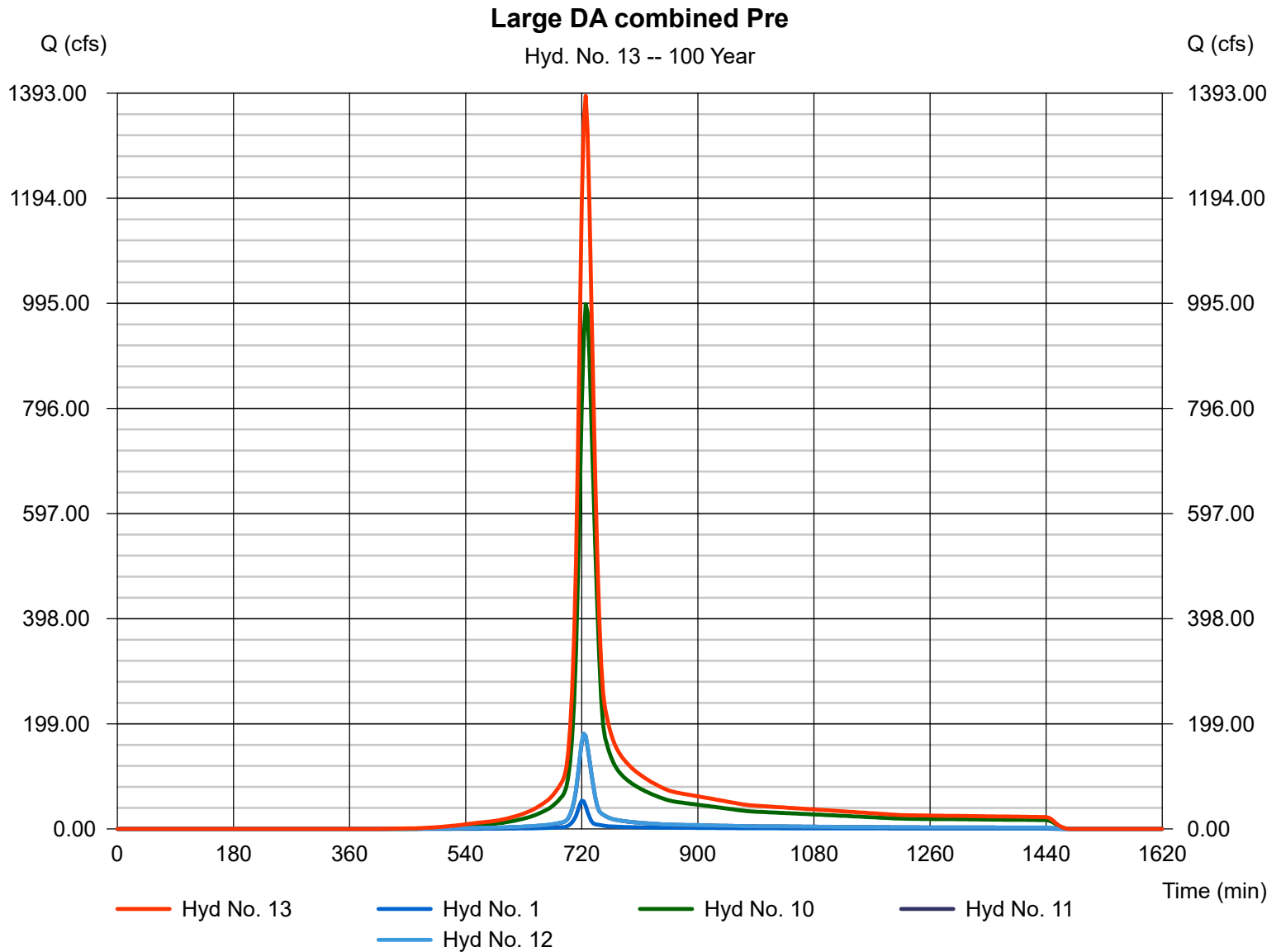
Wednesday, Jan 16, 2019

Hyd. No. 13

Large DA combined Pre

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 3 min
Inflow hyds. = 1, 10, 11, 12

Peak discharge = 1387.88 cfs
Time to peak = 726 min
Hyd. volume = 4,781,543 cuft
Contrib. drain. area = 292.830 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

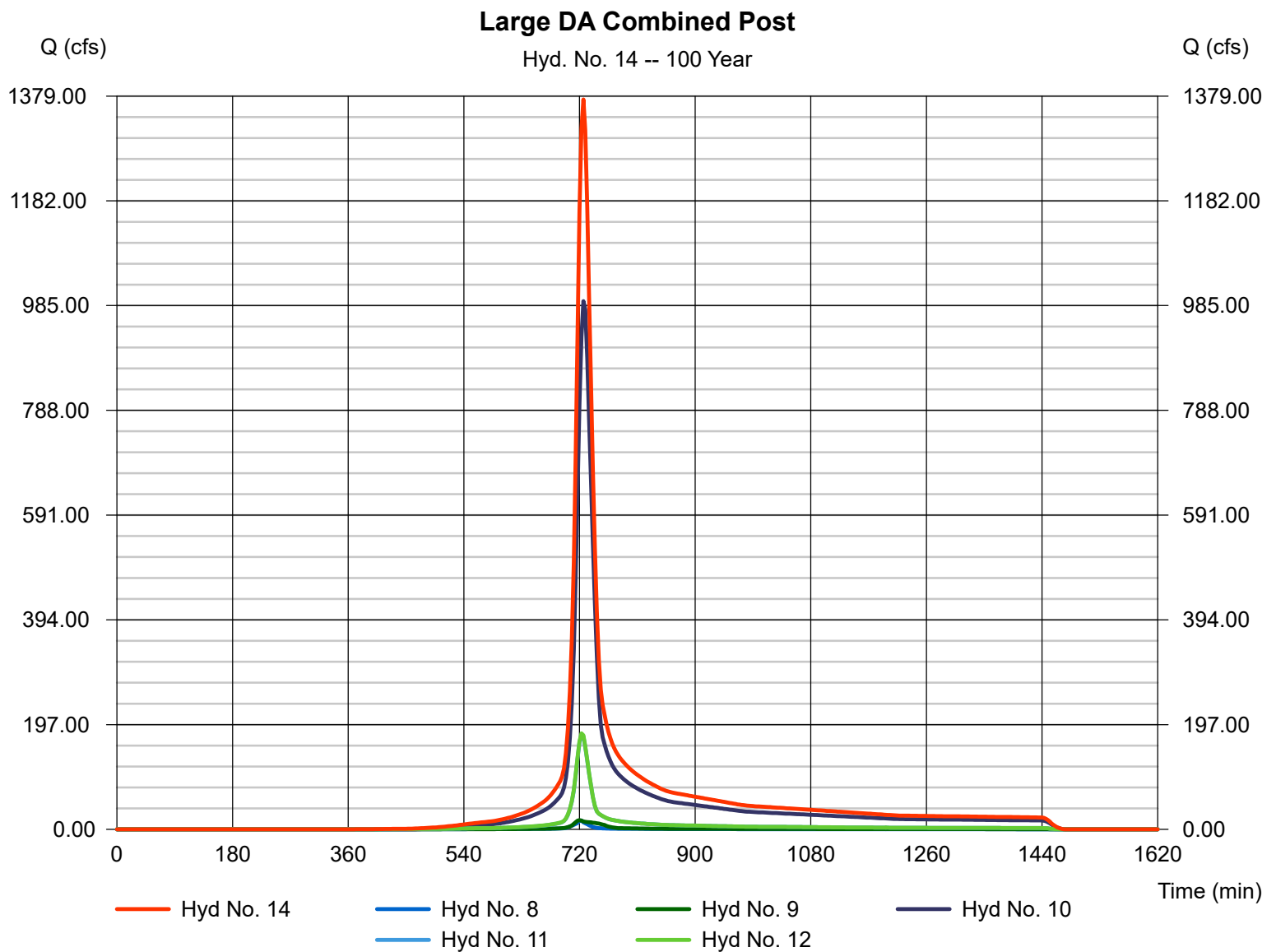
Wednesday, Jan 16, 2019

Hyd. No. 14

Large DA Combined Post

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 3 min
Inflow hyds. = 8, 9, 10, 11, 12

Peak discharge = 1372.66 cfs
Time to peak = 726 min
Hyd. volume = 4,774,282 cuft
Contrib. drain. area = 284.040 ac

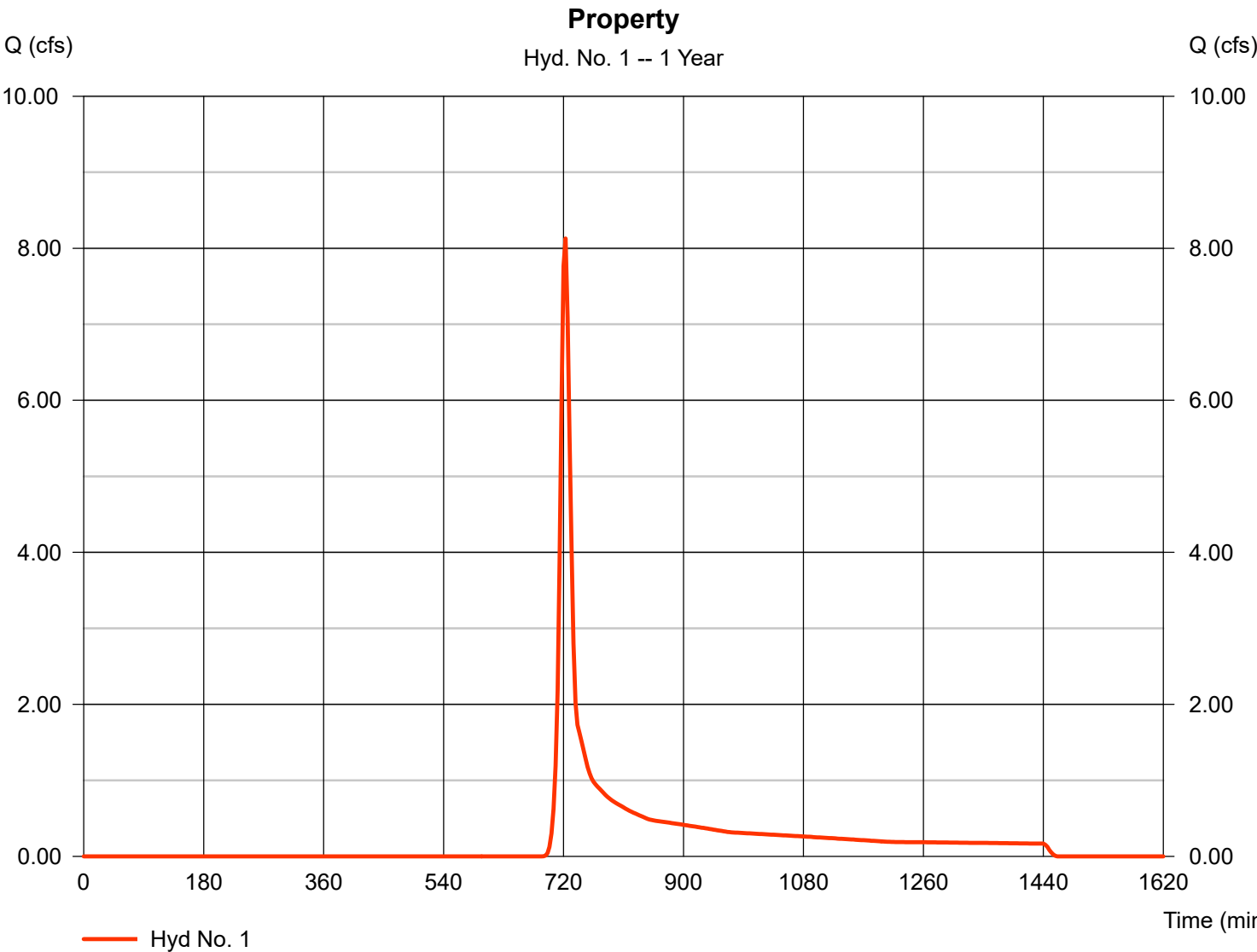


Hydrograph Report

Hyd. No. 1

Property

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.127 cfs
Storm frequency	=	1 yrs	Time to peak	=	723 min
Time interval	=	3 min	Hyd. volume	=	23,964 cuft
Drainage area	=	8.790 ac	Curve number	=	70.8
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	12.60 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

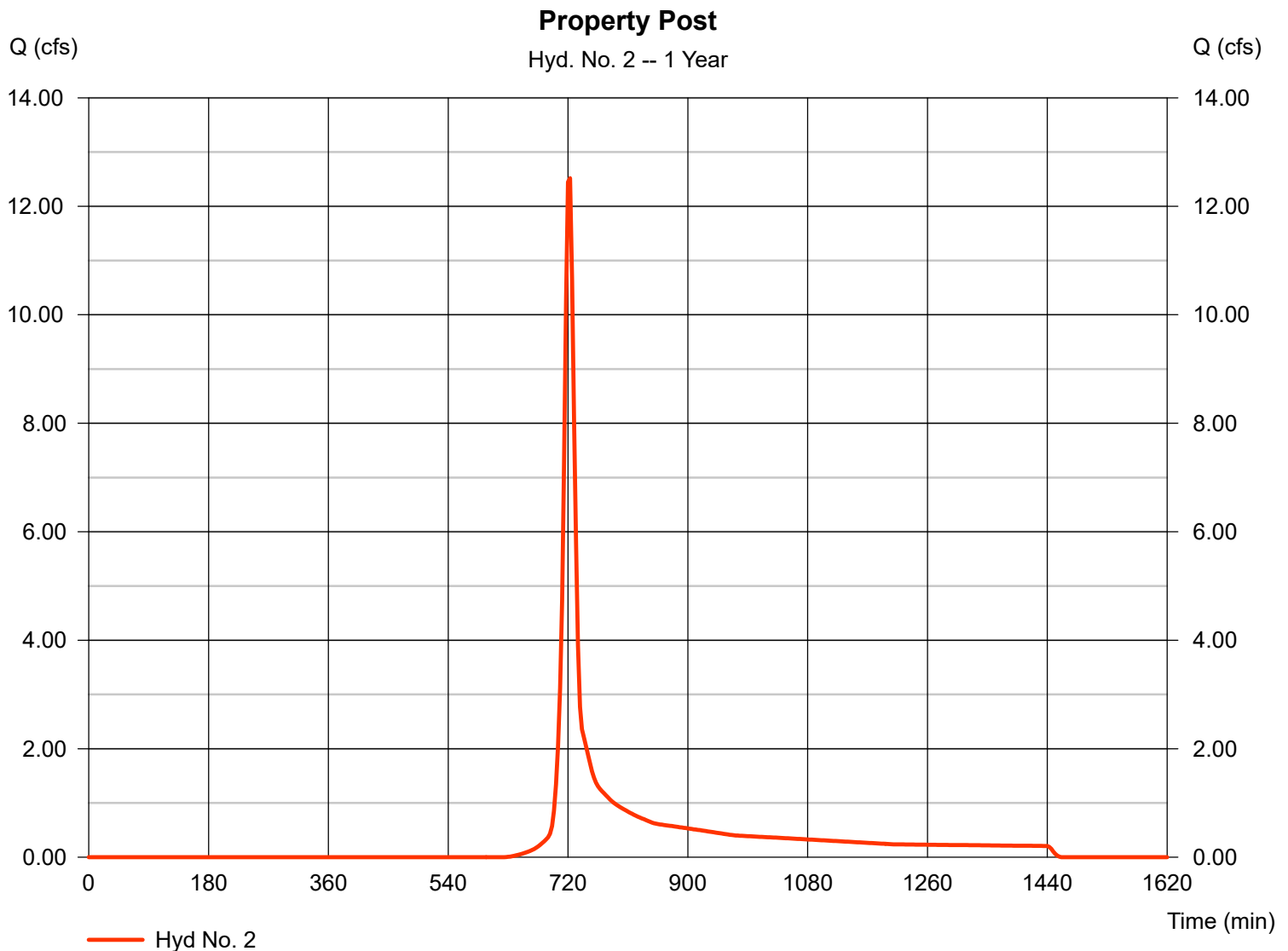
Wednesday, Jan 16, 2019

Hyd. No. 2

Property Post

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 12.52 cfs
Time to peak = 723 min
Hyd. volume = 34,905 cuft
Curve number = 77.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

