Shade Valley

TETRA TECH, INC.

By: RH Date: 1/30/2017 Subject: Shade Valley Road
Checked By: JB Date: 2/1/2017 PCSM Design and Evaluation

PURPOSE:

The purpose of these calculations is to design a Post-Construction Stormwater Management (PCSM) Plan for the Shade Valley Road block valve site as part of the Sunoco Pipeline L.P. Pennsylvania Pipeline Project. The site is located within Tell Township, Huntingdon County, Pennsylvania. Permanent stormwater controls will be developed to satisfy PADEP requirements.

PCSM DESIGN REQUIREMENTS:

The PCSM design for this project follows the PA Department of Environmental Protection's (PADEP) Pennsylvania Stormwater Best Management Practices Manual (BMP Manual), December 2006; and the standard design criteria from PA Title 25, Chapter 102.8.(g)(2) and (3). The design criteria evaluated for the site are summarized below.

Act 167 Consistency

Huntingdon County does not have an approved Act 167 Stormwater Management Plan, therefore, the county has adopted the PADEP Chapter 102 regulations as their county-wide stormwater guidance.

Recommended Volume Control Guideline

Use of Control Guideline 1 is recommended where site conditions offer the opportunity to reduce the increase in runoff volume as follows:

- Do not increase the post-development total runoff volume for all storms equal to or less than the two-year/24-hour event;
- Existing (pre-development) non-forested pervious areas must be considered meadow (good condition) or its equivalent; and
- 20 percent of existing impervious area, when present, shall be considered meadow (good condition) or its equivalent.

This site will utilize three infiltration berms to manage the two-year/24-hour volume increase.

Recommended Peak Rate Control Guideline

The recommended control guideline for peak rate control is:

- Do not increase the peak rate of discharge for the 2-year through 100-year events (at minimum).

This site will utilize five infiltration berms to manage the two-year through 100-year peak rate increases. These BMPs will also help to increase the time of concentration for the drainage area encompassing the block valve.

Recommended Water Quality Control Guideline

Control Guideline 1 will provide water quality control and stream channel protection as well as flood control protection.

Infiltration

Infiltration rates for the PCSM BMPs have been determined from site infiltration testing conducted in accordance of the PA BMP Manual. Documentation for infiltration testing and design infiltration rates can be found in Attachment 5 of the Site Restoration/Post Construction Stormwater Management Plan. Infiltration test locations and recommended design rates are also labeled on the PCSM Plan Drawings in Attachment 6.

During the onsite infiltration tests, the depth to seasonal high groundwater and shallow bedrock or another confining layer were evaluated. The post-construction stormwater management facility for the site has been designed to maintain 2 feet of separation between the ponding elevation of the facility and the seasonal high water table and bedrock.

The post-construction stormwater management design will utilize onsite infiltration to meet Volume Control Guideline 1.

Loading Ratio

Loading ratios have been considered for the design of infiltration BMPs. In general, the following Loading Ratio guidelines are recommended:

- Maximum Impervious Loading Ratio of 5:1 relating impervious drainage area to infiltration area.
- Maximum Drainage Area Loading Ratio of 8:1 relating total drainage area to infiltration area.

The maximum impervious loading ratio of 5:1 has been met. The impervious loading ratio for Drainage Area 1 is 1.9:1. The impervious loading ratio for Drainage Area 2 is 1.2:1.

The maximum Drainage Area loading ratio of 8:1 has been met in both drainage areas. The drainage area loading ratio for Drainage Area 1 is 5.7:1, and the drainage area loading ratio for Drainage Area 2 is 7.9:1.

Disturbed Area

To meet Standard Worksheet 10 guidelines, 90% of the disturbed area is contained by the proposed PCSM BMPs.

Karst Topography

Shade Valley Road block valve is located in an area of karst terrain. Several design principles were incorporated to minimize the risk of sinkholes to the maximum extent practicable, including reducing the proposed impervious area to the maximum extent practicable.