Hyd. No. 3

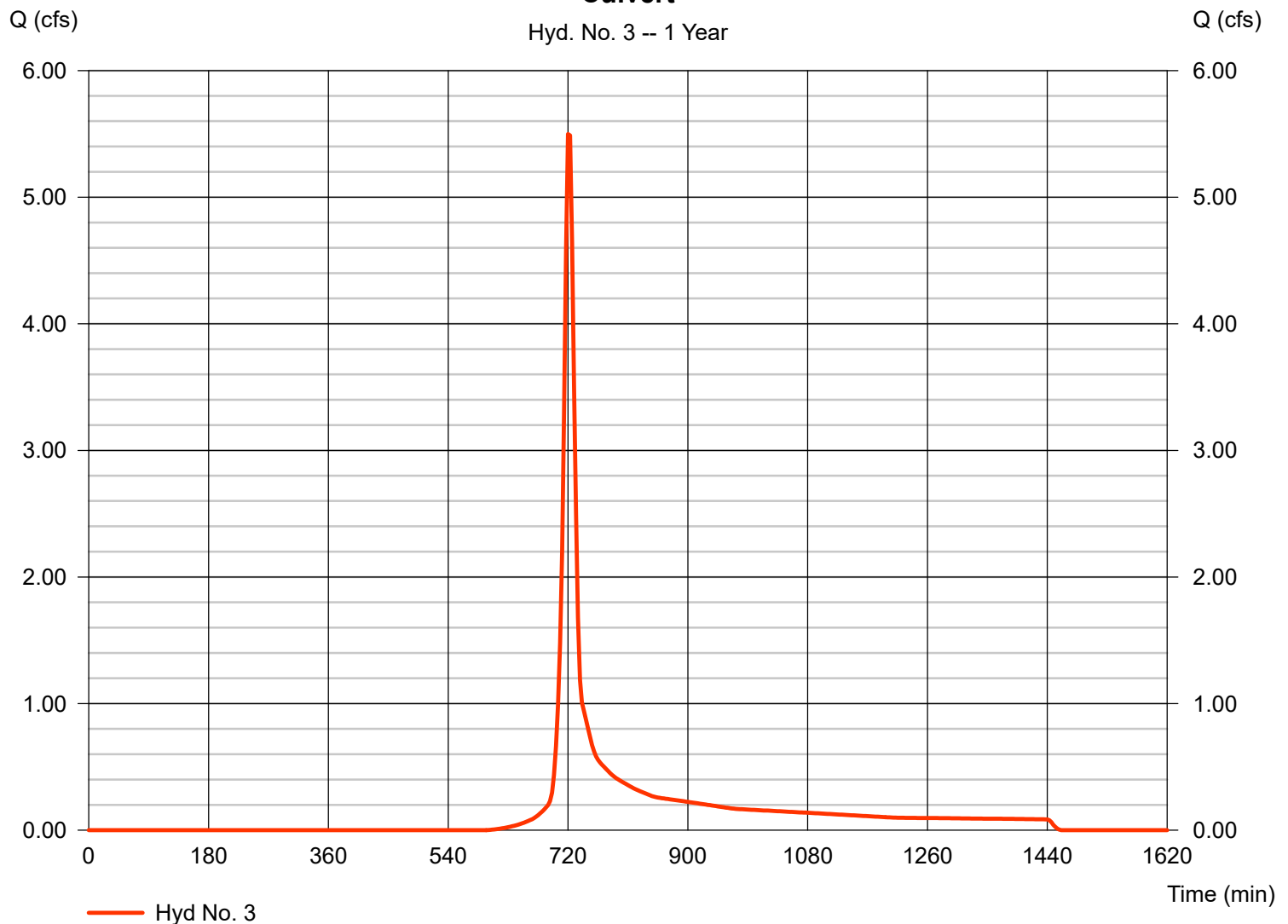
Culvert

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 3.490 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 5.498 cfs
Time to peak = 720 min
Hyd. volume = 15,210 cuft
Curve number = 79.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.80 min
Distribution = Type II
Shape factor = 484

Culvert

Hyd. No. 3 -- 1 Year



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

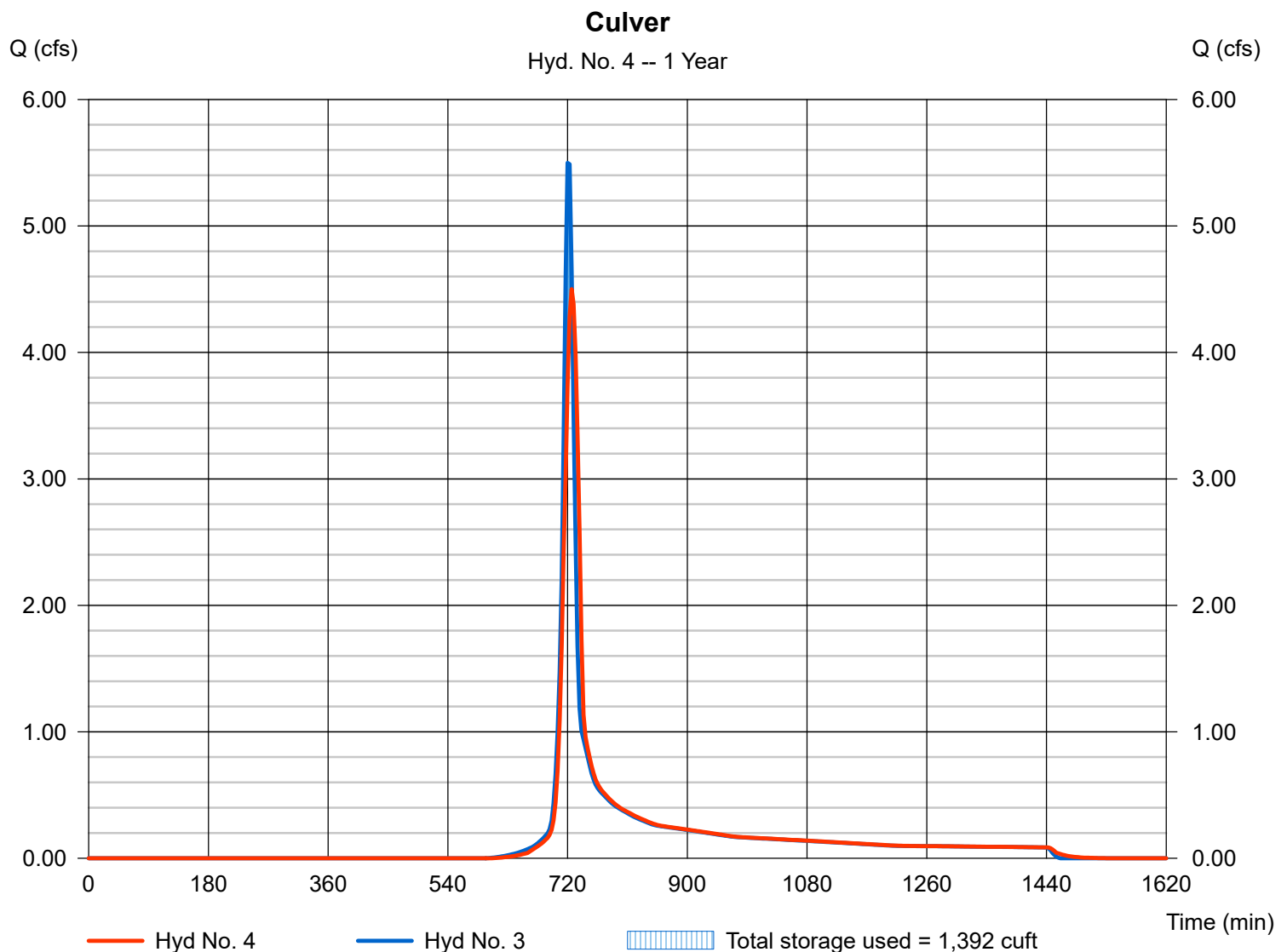
Hyd. No. 4

Culver

Hydrograph type = Reservoir
Storm frequency = 1 yrs
Time interval = 3 min
Inflow hyd. No. = 3 - Culvert
Reservoir name = Culvert

Peak discharge = 4.500 cfs
Time to peak = 726 min
Hyd. volume = 15,209 cuft
Max. Elevation = 497.02 ft
Max. Storage = 1,392 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

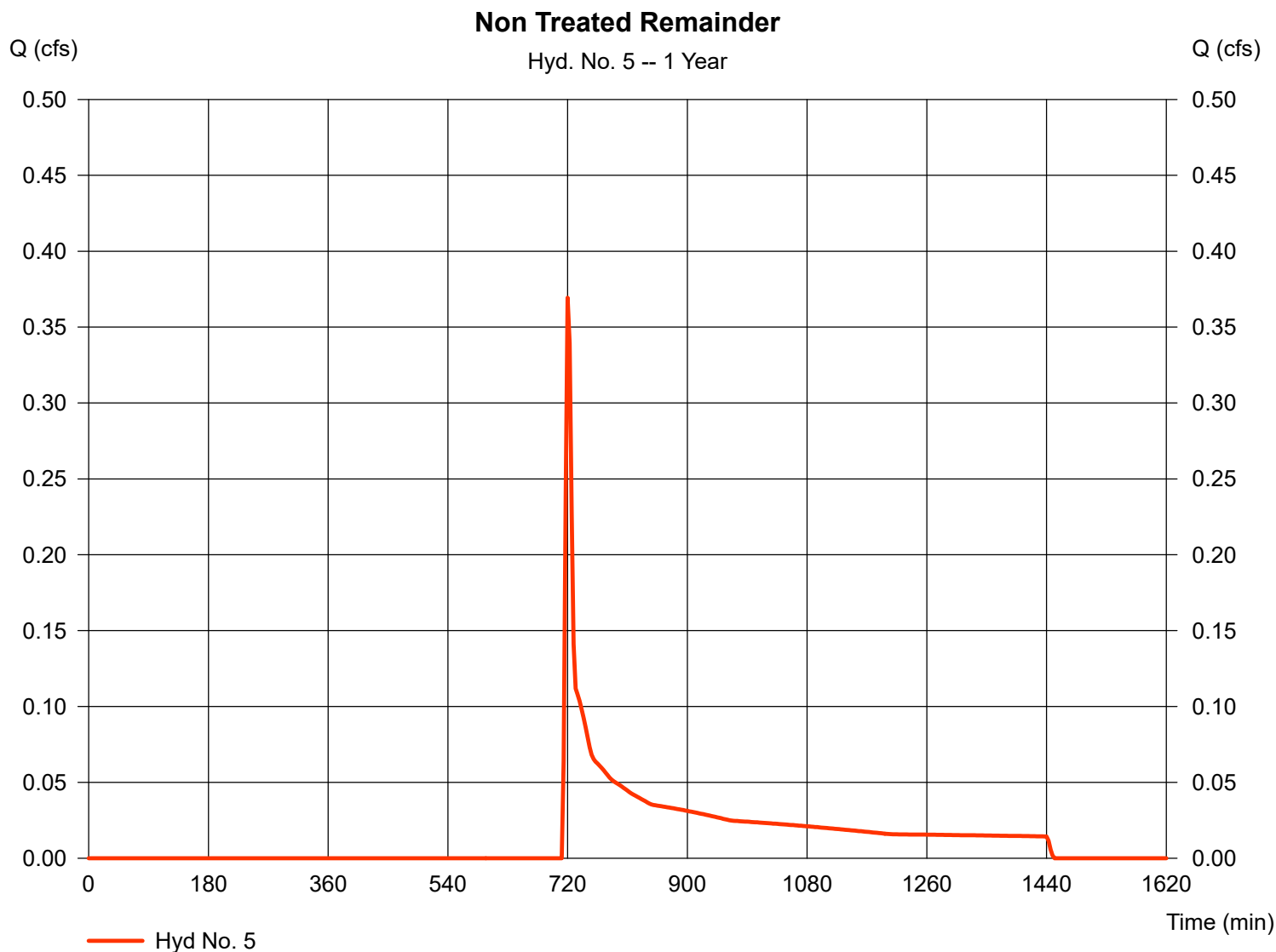
Wednesday, Jan 16, 2019

Hyd. No. 5

Non Treated Remainder

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 1.350 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 0.369 cfs
Time to peak = 720 min
Hyd. volume = 1,387 cuft
Curve number = 59
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

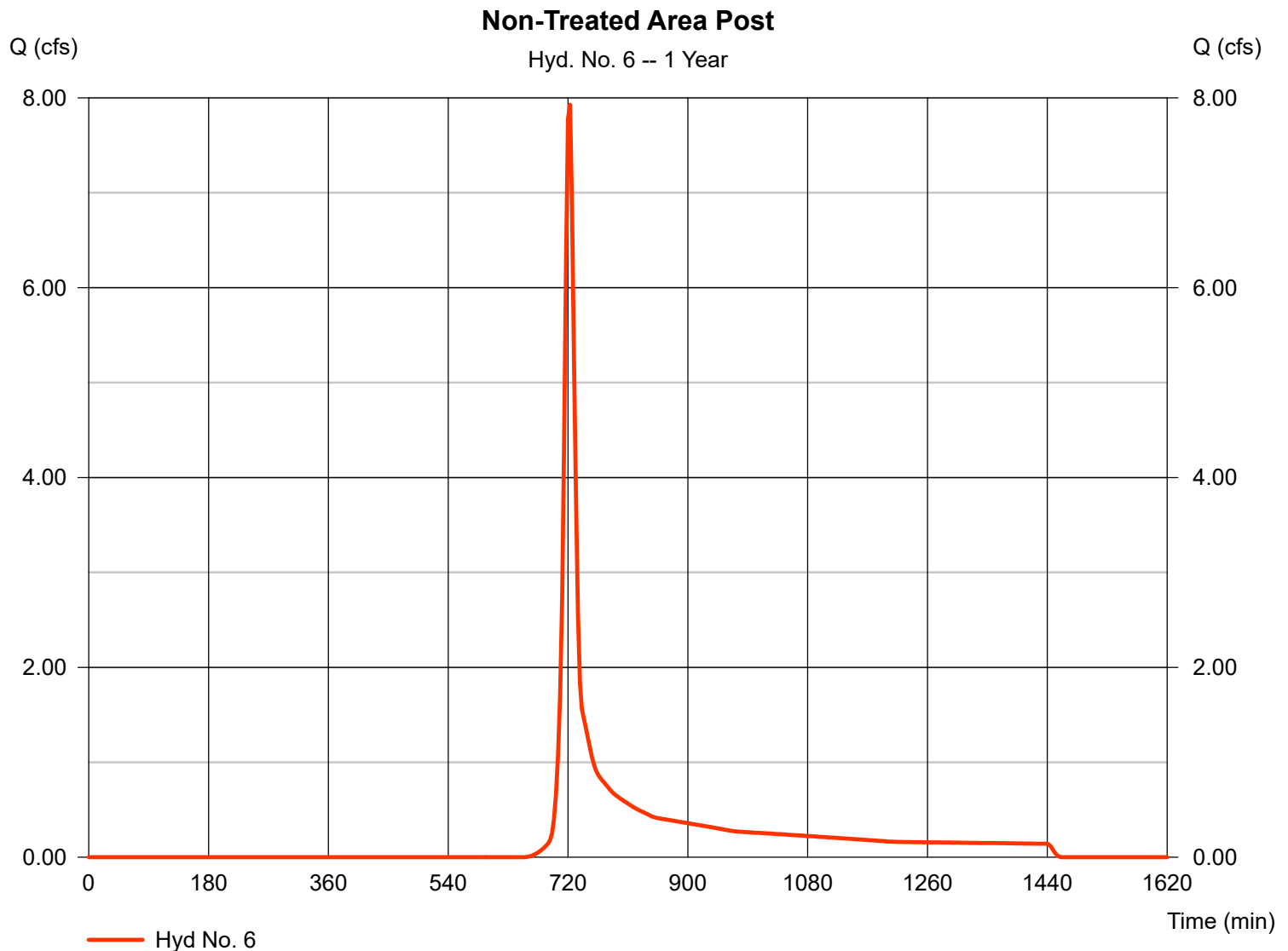
Wednesday, Jan 16, 2019

Hyd. No. 6

Non-Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 6.500 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 7.927 cfs
Time to peak = 723 min
Hyd. volume = 22,419 cuft
Curve number = 74.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

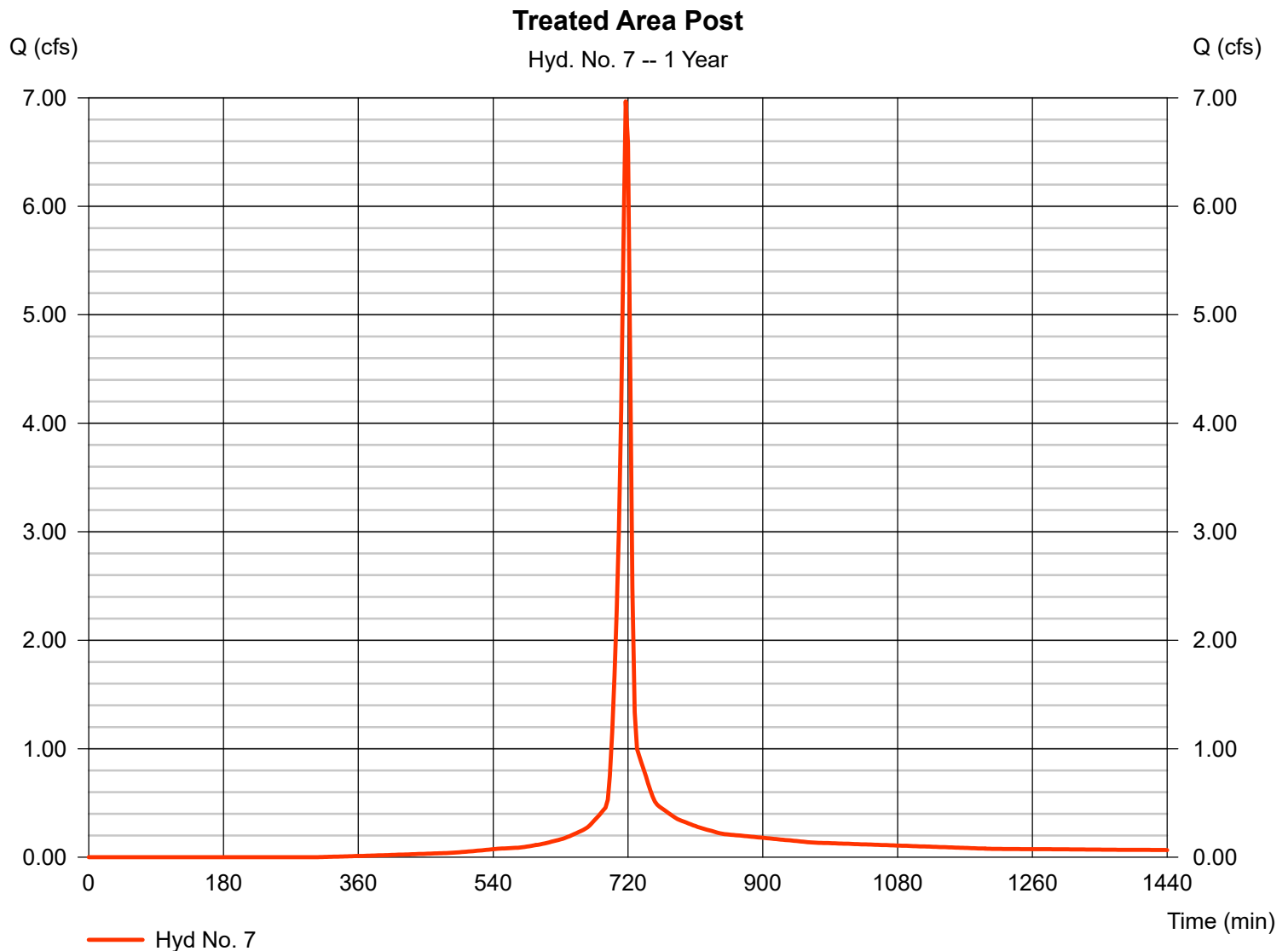
Wednesday, Jan 16, 2019

Hyd. No. 7

Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 2.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 6.968 cfs
Time to peak = 717 min
Hyd. volume = 16,129 cuft
Curve number = 91.5
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

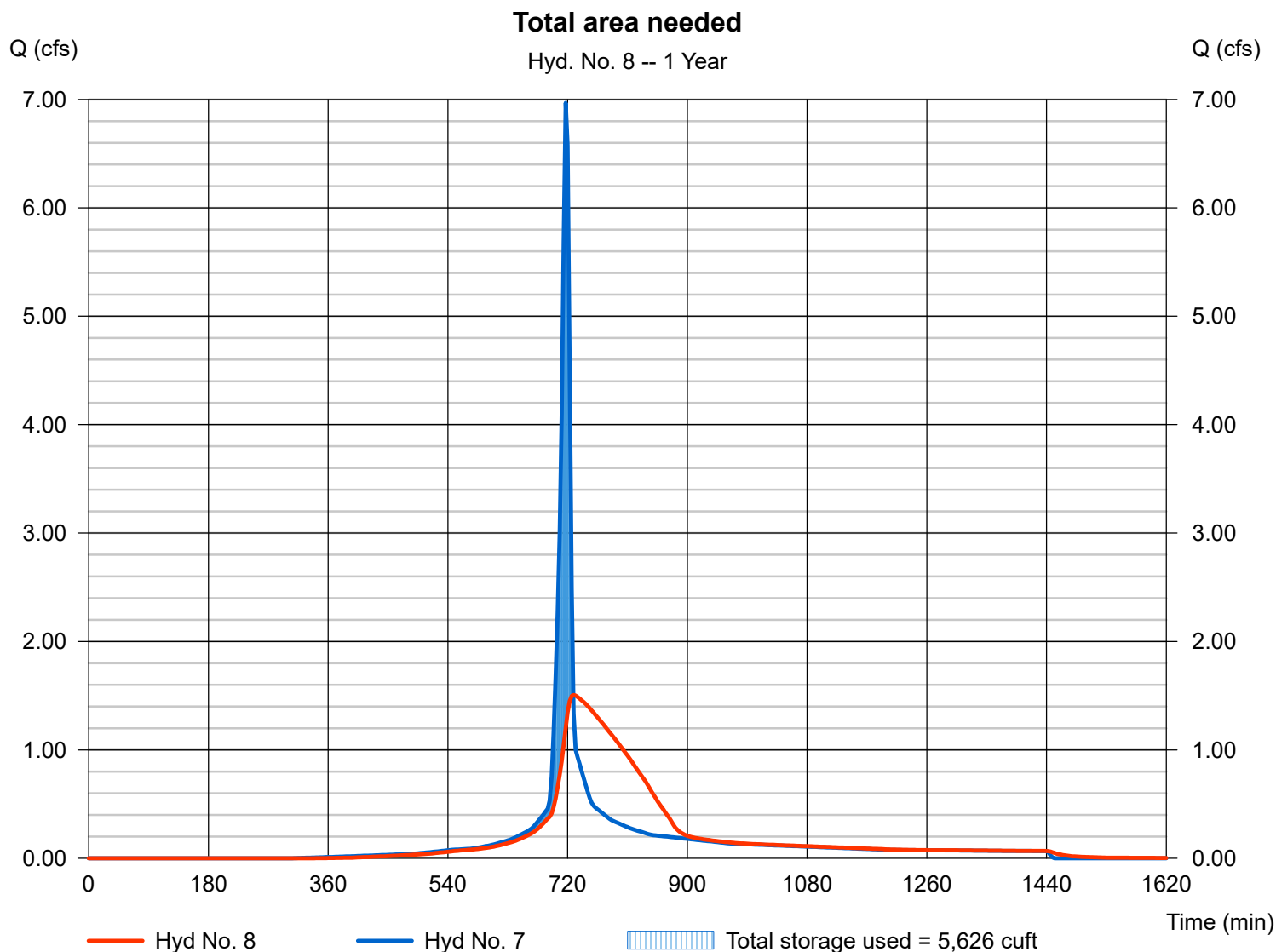
Hyd. No. 8

Total area needed

Hydrograph type = Reservoir
Storm frequency = 1 yrs
Time interval = 3 min
Inflow hyd. No. = 7 - Treated Area Post
Reservoir name = Pipe

Peak discharge = 1.508 cfs
Time to peak = 729 min
Hyd. volume = 16,121 cuft
Max. Elevation = 491.80 ft
Max. Storage = 5,626 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

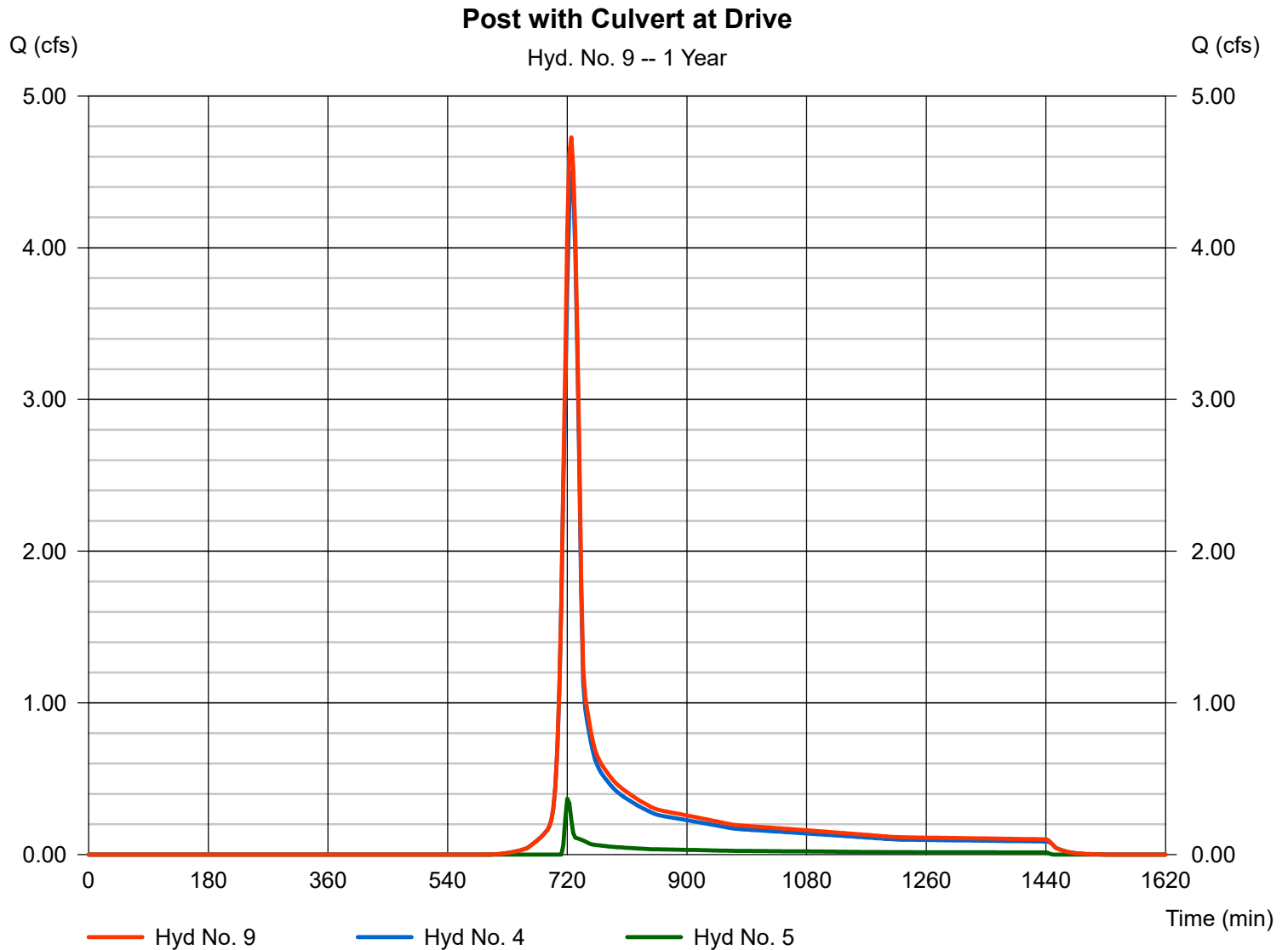
Wednesday, Jan 16, 2019

Hyd. No. 9

Post with Culvert at Drive

Hydrograph type = Combine
Storm frequency = 1 yrs
Time interval = 3 min
Inflow hyds. = 4, 5

Peak discharge = 4.727 cfs
Time to peak = 726 min
Hyd. volume = 16,596 cuft
Contrib. drain. area = 1.350 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

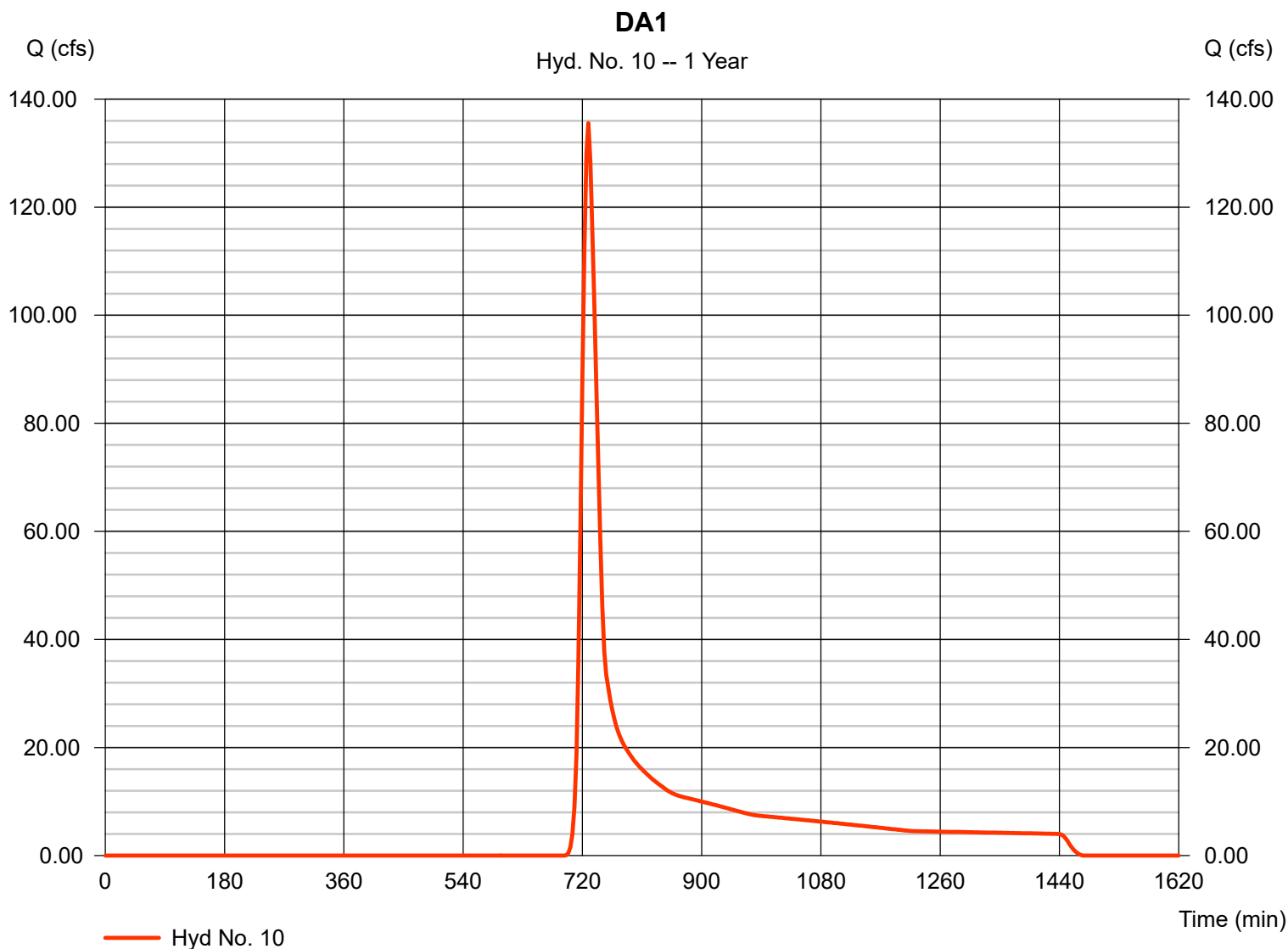
Wednesday, Jan 16, 2019

Hyd. No. 10

DA1

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 222.600 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 135.55 cfs
Time to peak = 729 min
Hyd. volume = 552,068 cuft
Curve number = 69.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 21.16 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