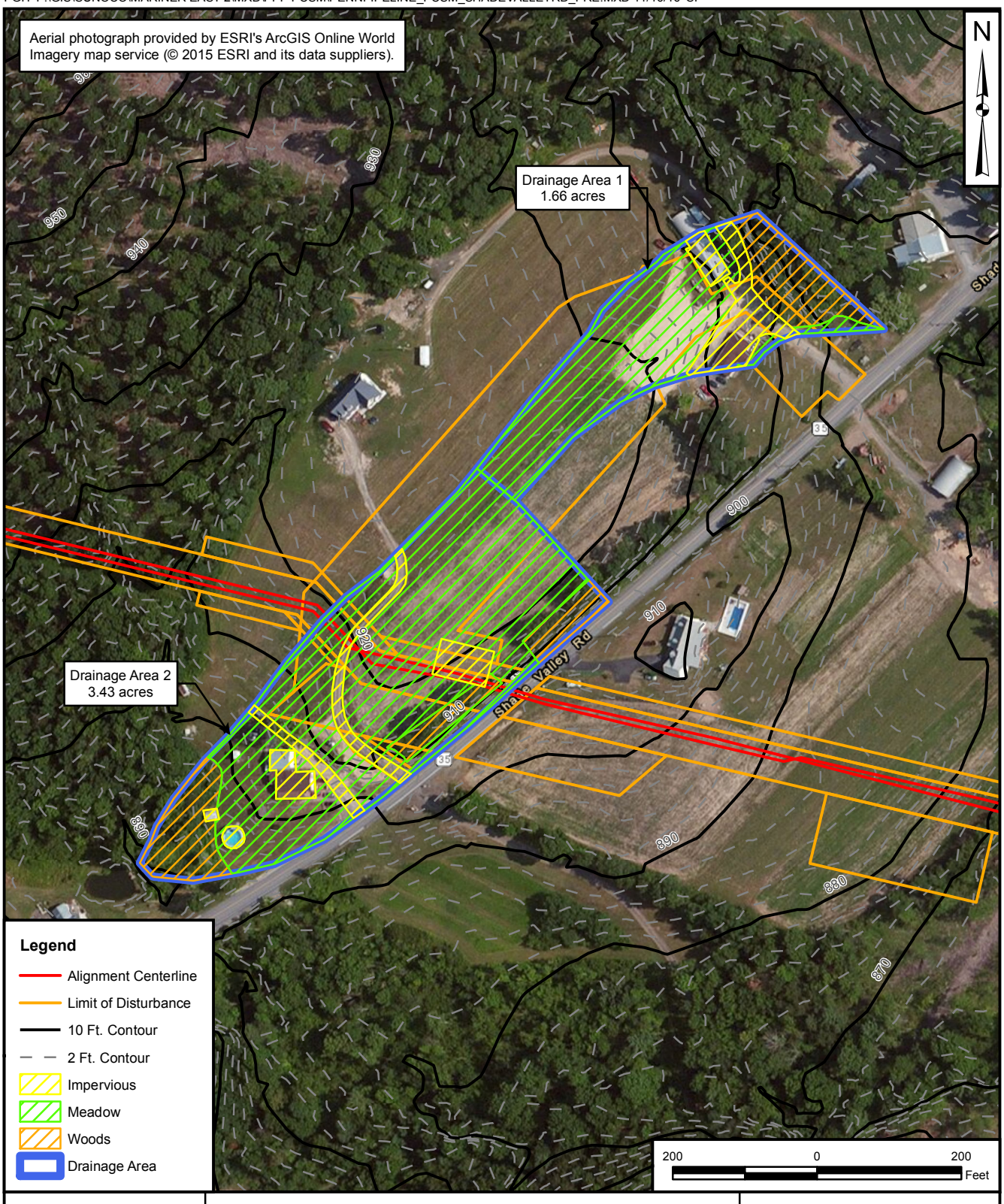
Stormwater runoff from the site is being spread out over a relatively large area. The site will achieve a 1.9:1 and 1.2:1 impervious loading ratio in Drainage Area 1 and Drainage Area 2, respectively, by directing stormwater runoff into infiltration berms. The infiltration berms will avoid concentrating stormwater runoff and will encourage relatively shallow and broad ponding areas. Additional post-construction inspection and

maintenance will be required onsite as documented in the Sinkhole Repair Plan in Attachment 2. In areas of known karst terrain, stormwater BMPs shall be inspected at regular intervals of at least once every quarter for the first two years following installation and then at regular periods thereafter. Inspections shall also be made after every storm event greater than 1 inch during the establishment period. Inspections shall consist of an examination of any noticeable subsidence, surface depressions, or sinkholes. Inspections shall include an evaluation of all inlet and outlet structures and document any areas to be cleaned, maintained, or repaired.

Special Protection Watershed

Shade Valley Road is not located within a special protection watershed, so antidegradation requirements do not apply.

PGH P:\GIS\SUNOCO\MARINER EAST 2\MXD\PPP PCSM\PENNPIPELINE_PCSM_SHADEVALLEYRD_PRE.MXD 11/16/16 SP



TETRA TECH

PRE-DEVELOPMENT DRAINAGE AREA MAP
SHADE VALLEY ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
HUNTINGDON COUNTY, PENNSYLVANIA