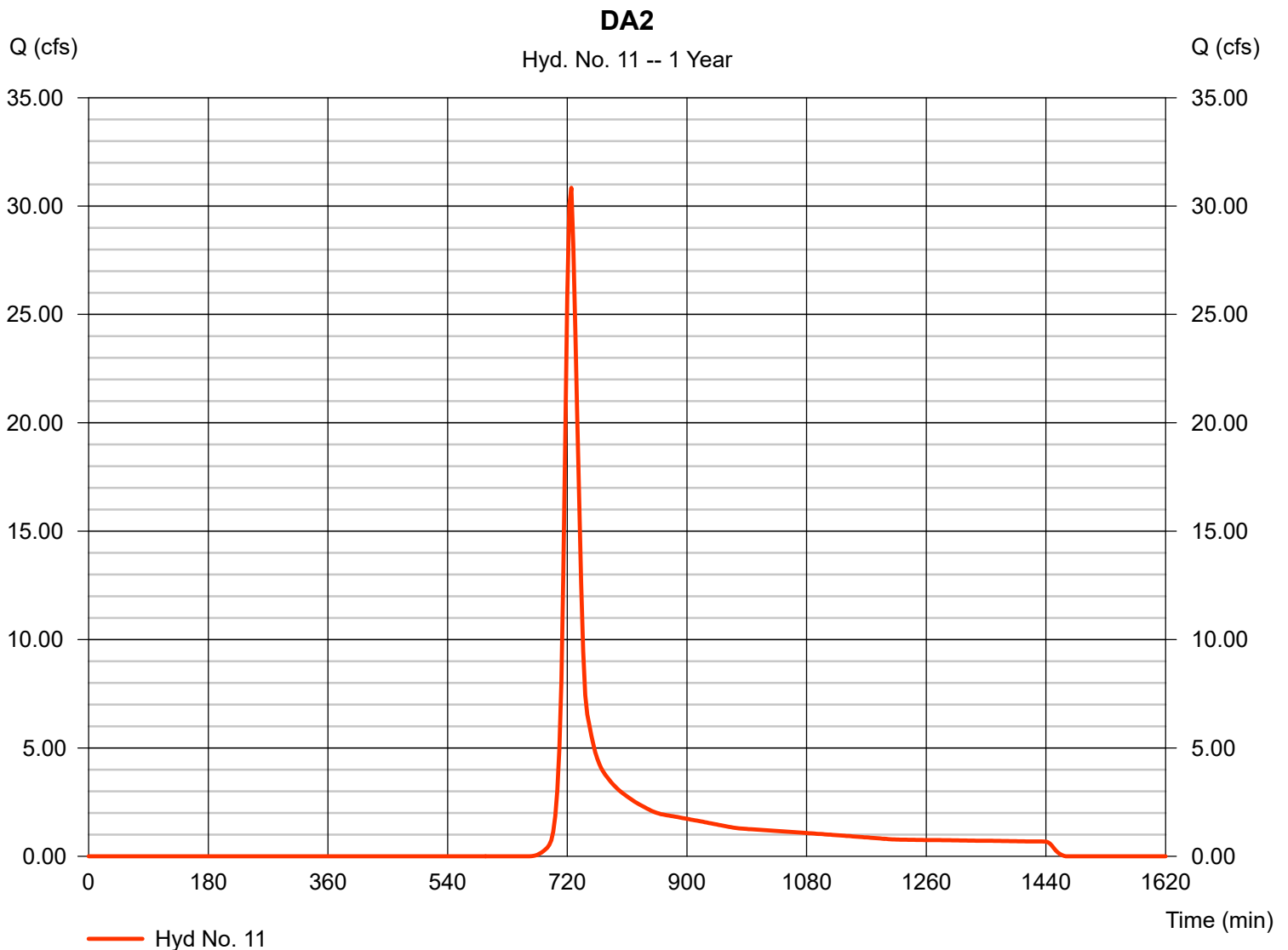
Wednesday, Jan 16, 2019

Hyd. No. 11

DA2

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 30.870 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 30.84 cfs
Time to peak = 726 min
Hyd. volume = 104,955 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 16.17 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

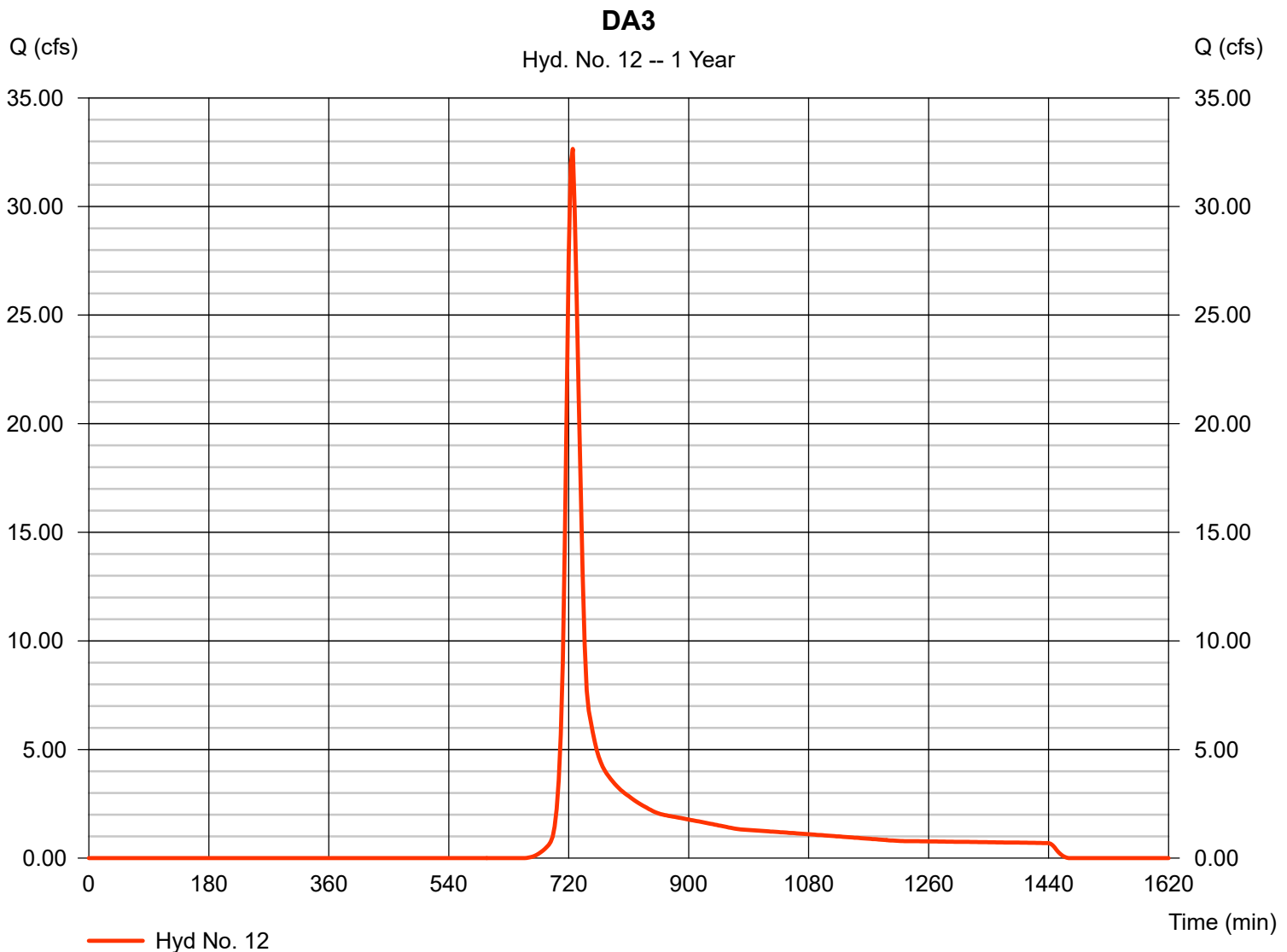
Wednesday, Jan 16, 2019

Hyd. No. 12

DA3

Hydrograph type = SCS Runoff
Storm frequency = 1 yrs
Time interval = 3 min
Drainage area = 30.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 32.65 cfs
Time to peak = 726 min
Hyd. volume = 109,949 cuft
Curve number = 75
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.95 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

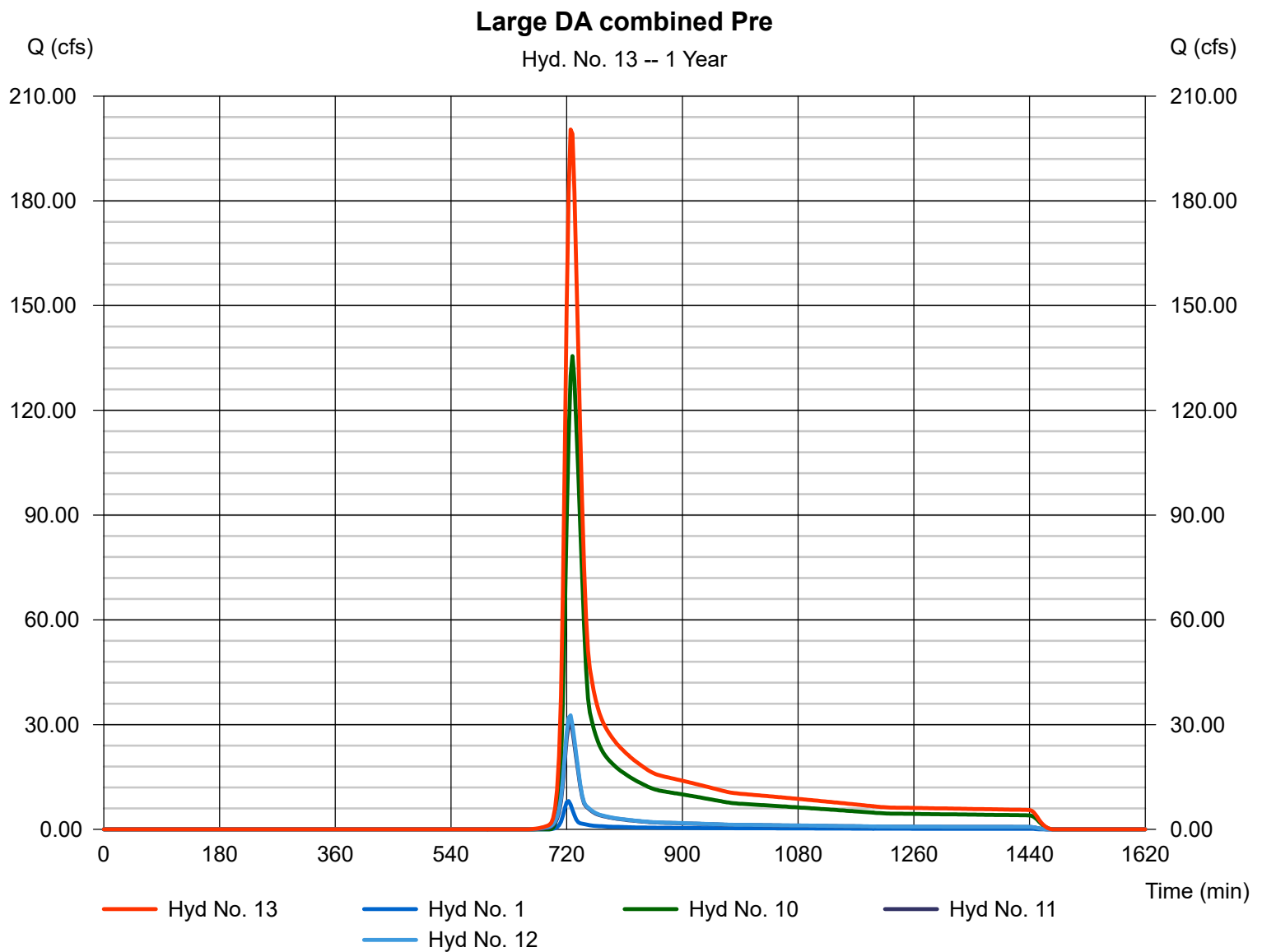
Wednesday, Jan 16, 2019

Hyd. No. 13

Large DA combined Pre

Hydrograph type = Combine
Storm frequency = 1 yrs
Time interval = 3 min
Inflow hyds. = 1, 10, 11, 12

Peak discharge = 200.43 cfs
Time to peak = 726 min
Hyd. volume = 790,937 cuft
Contrib. drain. area = 292.830 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

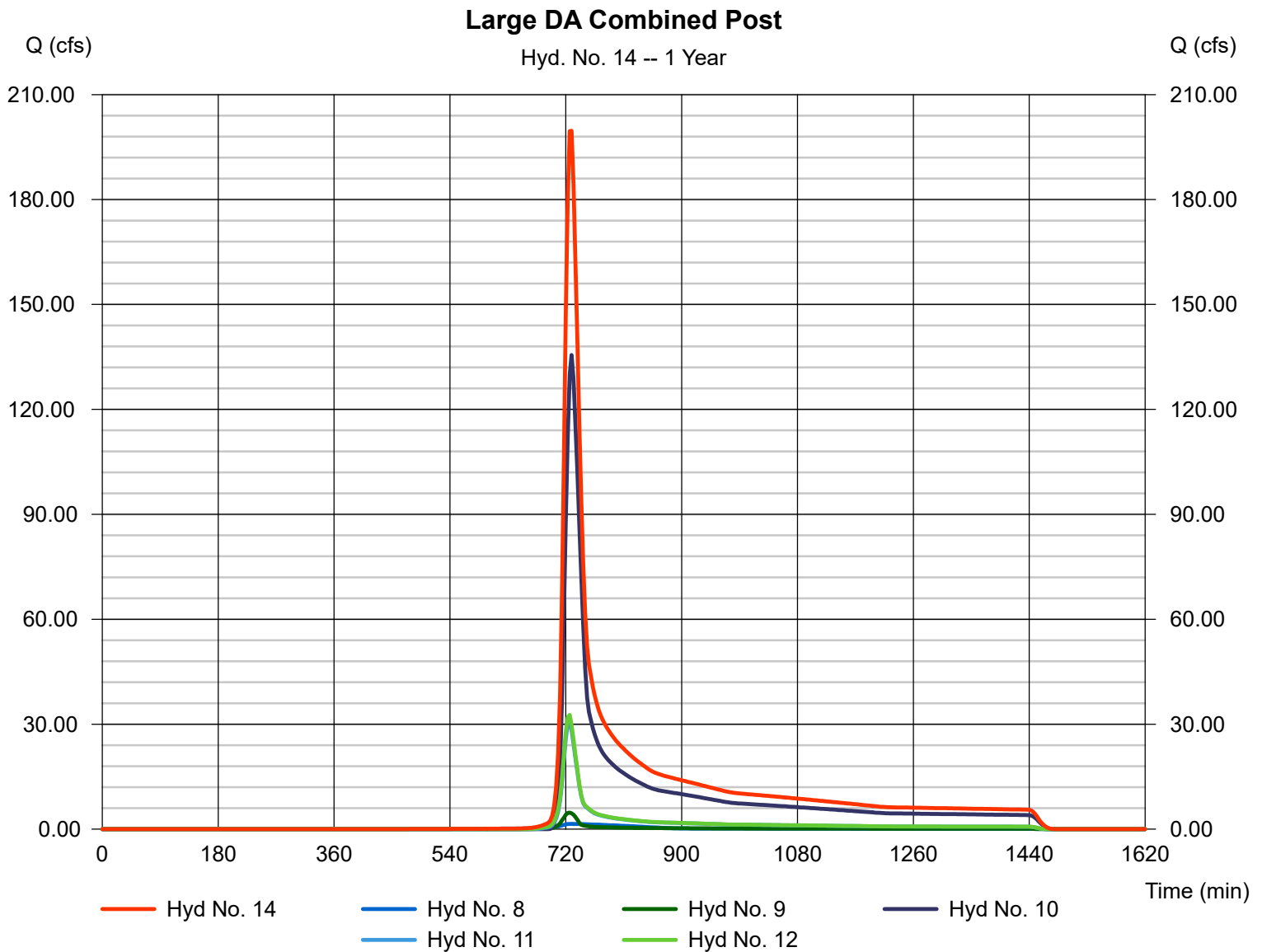
Wednesday, Jan 16, 2019

Hyd. No. 14

Large DA Combined Post

Hydrograph type = Combine
Storm frequency = 1 yrs
Time interval = 3 min
Inflow hyds. = 8, 9, 10, 11, 12

Peak discharge = 199.65 cfs
Time to peak = 729 min
Hyd. volume = 799,690 cuft
Contrib. drain. area = 284.040 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

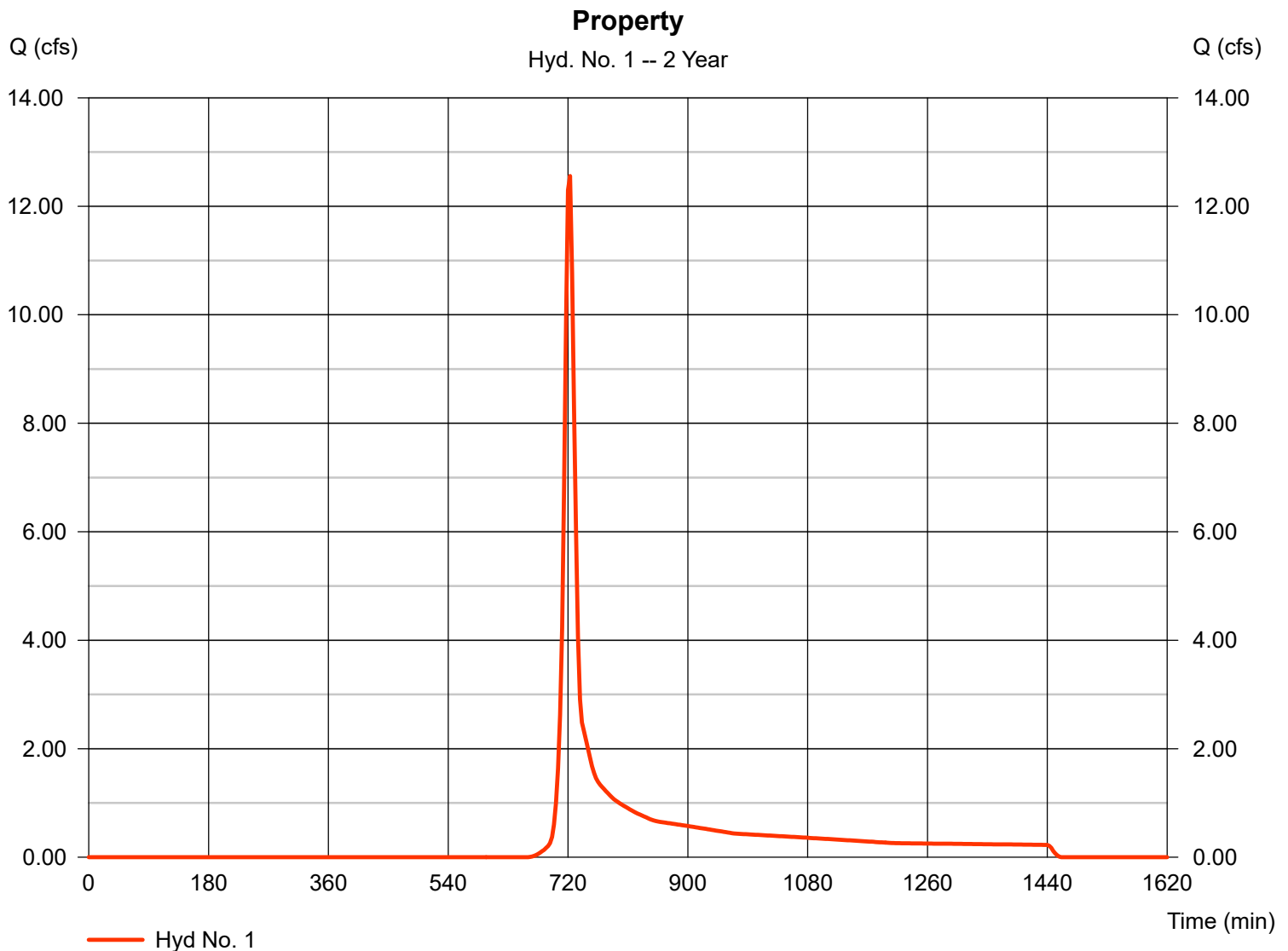
Wednesday, Jan 16, 2019

Hyd. No. 1

Property

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 12.56 cfs
Time to peak = 723 min
Hyd. volume = 35,616 cuft
Curve number = 70.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

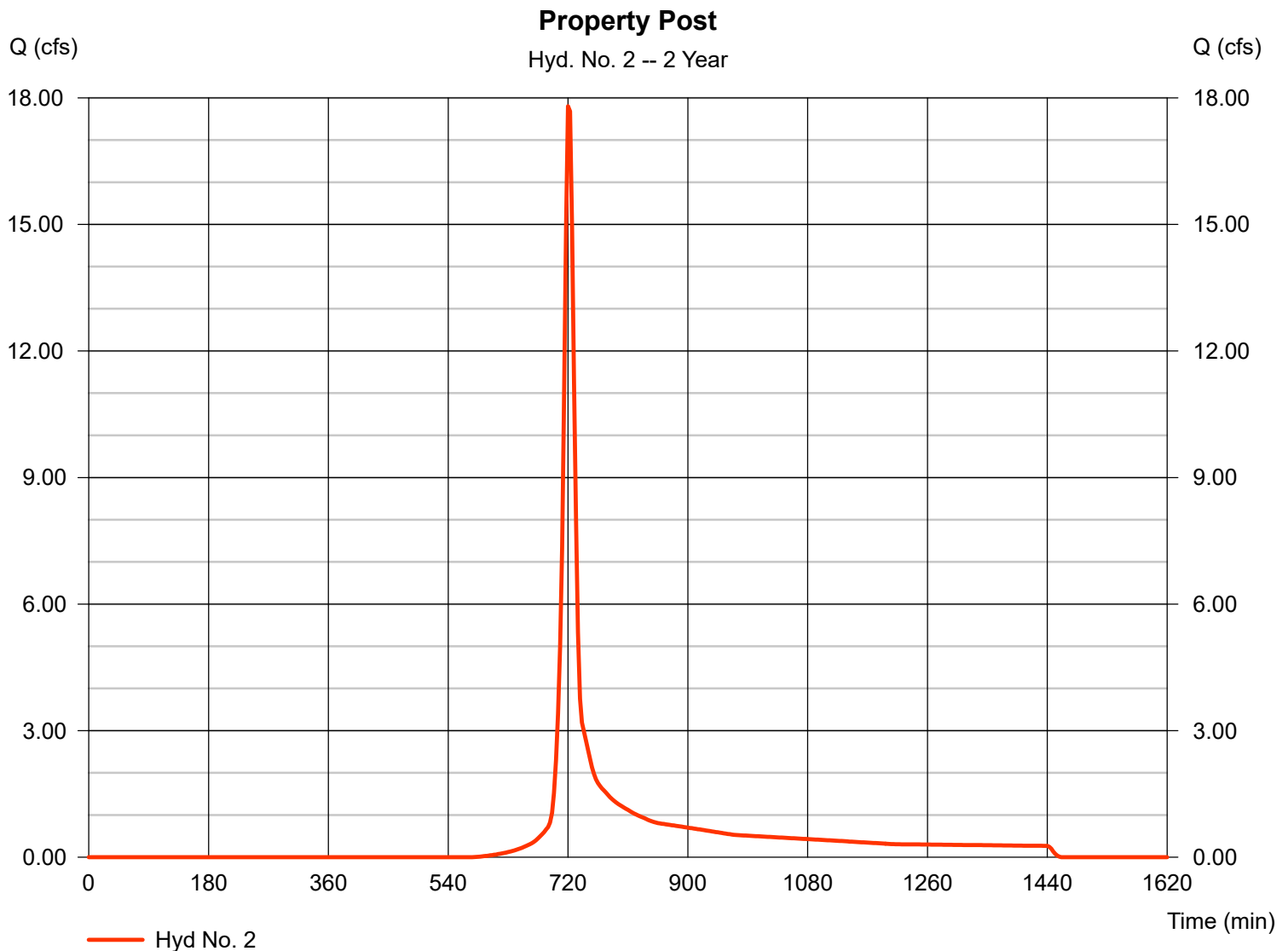
Wednesday, Jan 16, 2019

Hyd. No. 2

Property Post

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 8.790 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 17.80 cfs
Time to peak = 720 min
Hyd. volume = 48,896 cuft
Curve number = 77.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

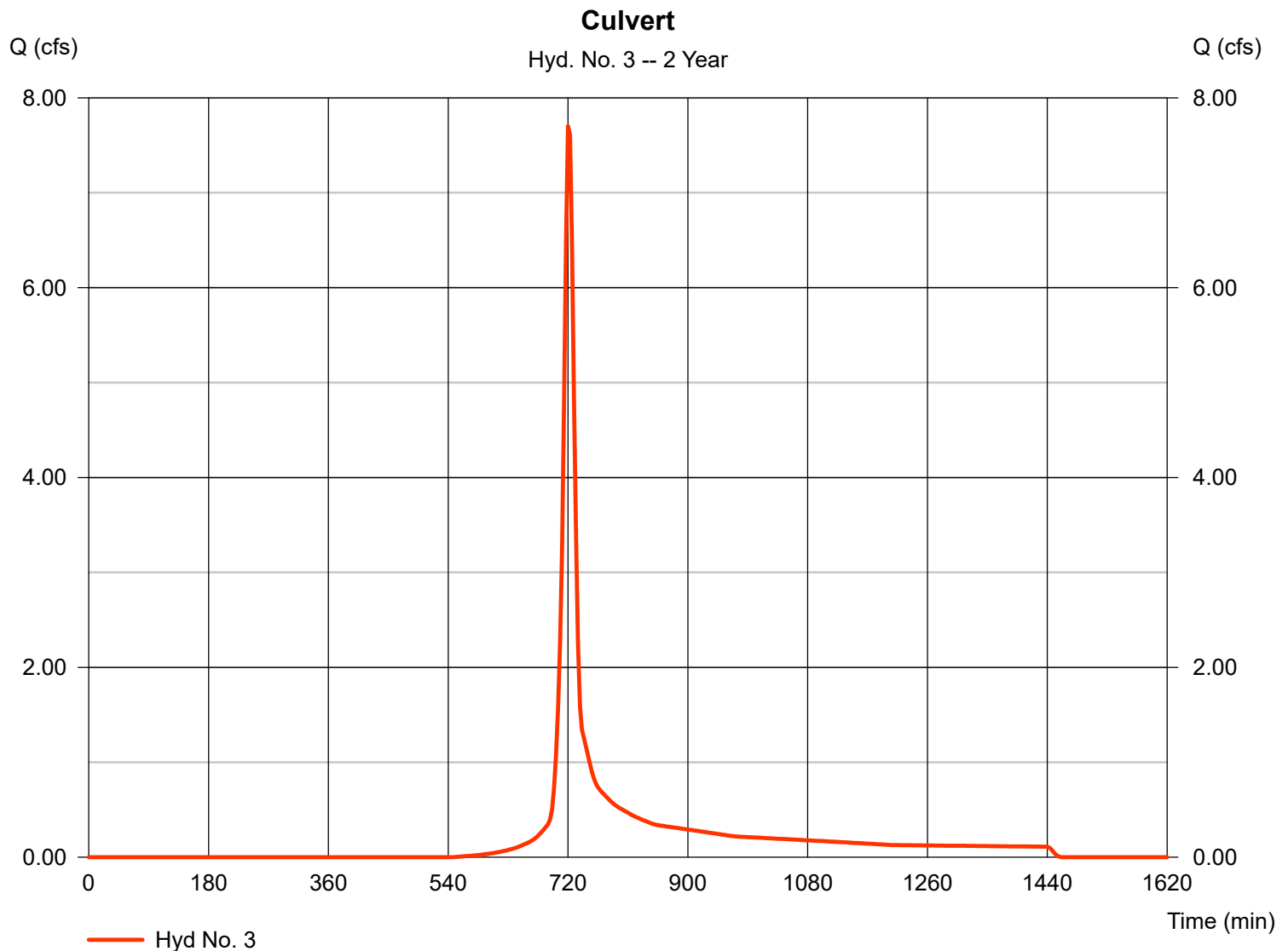
Wednesday, Jan 16, 2019

Hyd. No. 3

Culvert

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 3.490 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 7.702 cfs
Time to peak = 720 min
Hyd. volume = 21,009 cuft
Curve number = 79.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.80 min
Distribution = Type II
Shape factor = 484



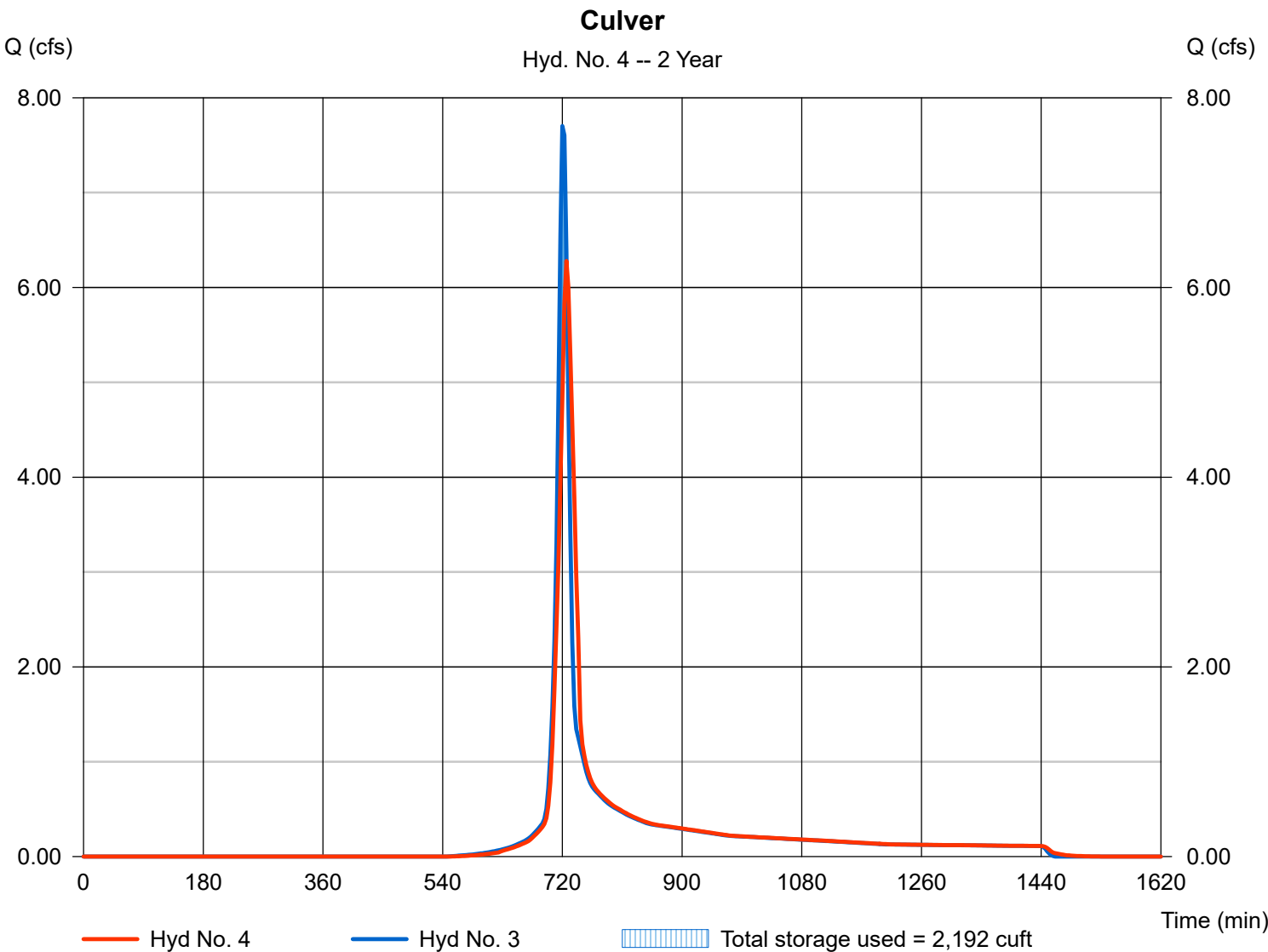
Hydrograph Report

Hyd. No. 4

Culver

Hydrograph type	= Reservoir	Peak discharge	= 6.279 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 21,007 cuft
Inflow hyd. No.	= 3 - Culvert	Max. Elevation	= 497.59 ft
Reservoir name	= Culvert	Max. Storage	= 2,192 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