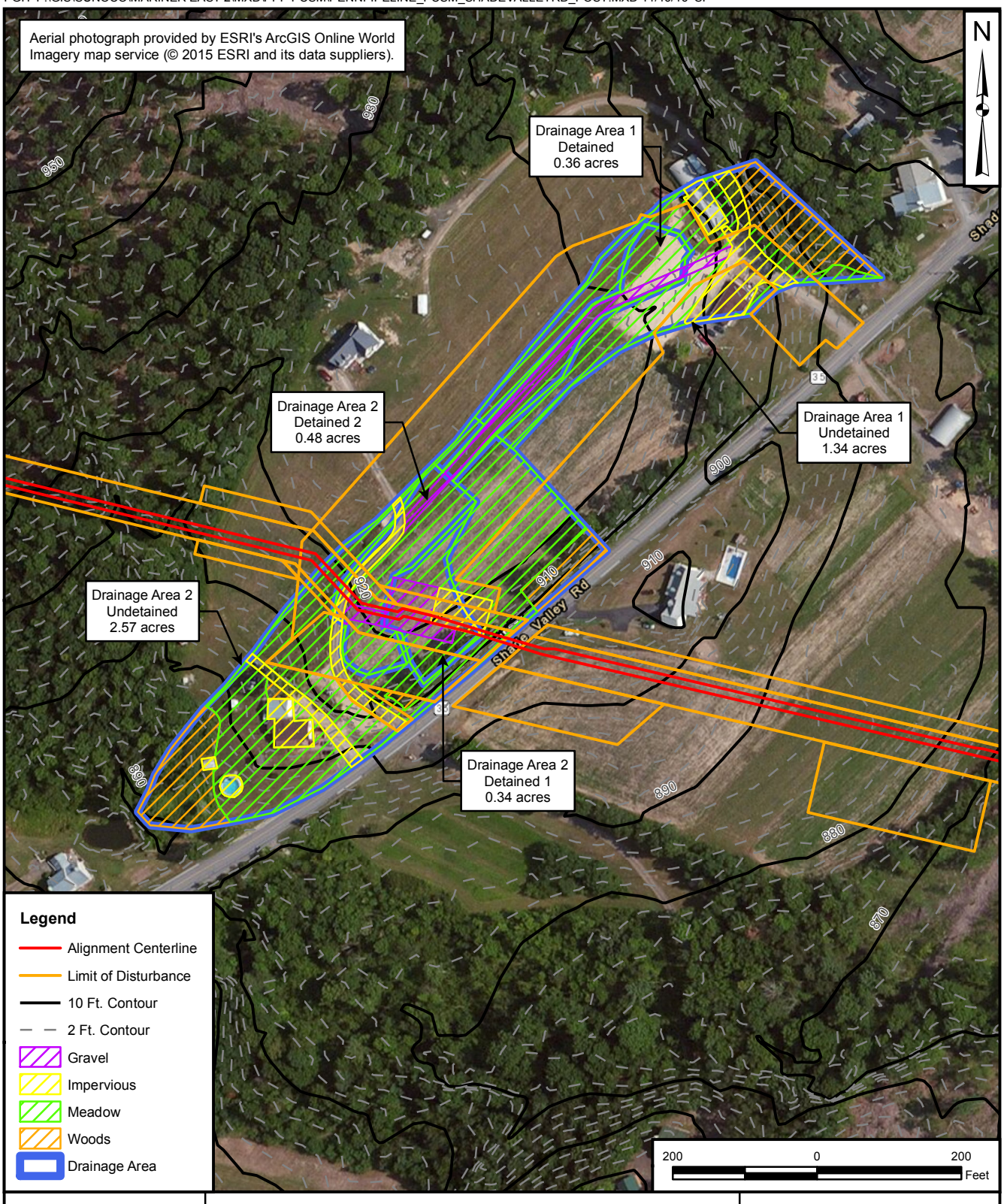
DRAWN BY: S. PAXTON 05/22/16
CHECKED BY: J. BRODY 11/16/16

APPROVED BY:

CONTRACT NUMBER: 112IC05958

FIGURE NUMBER	REV
1	0

PGH P:\GIS\SUNOCO\MARINER EAST 2\MXD\PPP PCSM\PENNPIPELINE_PCSM_SHADEVALLEYRD_POST.MXD 11/16/16 SP



TETRA TECH

POST-DEVELOPMENT DRAINAGE AREA MAP
SHADE VALLEY ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
HUNTINGDON COUNTY, PENNSYLVANIA

DRAWN BY: S. PAXTON 05/22/16
CHECKED BY: J. BRODY 11/16/16

APPROVED BY:

CONTRACT NUMBER: 112IC05958

FIGURE NUMBER	REV
2	0

NOAA Atlas 14, Volume 2, Version 3
Location name: Tell Twp, Pennsylvania, USA*
Latitude: 40.3137°, Longitude: -77.7529°
Elevation: 913.85 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.319** (0.280-0.365)	**0.380** (0.335-0.434)	**0.463** (0.406-0.528)	**0.528** (0.462-0.602)	**0.618** (0.539-0.702)	**0.689** (0.597-0.782)	**0.762** (0.657-0.863)	**0.841** (0.720-0.950)	**0.952** (0.807-1.07)	**1.04** (0.875-1.17)
10-min	**0.496** (0.436-0.567)	**0.593** (0.523-0.678)	**0.720** (0.630-0.821)	**0.816** (0.714-0.929)	**0.945** (0.824-1.07)	**1.04** (0.905-1.19)	**1.15** (0.989-1.30)	**1.25** (1.07-1.42)	**1.40** (1.19-1.58)	**1.51** (1.27-1.71)
15-min	**0.608** (0.534-0.695)	**0.725** (0.639-0.829)	**0.883** (0.774-1.01)	**1.00** (0.878-1.14)	**1.17** (1.02-1.33)	**1.29** (1.12-1.47)	**1.43** (1.23-1.61)	**1.56** (1.34-1.76)	**1.75** (1.48-1.97)	**1.89** (1.59-2.13)
30-min	**0.804** (0.707-0.919)	**0.971** (0.856-1.11)	**1.21** (1.06-1.38)	**1.39** (1.22-1.59)	**1.65** (1.44-1.87)	**1.85** (1.60-2.10)	**2.06** (1.77-2.33)	**2.28** (1.95-2.57)	**2.59** (2.19-2.92)	**2.84** (2.39-3.19)
60-min	**0.982** (0.863-1.12)	**1.19** (1.05-1.36)	**1.52** (1.33-1.73)	**1.77** (1.55-2.02)	**2.14** (1.86-2.43)	**2.44** (2.11-2.76)	**2.75** (2.37-3.12)	**3.09** (2.65-3.49)	**3.58** (3.03-4.04)	**3.98** (3.35-4.49)
2-hr	**1.12** (0.977-1.29)	**1.35** (1.19-1.56)	**1.72** (1.51-1.99)	**2.03** (1.77-2.34)	**2.47** (2.14-2.84)	**2.85** (2.45-3.26)	**3.27** (2.79-3.72)	**3.73** (3.16-4.24)	**4.43** (3.72-5.02)	**5.02** (4.17-5.69)
3-hr	**1.21** (1.06-1.40)	**1.46** (1.28-1.69)	**1.84** (1.62-2.14)	**2.16** (1.89-2.50)	**2.63** (2.29-3.03)	**3.03** (2.62-3.47)	**3.48** (2.99-3.98)	**3.98** (3.39-4.54)	**4.74** (3.98-5.38)	**5.39** (4.48-6.12)
6-hr	**1.51** (1.35-1.73)	**1.82** (1.62-2.08)	**2.26** (2.01-2.58)	**2.65** (2.35-3.01)	**3.21** (2.82-3.63)	**3.69** (3.22-4.16)	**4.22** (3.66-4.74)	**4.81** (4.14-5.39)	**5.71** (4.86-6.38)	**6.48** (5.45-7.24)
12-hr	**1.89** (1.68-2.13)	**2.26** (2.01-2.55)	**2.81** (2.48-3.15)	**3.27** (2.89-3.67)	**3.97** (3.48-4.44)	**4.58** (3.99-5.10)	**5.27** (4.55-5.85)	**6.04** (5.16-6.68)	**7.22** (6.09-7.97)	**8.25** (6.87-9.08)
24-hr	**2.28** (2.07-2.52)	**2.74** (2.49-3.03)	**3.40** (3.08-3.76)	**3.96** (3.58-4.37)	**4.79** (4.31-5.27)	**5.52** (4.93-6.05)	**6.33** (5.62-6.92)	**7.23** (6.36-7.88)	**8.62** (7.48-9.36)	**9.82** (8.44-10.6)
2-day	**2.64** (2.41-2.90)	**3.16** (2.89-3.48)	**3.93** (3.58-4.32)	**4.58** (4.16-5.03)	**5.57** (5.02-6.10)	**6.43** (5.75-7.02)	**7.41** (6.57-8.06)	**8.51** (7.47-9.23)	**10.2** (8.82-11.0)	**11.7** (9.97-12.6)
3-day	**2.81** (2.58-3.08)	**3.36** (3.09-3.69)	**4.16** (3.81-4.56)	**4.83** (4.42-5.29)	**5.85** (5.31-6.39)	**6.73** (6.06-7.33)	**7.71** (6.90-8.39)	**8.81** (7.81-9.57)	**10.5** (9.17-11.4)	**11.9** (10.3-13.0)
4-day	**2.98** (2.75-3.26)	**3.56** (3.29-3.90)	**4.39** (4.04-4.80)	**5.09** (4.67-5.56)	**6.13** (5.59-6.68)	**7.03** (6.38-7.64)	**8.01** (7.23-8.71)	**9.12** (8.15-9.91)	**10.8** (9.52-11.7)	**12.2** (10.7-13.3)
7-day	**3.50** (3.24-3.80)	**4.17** (3.87-4.54)	**5.09** (4.71-5.52)	**5.84** (5.40-6.33)	**6.94** (6.38-7.51)	**7.86** (7.20-8.50)	**8.87** (8.07-9.59)	**9.96** (8.99-10.8)	**11.6** (10.3-12.5)	**13.0** (11.5-14.0)
10-day	**4.03** (3.74-4.36)	**4.79** (4.45-5.19)	**5.75** (5.34-6.23)	**6.55** (6.07-7.08)	**7.69** (7.10-8.30)	**8.64** (7.94-9.32)	**9.66** (8.83-10.4)	**10.8** (9.77-11.6)	**12.4** (11.1-13.4)	**13.7** (12.2-14.8)
20-day	**5.50** (5.17-5.87)	**6.48** (6.10-6.92)	**7.58** (7.12-8.08)	**8.45** (7.93-9.01)	**9.65** (9.04-10.3)	**10.6** (9.91-11.3)	**11.6** (10.8-12.4)	**12.6** (11.7-13.5)	**14.1** (13.0-15.0)	**15.3** (13.9-16.3)
30-day	**6.83** (6.45-7.25)	**8.00** (7.56-8.51)	**9.21** (8.68-9.77)	**10.2** (9.56-10.8)	**11.4** (10.7-12.1)	**12.4** (11.7-13.2)	**13.5** (12.6-14.3)	**14.5** (13.5-15.4)	**15.9** (14.8-16.9)	**17.0** (15.7-18.1)
45-day	**8.62** (8.17-9.12)	**10.1** (9.55-10.7)	**11.4** (10.8-12.1)	**12.5** (11.8-13.2)	**13.8** (13.1-14.6)	**14.9** (14.0-15.7)	**15.9** (14.9-16.8)	**16.9** (15.9-17.9)	**18.2** (17.1-19.3)	**19.3** (18.0-20.4)
60-day	**10.3** (9.84-10.9)	**12.1** (11.5-12.7)	**13.6** (12.9-14.3)	**14.7** (13.9-15.4)	**16.1** (15.3-17.0)	**17.2** (16.3-18.1)	**18.3** (17.3-19.3)	**19.3** (18.3-20.4)	**20.7** (19.5-21.8)	**21.8** (20.4-23.0)