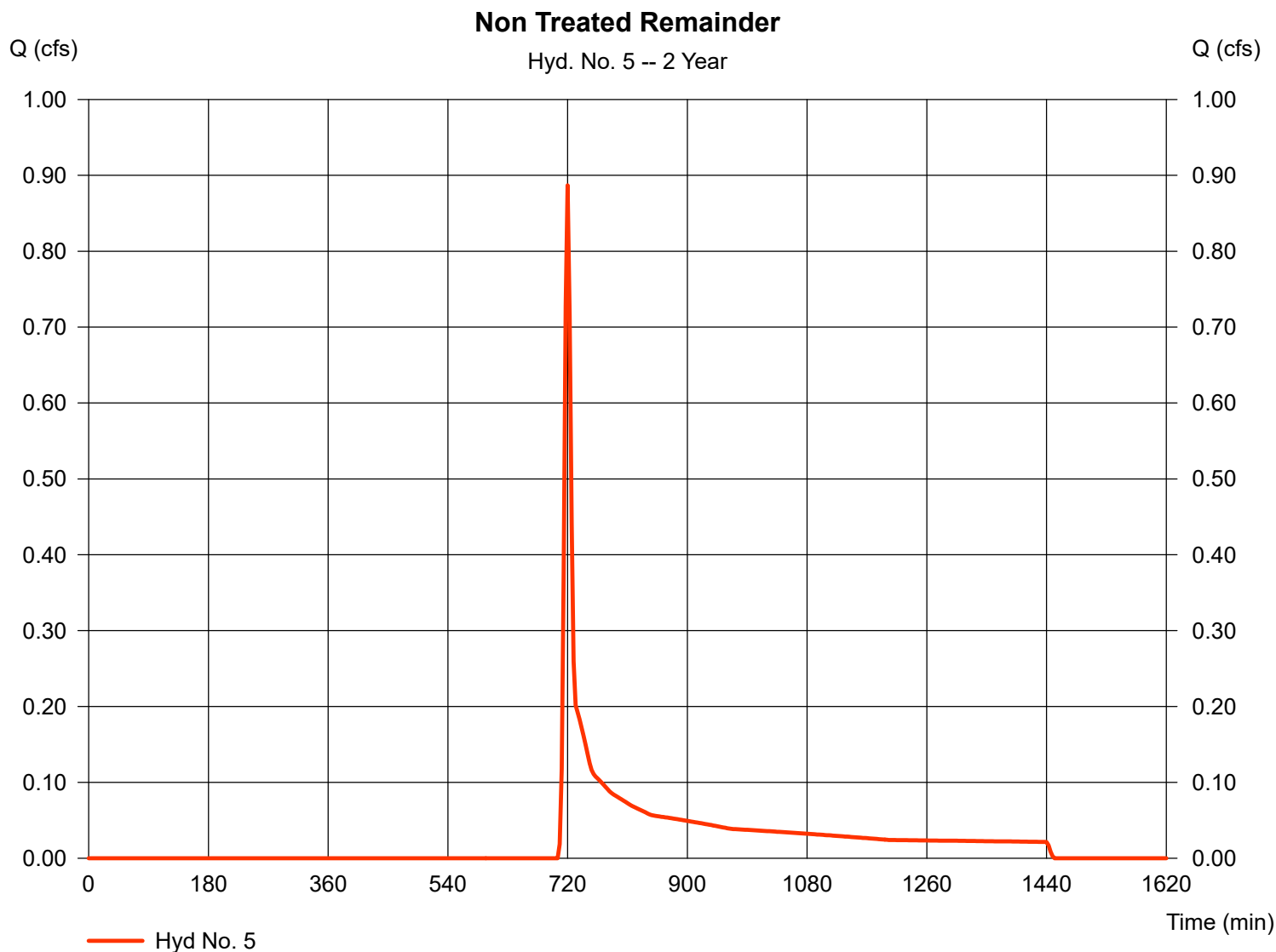
Wednesday, Jan 16, 2019

Hyd. No. 5

Non Treated Remainder

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 1.350 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 0.887 cfs
Time to peak = 720 min
Hyd. volume = 2,450 cuft
Curve number = 59
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

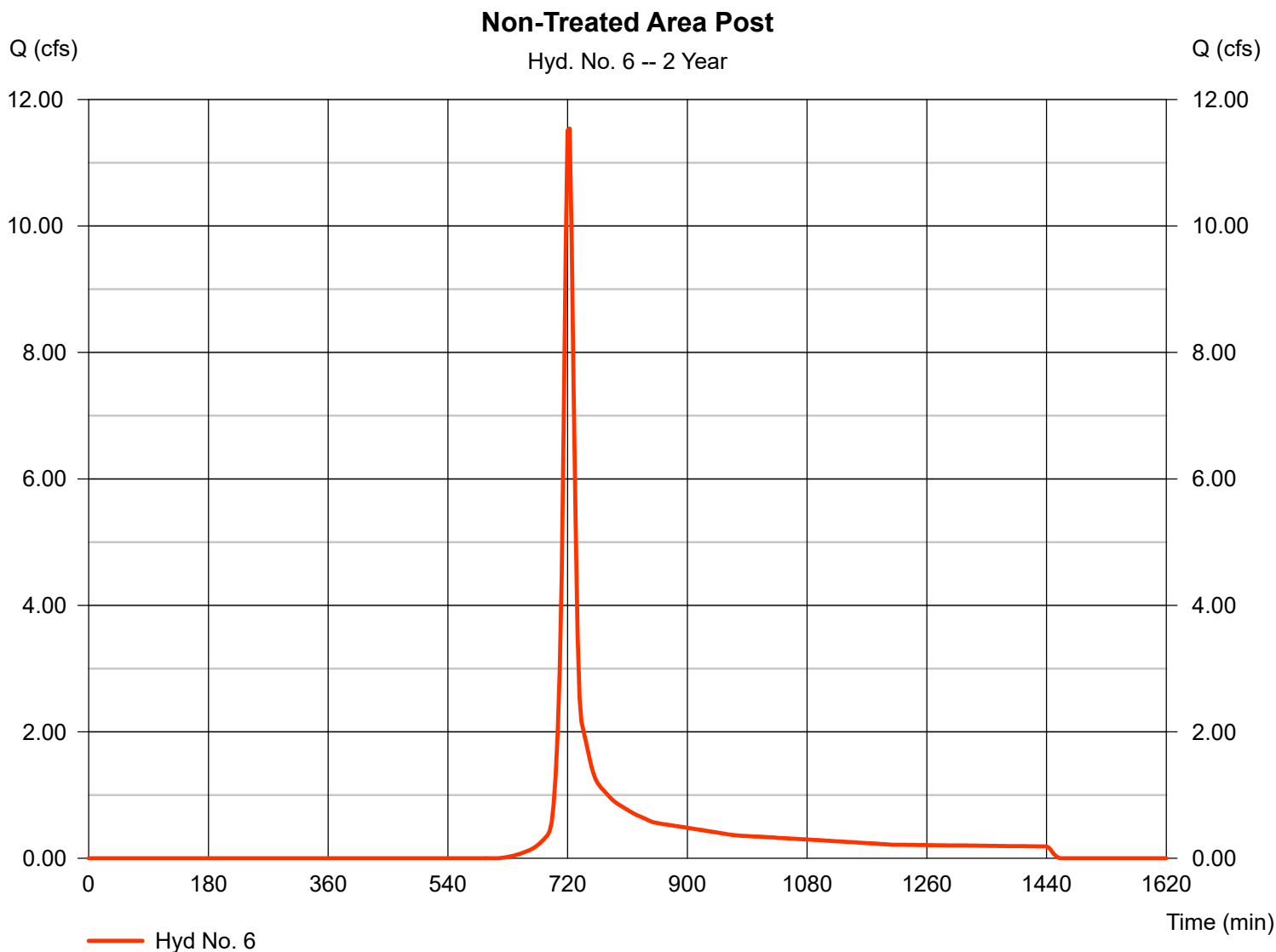
Wednesday, Jan 16, 2019

Hyd. No. 6

Non-Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 6.500 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 11.54 cfs
Time to peak = 723 min
Hyd. volume = 32,094 cuft
Curve number = 74.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

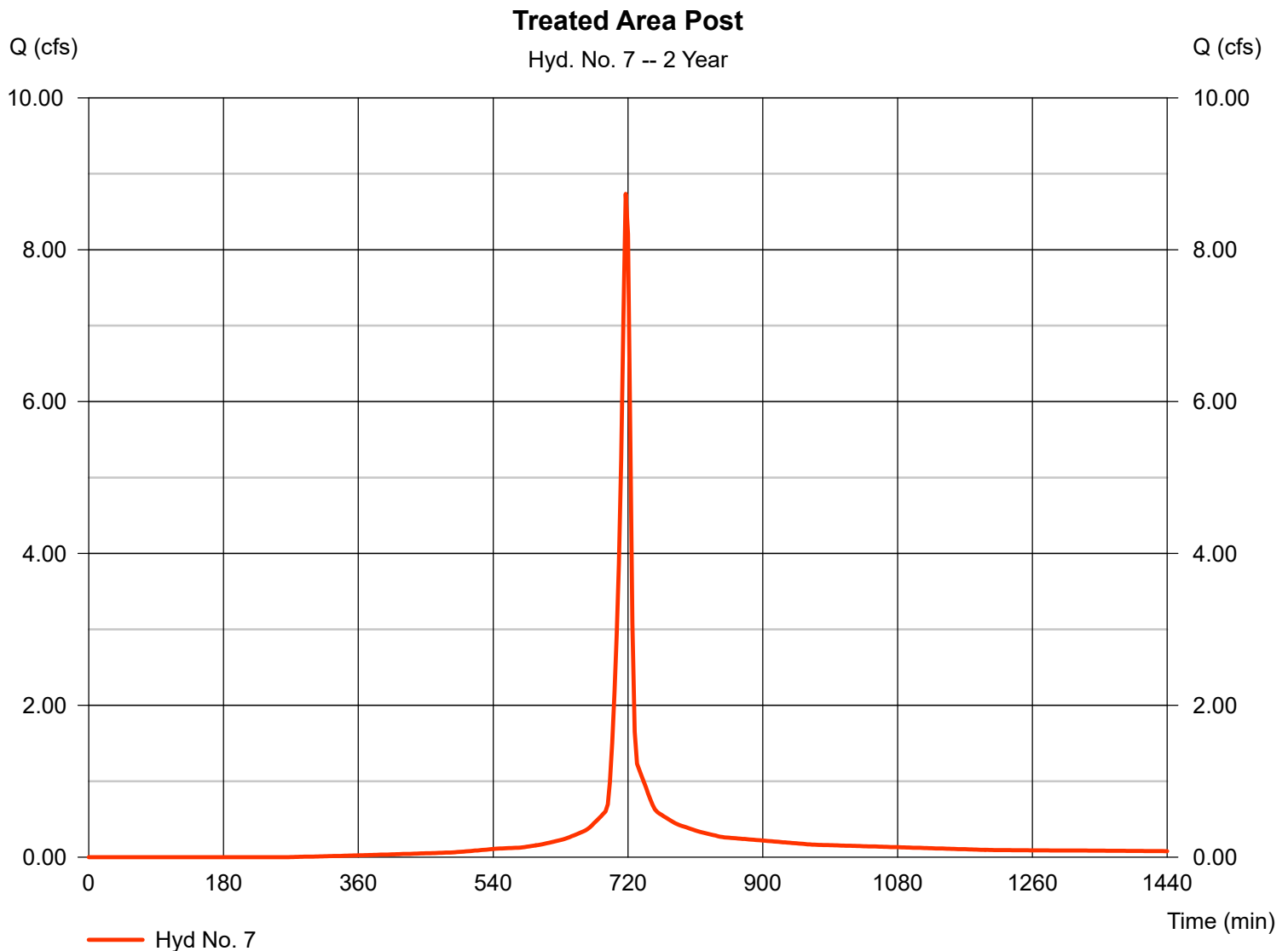
Wednesday, Jan 16, 2019

Hyd. No. 7

Treated Area Post

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 2.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 8.735 cfs
Time to peak = 717 min
Hyd. volume = 20,460 cuft
Curve number = 91.5
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Wednesday, Jan 16, 2019

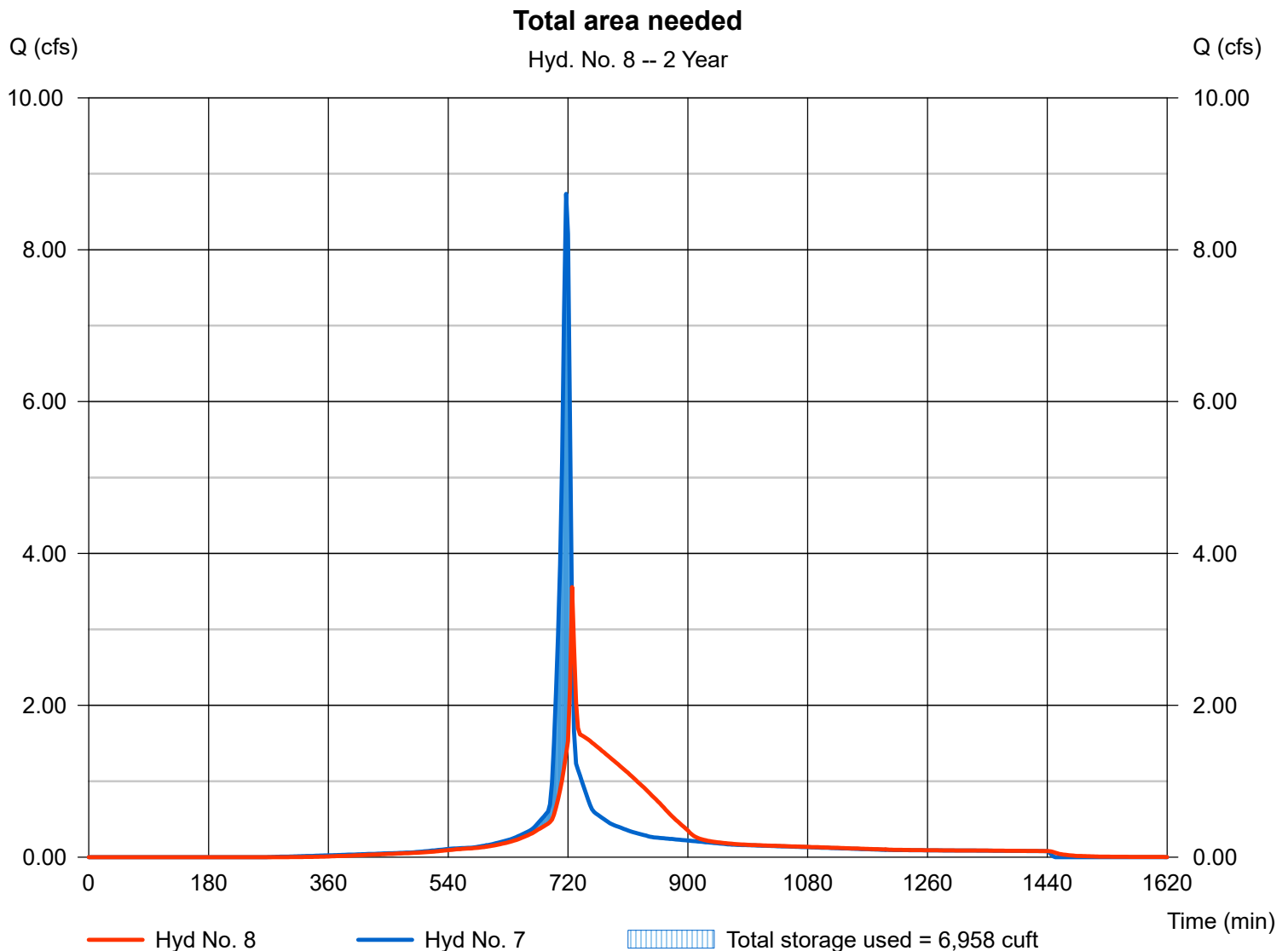
Hyd. No. 8

Total area needed

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 3 min
Inflow hyd. No. = 7 - Treated Area Post
Reservoir name = Pipe

Peak discharge = 3.557 cfs
Time to peak = 726 min
Hyd. volume = 20,452 cuft
Max. Elevation = 492.51 ft
Max. Storage = 6,958 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