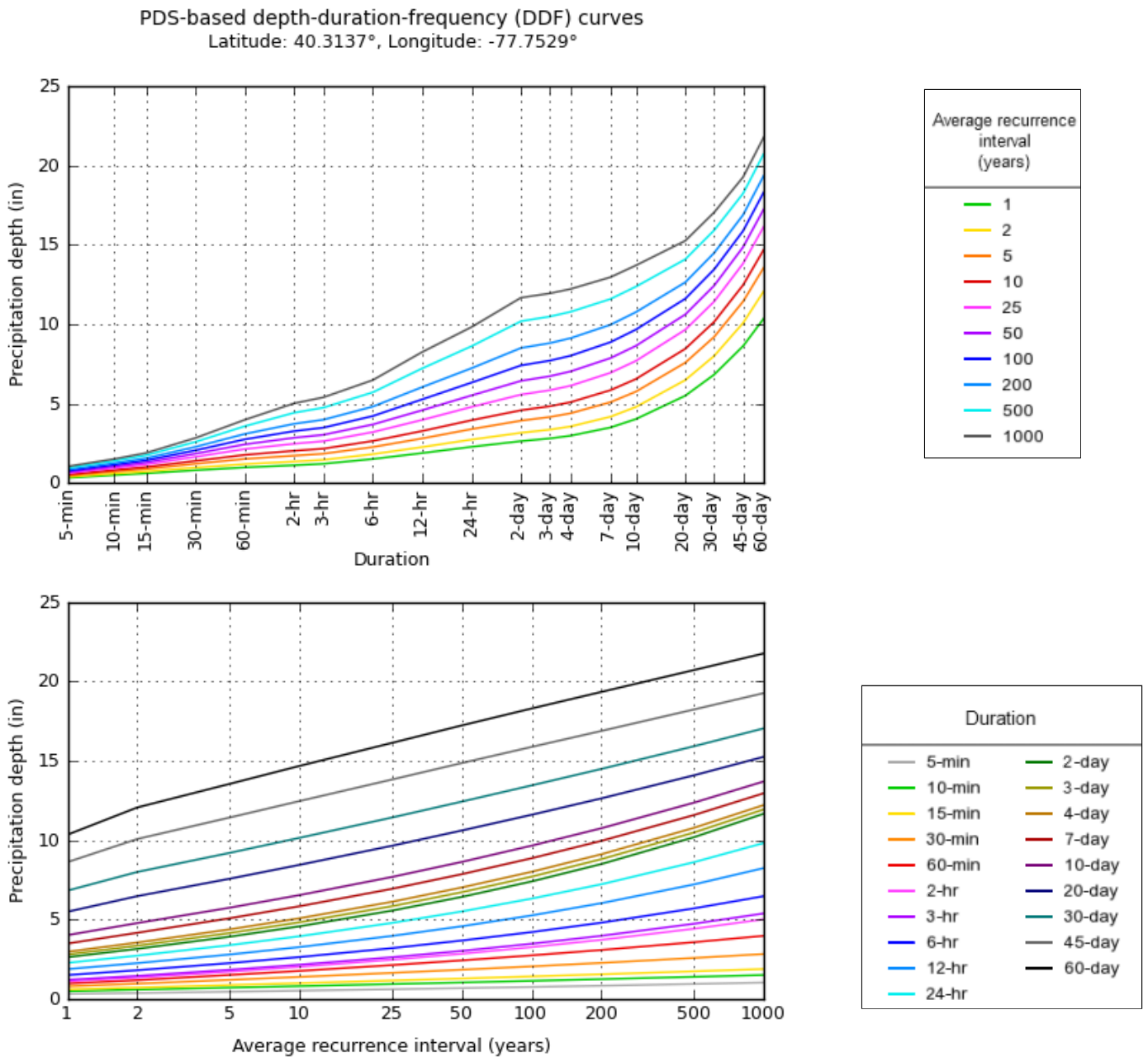
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



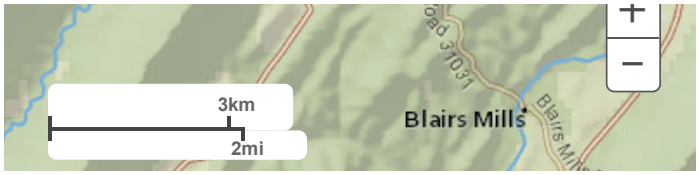
NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Wed Sep 28 17:12:42 2016