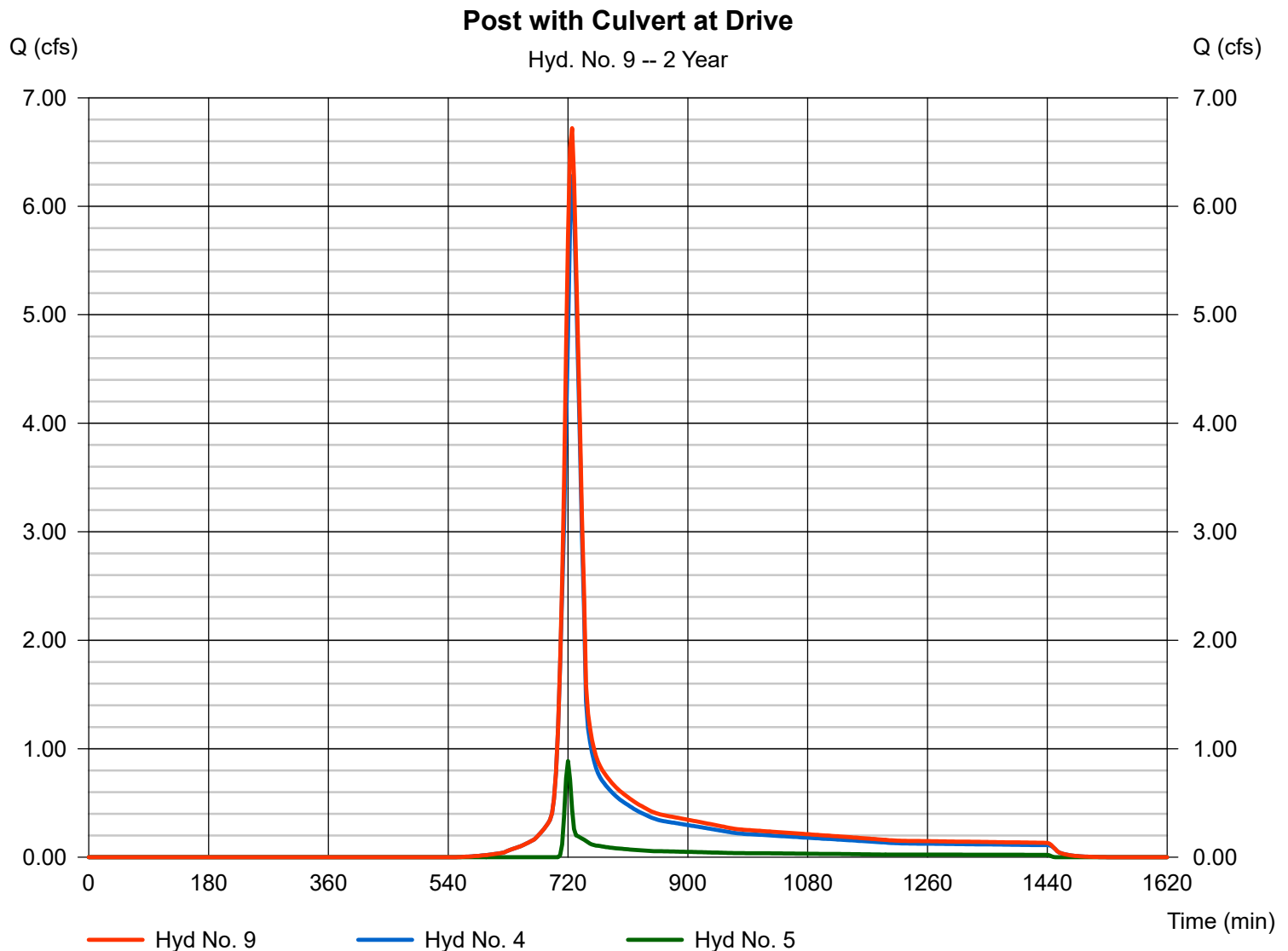
Wednesday, Jan 16, 2019

Hyd. No. 9

Post with Culvert at Drive

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 3 min
Inflow hyds. = 4, 5

Peak discharge = 6.721 cfs
Time to peak = 726 min
Hyd. volume = 23,458 cuft
Contrib. drain. area = 1.350 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

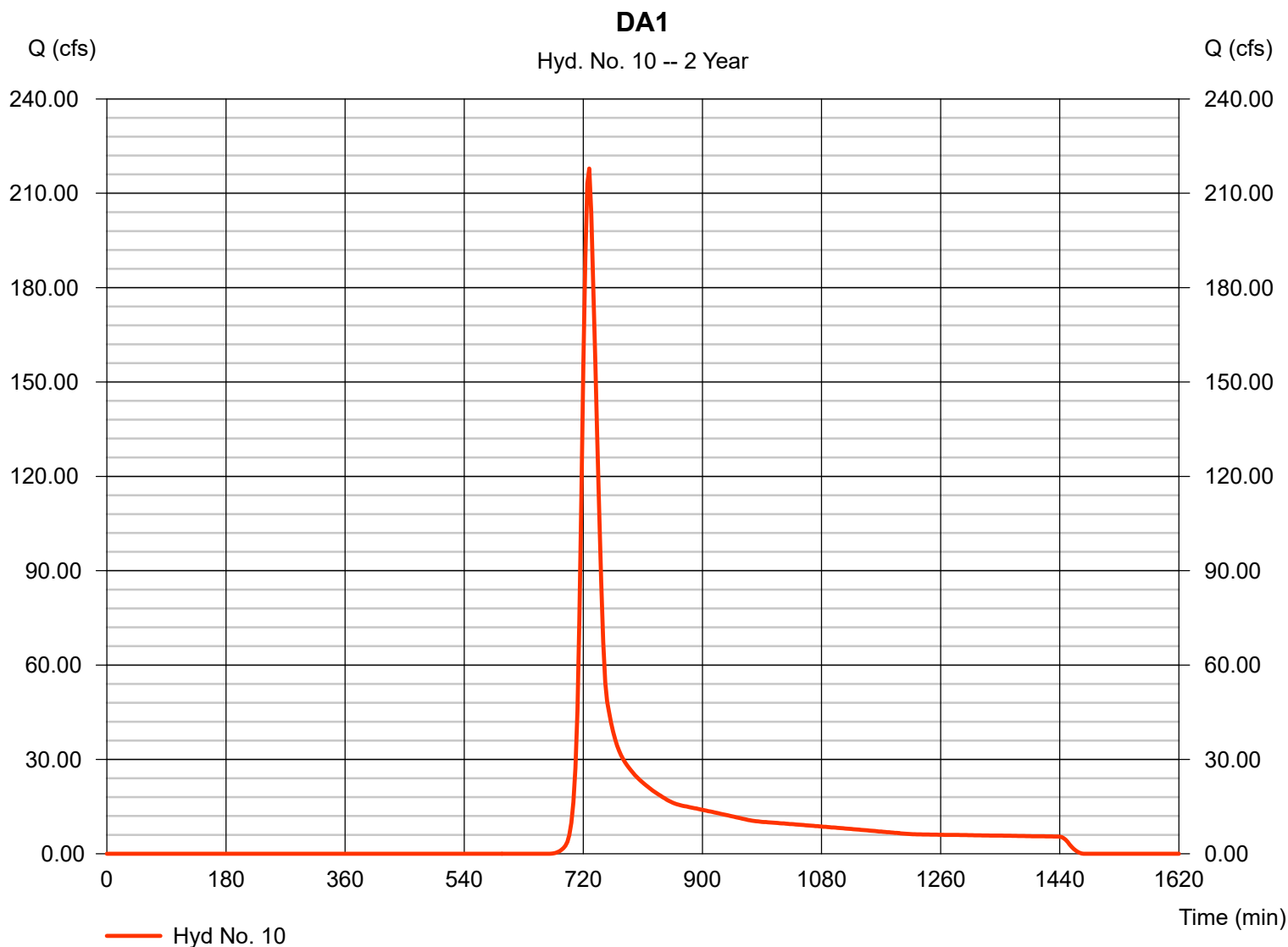
Wednesday, Jan 16, 2019

Hyd. No. 10

DA1

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 222.600 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 217.87 cfs
Time to peak = 729 min
Hyd. volume = 829,931 cuft
Curve number = 69.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 21.16 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

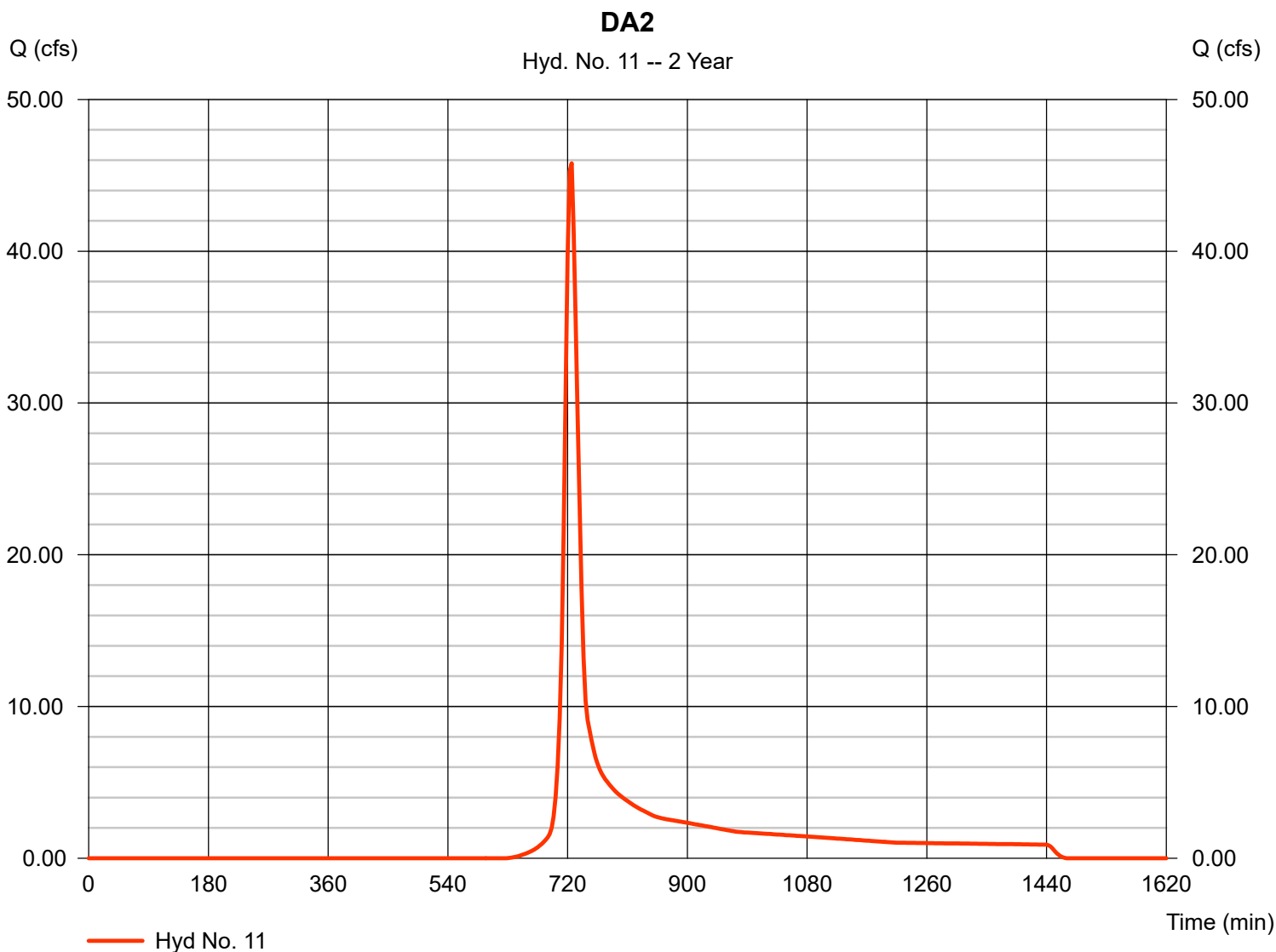
Wednesday, Jan 16, 2019

Hyd. No. 11

DA2

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 30.870 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 45.79 cfs
Time to peak = 726 min
Hyd. volume = 151,314 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 16.17 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

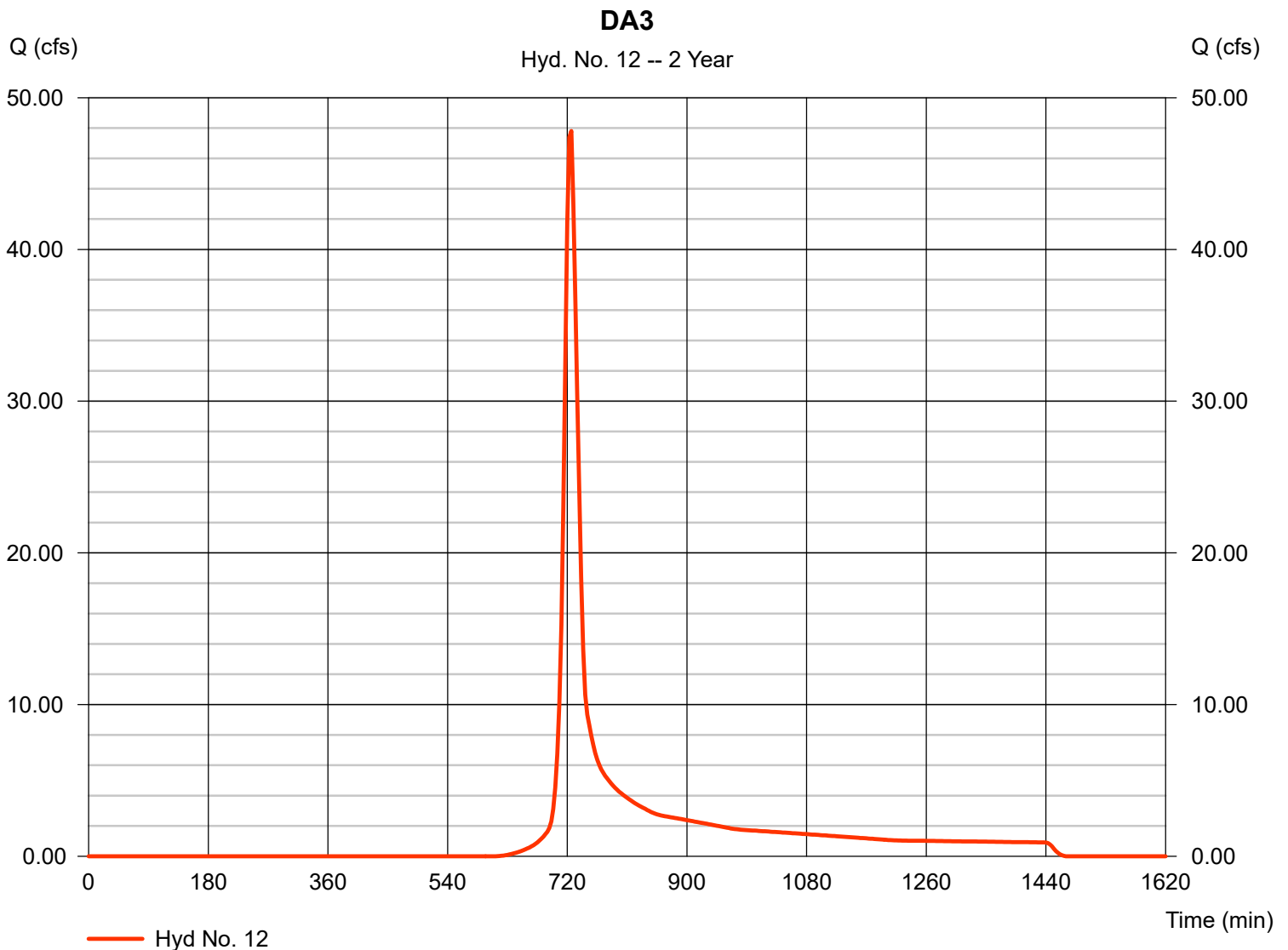
Wednesday, Jan 16, 2019

Hyd. No. 12

DA3

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 3 min
Drainage area = 30.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.60 in
Storm duration = 24 hrs

Peak discharge = 47.81 cfs
Time to peak = 726 min
Hyd. volume = 157,128 cuft
Curve number = 75
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.95 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

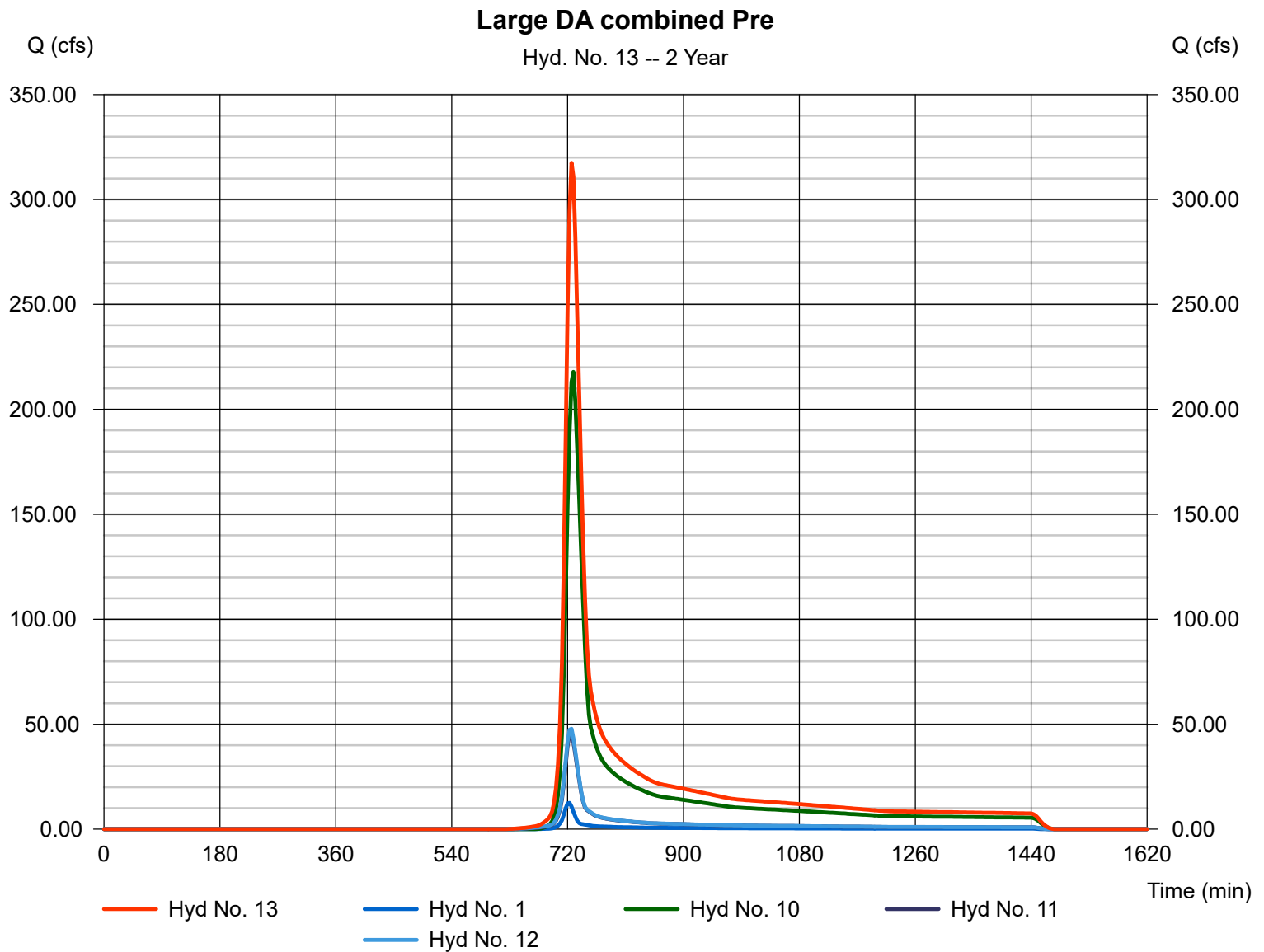
Wednesday, Jan 16, 2019

Hyd. No. 13

Large DA combined Pre

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 3 min
Inflow hyds. = 1, 10, 11, 12

Peak discharge = 317.50 cfs
Time to peak = 726 min
Hyd. volume = 1,173,989 cuft
Contrib. drain. area = 292.830 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

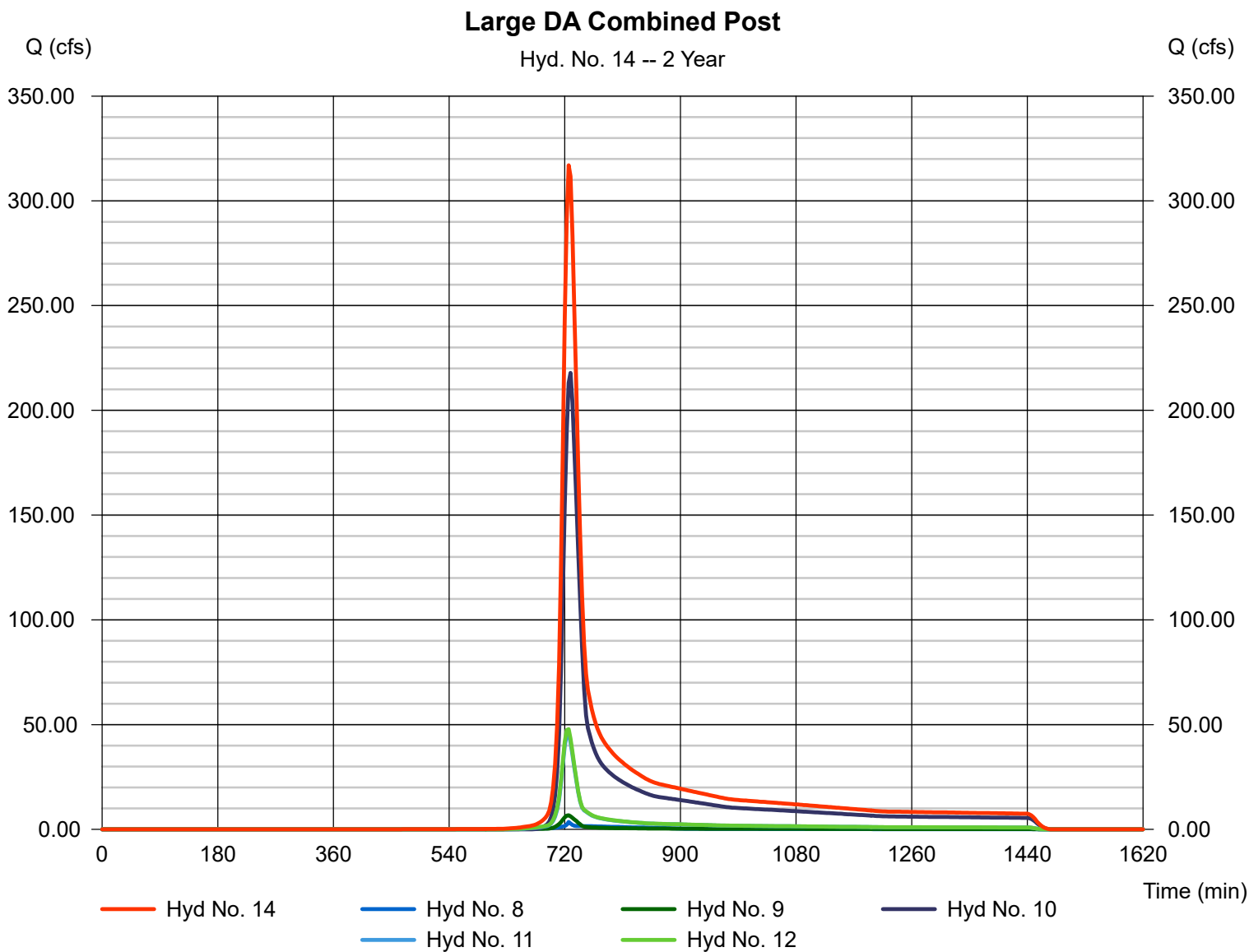
Wednesday, Jan 16, 2019

Hyd. No. 14

Large DA Combined Post

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 3 min
Inflow hyds. = 8, 9, 10, 11, 12

Peak discharge = 317.00 cfs
Time to peak = 726 min
Hyd. volume = 1,182,283 cuft
Contrib. drain. area = 284.040 ac



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Tuesday, Oct 30, 2018

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	74.0559	13.3000	0.8788	-----
3	0.0000	0.0000	0.0000	-----
5	83.5112	14.8000	0.8514	-----
10	105.7041	16.8000	0.8710	-----
25	118.9252	17.6000	0.8582	-----
50	137.0265	18.6000	0.8630	-----
100	157.1769	19.6000	0.8692	-----

File name: RDU(M).IDF

$$\text{Intensity} = B / (T_c + D)^E$$

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.76	4.65	3.92	3.40	3.01	2.70	2.45	2.25	2.08	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.64	4.07	3.63	3.28	3.00	2.76	2.57	2.40	2.25	2.12
10	7.22	6.03	5.19	4.57	4.09	3.71	3.40	3.13	2.91	2.72	2.56	2.41
25	8.19	6.90	5.98	5.29	4.75	4.32	3.97	3.67	3.41	3.20	3.01	2.84
50	8.95	7.59	6.60	5.86	5.27	4.80	4.41	4.08	3.81	3.57	3.36	3.17
100	9.71	8.27	7.22	6.42	5.79	5.28	4.86	4.50	4.20	3.93	3.70	3.50

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

[illegible]

Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Tuesday, Oct 30, 2018

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	74.0559	13.3000	0.8788	-----
3	0.0000	0.0000	0.0000	-----
5	83.5112	14.8000	0.8514	-----
10	105.7041	16.8000	0.8710	-----
25	118.9252	17.6000	0.8582	-----
50	137.0265	18.6000	0.8630	-----
100	157.1769	19.6000	0.8692	-----

File name: RDU(M).IDF

$$\text{Intensity} = B / (T_c + D)^E$$

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.76	4.65	3.92	3.40	3.01	2.70	2.45	2.25	2.08	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.64	4.07	3.63	3.28	3.00	2.76	2.57	2.40	2.25	2.12
10	7.22	6.03	5.19	4.57	4.09	3.71	3.40	3.13	2.91	2.72	2.56	2.41
25	8.19	6.90	5.98	5.29	4.75	4.32	3.97	3.67	3.41	3.20	3.01	2.84
50	8.95	7.59	6.60	5.86	5.27	4.80	4.41	4.08	3.81	3.57	3.36	3.17
100	9.71	8.27	7.22	6.42	5.79	5.28	4.86	4.50	4.20	3.93	3.70	3.50

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

[illegible]

Pipes acting as culverts with inlet control worksheet

1-yr Storm

Head Water (HW)	496.97
Diameter (D)	21
Elevation of Pipe invert	495
HW/D =	1.1

2-yr Storm

Head Water (HW)	497.25
Diameter (D)	21
Elevation of Pipe invert	495
HW/D =	1.3

10-yr Storm

Head Water (HW)	498.83
Diameter (D)	21
Elevation of Pipe invert	495
HW/D =	2.2

25-yr Storm

Head Water (HW)	499.56
Diameter (D)	21
Elevation of Pipe invert	495
HW/D =	2.6

The culvert pipe under the drive is acting as a storage device for downstream conditions

NUTRIENT CALCULATIONS

Project Information

Project Name:	Sanderway Subdivision	
Submission Date:		
Project Area (ft ²):	371,982	ft ²
Disturbed Area (ft ²):	151,910	ft ²
Development Land Use Type:	Single Family Residential	
Development Activity Type:	Development - New	
Designated Downtown Area?	no	
Project Location/Address:	Hillsborough Rd, Carrboro	
County:	Orange	
Local Jurisdiction:	Carrboro	
Project Latitude Coordinates:		N
Project Longitude Coordinates:		W
Precipitation Station:	Chapel Hill	
Physiographic Region:	Piedmont	
Nutrient Management Watershed:	Jordan Lake	
Subwatershed:	Jordan - Upper New Hope	
Phosphorus Delivery Zone:	Jordan Zone 10	
Nitrogen Delivery Zone:	Jordan Zone 10	
Project Designer and Contact Phone Number / Email:	Cliff Credle, (919) 682-2006, Cliff@CredleEngineering.com	
Part of Common Development Plan?	no	
Project Owner Type:	Private	
Project Description:	New single Family Home Subdivision	

Yellow cells require data for PROJECT AREA RUNOFF and NUTRIENT TREATMENT calculations

Green cells require data for NUTRIENT TARGETS, BUYDOWN, & CREDIT/DEBIT calculations

PROJECT AREA LAND COVERS	TN EMC (mg/L)	TP EMC (mg/L)	Pre- Project Area (ft ²)	Post- Project Area (ft ²)
Roof	1.18	0.11	1,248	36,000
Roadway	1.64	0.34	12,926	30,735
Parking/Driveway/Sidewalk	1.42	0.18	1,100	22,405
Protected Forest	0.97	0.03	257,455	179,536
Other Pervious/Landscaping	2.48	1.07	99,253	102,874
CUSTOM LAND COVER 1				
CUSTOM LAND COVER 2				
CUSTOM LAND COVER 3				
LAND TAKEN UP BY SCM	1.18	0.11		432

LAND COVER AREA CHECK	
Net Change of Land Covers (ft ²):	77,919
Total Project Area Entered (ft ²):	371,982
Total Pre-Project Calculated Area (ft ²):	371,982
Total Post-Project Calculated Area (ft ²):	371,982

Equations Used and Project Area Calculations

SIMPLE METHOD

Runoff Coefficient, R_v

$$R_v = 0.05 + (0.009 \cdot I)$$

where I = percent impervious (%)

Average Annual Pollutant Load, L

$$L = (P_j \cdot R_v \cdot (P/12)) \cdot (C \cdot A \cdot 2.72)$$

where C = event mean concentration (mg/L)

Stormwater Runoff Volume Generated, V

$$V = P_j \cdot R_v \cdot (P/12) \cdot A$$

where A = drainage area (ft²)

P_j = fraction of rain events with runoff

P = average annual rainfall depth (in)

Pre-Project:		Post-Project:	
A = 8.5395	ac	A = 8.5395	ac
P = 47.31	in.	P = 47.31	in.
V = 114771	ft ³	V = 352112	ft ³
I = 4%		I = 24%	
R_v = 0.09		R_v = 0.27	
P_j = 0.9		P_j = 0.9	
C_{TN} = 1.48	mg/L	C_{TN} = 1.42	mg/L
C_{TP} = 0.32	mg/L	C_{TP} = 0.24	mg/L
L_{TN} = 10.59	lb/yr	L_{TN} = 31.12	lb/yr
L_{TP} = 2.26	lb/yr	L_{TP} = 5.17	lb/yr

Catchment ID	1			2			3			4			5			6		
SCM ID	101	102	103	201	202	203	301	302	303	401	402	403	501	502	503	601	602	603
Type of SCM	Custom SCM/BMP			Custom SCM/BMP			Custom SCM/BMP			Custom SCM/BMP			Custom SCM/BMP			Custom SCM/BMP		
Predominant hydrologic soil group at SCM location	B			B			B			B			B			B		
SCM Description	12' x 6' Filterra			12' x 6' Filterra			12' x 6' Filterra			12' x 6' Filterra			12' x 6' Filterra			12' x 6' Filterra		
Design Storm Size (inches/24hrs)	3.00			3.00			3.00			3.00			3.00			3.00		
Percent of Full Size	100%			100%			100%			100%			100%			100%		
Hydrologic Value - Percent Annual Effluent	75%			75%			75%			75%			75%			75%		
Hydrologic Value - Percent Annual Overflow	6%			6%			6%			6%			6%			6%		
Hydrologic Value - Percent Annual ET/Infiltrated	19%			19%			19%			19%			19%			19%		
SCM Effluent TP EMC (mg/L)	0.13			0.13			0.13			0.13			0.13			0.13		
SCM Effluent TN EMC (mg/L)	1.20			1.20			1.20			1.20			1.20			1.20		
SCM Land Cover TP EMC (mg/L)	0.11			0.11			0.11			0.11			0.11			0.11		
SCM Land Cover TN EMC (mg/L)	1.18			1.18			1.18			1.18			1.18			1.18		
Drains to SCM ID	0			0			0			0			0			0		
Catchment Routing (Source Catchment)	Catchments Draining to SCM 101			Catchments Draining to SCM 201			Catchments Draining to SCM 301			Catchments Draining to SCM 401			Catchments Draining to SCM 501			Catchments Draining to SCM 601		
SCM ID:	101			201			301			401			501			601		
SCM Drainage Area Land Covers	Area Draining Directly to SCM 101 (ft2)	Area Draining Directly to SCM 102 (ft2)	Area Draining Directly to SCM 103 (ft2)	Area Draining Directly to SCM 201 (ft2)	Area Draining Directly to SCM 202 (ft2)	Area Draining Directly to SCM 203 (ft2)	Area Draining Directly to SCM 301 (ft2)	Area Draining Directly to SCM 302 (ft2)	Area Draining Directly to SCM 303 (ft2)	Area Draining Directly to SCM 401 (ft2)	Area Draining Directly to SCM 402 (ft2)	Area Draining Directly to SCM 403 (ft2)	Area Draining Directly to SCM 501 (ft2)	Area Draining Directly to SCM 502 (ft2)	Area Draining Directly to SCM 503 (ft2)	Area Draining Directly to SCM 601 (ft2)	Area Draining Directly to SCM 602 (ft2)	Area Draining Directly to SCM 603 (ft2)
Roof	6,000			6,000			6,000			6,000			6,000			6,000		
Roadway	2,968			2,942			2,968			2,915			3,126			2,890		
Parking/Driveway/Sidewalk	2,516			2,416			2,402			2,408			2,374			2,380		
Protected Forest																		
Other Pervious/Landscaping	3,358			3,218			5,125			5,576			10,554			1,839		
CUSTOM LAND COVER 1																		
CUSTOM LAND COVER 2																		
CUSTOM LAND COVER 3																		
LAND TAKEN UP BY SCM	72			72			72			72			72			72		
TOTAL AREA DRAINING TO SCM (ft²):	14,914	0	0	14,648	0	0	16,567	0	0	16,971	0	0	22,126	0	0	13,181	0	0
CATCHMENT AREA (ft²):	14,914			14,648			16,567			16,971			22,126			13,181		

Total Land Use Area Treated By All SCMs (ft²)	Allowable Total Land Use Area to be Treated Based on Post-Project Areas (ft²)	Post-Project Untreated Land Area (ft²)
36,000	36,000	0
17,809	30,735	12,926
14,496	22,405	7,909
0	179,536	179,536
29,670	102,874	73,204
0	0	0
0	0	0
0	0	0
432	432	0
98,407	371,982	273,575