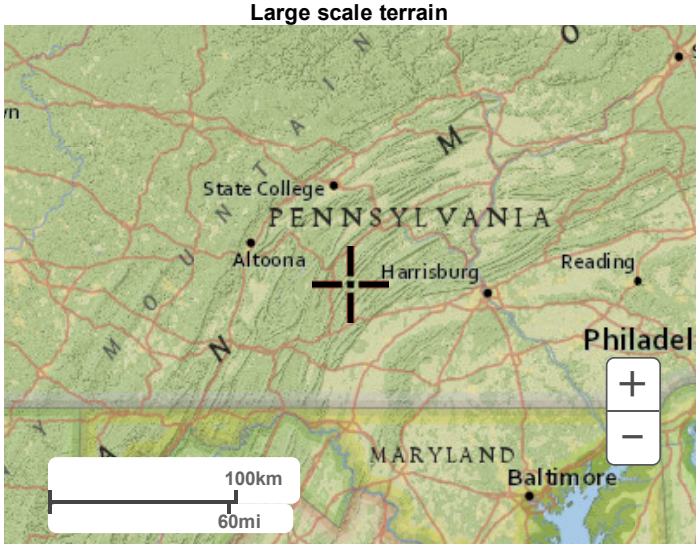
Back to Top

Maps & aerials

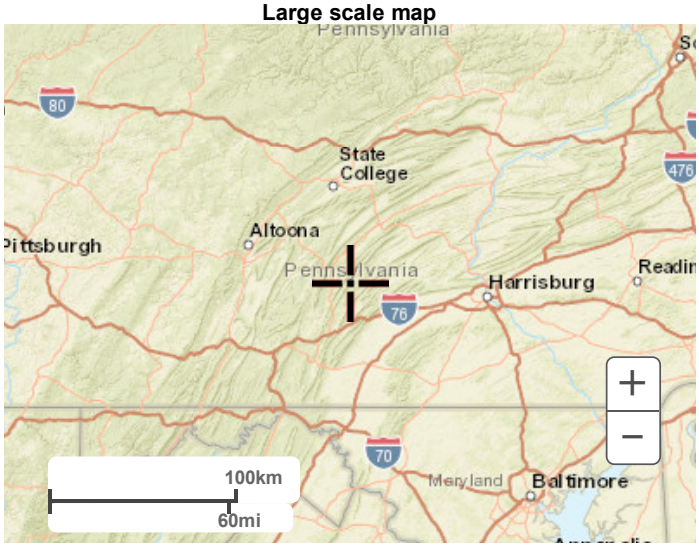
Small scale terrain



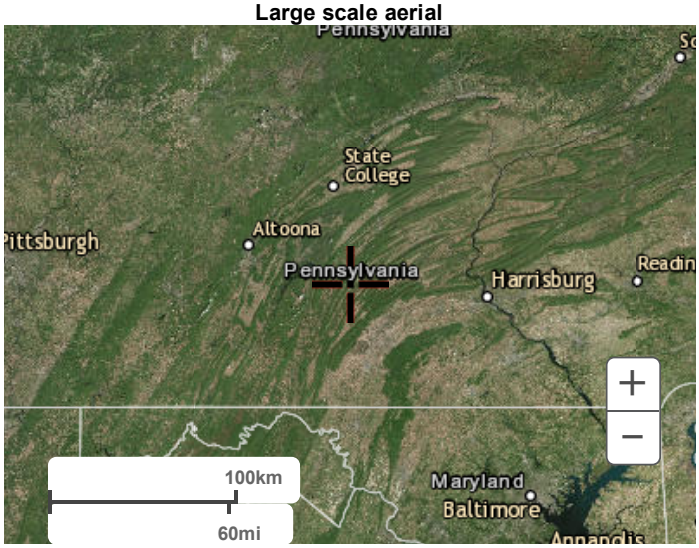
Large scale terrain



Large scale map



Large scale aerial



Back to Top

WORKSHEET 1. GENERAL SITE INFORMATION

Date: November 17, 2016

Project Name: Shade Valley

Municipality: Tell

County: Huntingdon

Total Area (acres): DA1 - 1.66 acres (pre), 1.70 acres (post)

Major River Basin: Susquehanna River

Watershed: Juniata River

Sub Basin: Tuscarora Creek

Nearest Surface Water to Receive Runoff: George Creek

Chapter 93 - Designated Water Use: Cold Water Fishes (CWF)

Impaired according to Chapter 303(d) list?	YES	
List Causes of Impairment:	NO	X

Is Project Subject to, or Part of:

Municipal Separate Storm Sewer System (MS4) Requirements	YES	
	NO	X
Existing or Planned drinking water supply?	YES	
	NO	X
If yes, distance from proposed discharge (miles):		
Approved Act 167 Plan?	YES	
	NO	X
Existing River Conservation Plan?	YES	X
	NO	

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

   See pre-development drainage area map

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

   Woodlands - 0.04 acres

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

   0.00 acres

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? Yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A		
Floodplains	N/A		
Riparian Areas	N/A		
Wetlands	N/A		
Woodlands	Yes	0.04	
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
TOTAL EXISTING:		**0.04**	**0.00**

Worksheet 3. Nonstructural BMP Credits

PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2) 0.00 **Ac.**

1.2 Area of Riparian Forest Buffer Protection 0.00 **Ac.**

3.1 Area of Minimum Disturbance/Reduced Grading 0.00 **Ac**

TOTAL 0.00 **Ac**

Site Area	Minus	Protected Area	=	Stormwater Management Area
1.07	-	0	=	1.07

This is the area that requires stormwater management

VOLUME CREDITS

3.1 Minimum Soil Compaction (See Chapter 8, page 22 – SW BMP Manual)

Lawn _____ ft^2 x 1/4" x 1/12 = _____ ft^3

Meadow _____ ft^2 x 1/3" x 1/12 = _____ ft^3

3.3 Protect Existing Trees (See Chapter 8, page 23 – SW BMP Manual)

For Trees within 100 feet of impervious area:

Tree Canopy _____ ft^2 x 1/2" x 1/12 = _____ ft^3

5.1 Disconnect Roof Leaders to Vegetated Areas (See Chapter 8 page 25 – SW BMP Manual)

For runoff directed to areas protected under 5.8.1 and 5.8.2

Roof Area _____ ft^2 x 1/3" x 1/12 = _____ ft^3

For all other disconnected roof areas

Roof Area _____ ft^2 x 1/4" x 1/12 = _____ ft^3

5.2 Disconnect Non-Roof impervious to Vegetated Areas (See Chapter 8, page 26 – SW BMP Manual)

For Runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Area _____ ft^2 x 1/3" x 1/12 = _____ ft^3

For all other disconnected roof areas

Impervious Area _____ ft^2 x 1/4" x 1/12 = _____ ft^3

TOTAL NON-STRUCTURAL VOLUME CREDIT* _____ ft^3

**For use on Worksheet 5*

WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: Shade Valley - DA1
Drainage Area: 1.66 acres (pre; 1.70 acres post)
2-Year Rainfall: 2.74 in

Total Site Area: 1.03 acres (pre; 1.07 acres post)
Protected Site Area: N/A acres
Managed Site Area: 1.03 acres (pre; 1.07 acres post)

Existing Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[3] (ft^3)
Meadow	B	37,026	0.85	58	7.24	1.45	0.20	603
Meadow	D	3,049	0.07	78	2.82	0.56	0.95	241
Impervious	-	2,614	0.06	98	0.20	0.04	2.51	547
Impervious - 20% as meadow	D	436	0.01	78	2.82	0.56	0.95	34
Woods	D	1,742	0.04	77	2.99	0.60	0.89	130
TOTAL:		**44,867**	**1.03**					**1,555**

Developed Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[3] (ft^3)
Meadow	B	33,106	0.76	58	7.24	1.45	0.20	539
Meadow	D	4,356	0.10	78	2.82	0.56	0.95	344
Gravel	B	5,663	0.13	85	1.76	0.35	1.37	648
Gravel	D	436	0.01	91	0.99	0.20	1.83	66
Impervious	D	3,049	0.07	98	0.20	0.04	2.51	638
Woods	D	0	0.00	77	2.99	0.60	0.89	0
TOTAL:		**46,609**	**1.07**					**2,235**

2-Year Volume Increase (ft^3):	**680**

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = Q = (P - 0.2S)2 / (P+ 0.8S) where
   P = 2-Year Rainfall (in)
   S = (1000/CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12
   Q = Runoff (in)
   Area = Land use area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.
The use of a weighted CN value for volume calculations is not acceptable.

WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: Shade Valley DA1
2-Year Rainfall: 2.74 in

RUNOFF TO BERM (DA 1 DETAINED)

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[3] (ft^3)
Impervious - Gravel	B	5,314	0.12	85	1.76	0.35	1.37	608
Meadow	B	10,454	0.24	58	7.24	1.45	0.20	170
TOTAL:		**15,769**	**0.36**					**778**

1. Runoff (in) = Q = (P - 0.2S)2 / (P+ 0.8S) where

P = 2-Year Rainfall (in)
S = (1000/CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12

Q = Runoff (in)
Area = Land use area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.
The use of a weighted CN value for volume calculations is not acceptable.

Worksheet 5. Structural BMP Volume Credits

PROJECT: Shade Valley
SUB-BASIN:

Required Control Volume (ft^3) - *from Worksheet 4:* 680

Non-structural Volume Credit (ft^3) - *from Worksheet 3:* N/A
(maximum is 25% of required volume)

Structural Volume Reqmt (ft^3) 680
(Required Control Volume minus Non-structural Credit)

Proposed BMPs from PA Stormwater Best Management Practices Manual Chapter 6		Area (ft^2)	Volume Reduction Permanently Removed (ft^3)
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well/Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm	948	778
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-Use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond/Retention Basin		
6.7.1	Riparian Buffer/Riparian Forest Buffer Restoration		
6.7.2	Landscape Restoration/Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other:			
		Total Structural Volume (ft^3):	**778**
		Structural Volume Requirement (ft^3):	**680**
		DIFFERENCE:	**-98**

VOLUME CREDIT DETERMINATION

1	Detained area runoff volume from calculation	=	778	cf
2a	Storage volume of the BMP	=	3,081	cf
2b	Infiltrated volume within 2 hours after the 2-yr/24-hr event (Infiltration Rate/12) x Infiltration Area x 2 hrs	=	1,333	cf
2 (total)	2a + 2b	=	4,414	cf

WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers		
NS BMP 5.5.4 - Cluster Uses at Each Site		
NS BMP 5.6.1 - Minimize Total Disturbed Area	X	
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native Species)	X	
NS BMP 5.9.1 - Street Sweeping / Vacuuming		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		

SECONDARY BMPs FOR NITRATE:

NS BMP 5.4.1 - Protect Sensitive / Special Value Features		
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features		
NS BMP 5.6.2 - Minimize Soil Compaction	X	
Structural BMP 6.4.5 - Rain Garden / Bioretention		
Structural BMP 6.4.8 - Vegetated Swale		
Structural BMP 6.4.9 - Vegetated Filter Strip		
Structural BMP 6.6.1 - Constructed Wetland		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		
Structural BMP 6.7.3 - Soils Amendment/Restoration	X	

TIME OF CONCENTRATION ADJUSTMENT - DA1

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 4.2 MIN

STRUCTURAL VOLUME PROVIDED BY BMP

580 CF FOR 2-YR/24-HR EVENT
1,411 CF FOR 10-YR/24-HR EVENT
2,737 CF FOR 50-YR/24-HR EVENT
3,081 CF FOR 100-YR/24-HR EVENT

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.259
10 YR/24 HR	0.698
50 YR/24 HR	1.368
100 YR/24 HR	1.743

ADDITIONAL RESIDENCE TIME (MIN) = (STRUCTURAL VOLUME PROVIDED BY BMP / RATE OF RUNOFF TO BMP) / 60

Storm Event	Q (CFS)	Additional Residence Time (min.)
2 YR/24 HR	0.259	37.323
10 YR/24 HR	0.698	33.691
50 YR/24 HR	1.368	33.346
100 YR/24 HR	1.743	29.461

ADJUSTED TC = POST CONSTRUCTION TC TO BMP BEFORE ADJUSTMENT + ADDITIONAL RESIDENCE TIME

Storm Event	Q (CFS)	Additional Residence Time (min.)	Adjusted Time of Concentration (min.)
2 YR/24 HR	0.259	37.323	41.523
10 YR/24 HR	0.698	33.691	37.891
50 YR/24 HR	1.368	33.346	37.546
100 YR/24 HR	1.743	29.461	33.661

INFILTRATION BERM DEWATERING CALCULATION SITE NAME: Shade Valley

DA 1

STORAGE VOLUME	3,081	CF	
DESIGN INFILTRATION RATE	2.9	IN/HR	BASED ON IT-D
INFILTRATION AREA	2,758	SF	

DEWATERING TIME = STORAGE VOLUME / ((DESIGN INFILTRATION RATE /12) * INFILTRATION AREA)

DEWATERING TIME = 4.6 HOURS

WORKSHEET 1. GENERAL SITE INFORMATION

Date: November 11, 2016

Project Name: Shade Valley

Municipality: Tell

County: Huntingdon

Total Area (acres): DA2 - 3.43 acres (pre), 3.40 acres (post)

Major River Basin: Susquehanna River

Watershed: Juniata River

Sub Basin: Tuscarora Creek

Nearest Surface Water to Receive Runoff: George Creek

Chapter 93 - Designated Water Use: Cold Water Fishes (CWF)

Impaired according to Chapter 303(d) list?	YES	
List Causes of Impairment:	NO	X

Is Project Subject to, or Part of:

Municipal Separate Storm Sewer System (MS4) Requirements	YES	
	NO	X
Existing or Planned drinking water supply?	YES	
	NO	X
If yes, distance from proposed discharge (miles):		
Approved Act 167 Plan?	YES	
	NO	X
Existing River Conservation Plan?	YES	X
	NO	

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

   See pre-development drainage area map

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

   Woodlands - 0.09 acres

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

   0.00 acres

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? Yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A		
Floodplains	N/A		
Riparian Areas	N/A		
Wetlands	N/A		
Woodlands	Yes	0.09	
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
TOTAL EXISTING:		**0.09**	**0.00**

Worksheet 3. Nonstructural BMP Credits

PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2) 0.00 **Ac.**

1.2 Area of Riparian Forest Buffer Protection 0.00 **Ac.**

3.1 Area of Minimum Disturbance/Reduced Grading 0.00 **Ac**

TOTAL 0.00 **Ac**

Site Area	Minus	Protected Area	=	Stormwater Management Area
1.78	-	0	=	1.78

This is the area that requires stormwater management

VOLUME CREDITS

3.1 Minimum Soil Compaction (See Chapter 8, page 22 – SW BMP Manual)

Lawn _____ ft^2 x 1/4" x 1/12 = _____ ft^3

Meadow _____ ft^2 x 1/3" x 1/12 = _____ ft^3

3.3 Protect Existing Trees (See Chapter 8, page 23 – SW BMP Manual)

For Trees within 100 feet of impervious area:

Tree Canopy _____ ft^2 x 1/2" x 1/12 = _____ ft^3

5.1 Disconnect Roof Leaders to Vegetated Areas (See Chapter 8 page 25 – SW BMP Manual)

For runoff directed to areas protected under 5.8.1 and 5.8.2

Roof Area _____ ft^2 x 1/3" x 1/12 = _____ ft^3

For all other disconnected roof areas

Roof Area _____ ft^2 x 1/4" x 1/12 = _____ ft^3

5.2 Disconnect Non-Roof impervious to Vegetated Areas (See Chapter 8, page 26 – SW BMP Manual)

For Runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Area _____ ft^2 x 1/3" x 1/12 = _____ ft^3

For all other disconnected roof areas

Impervious Area _____ ft^2 x 1/4" x 1/12 = _____ ft^3

TOTAL NON-STRUCTURAL VOLUME CREDIT* _____ ft^3

**For use on Worksheet 5*

WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: Shade Valley - DA2
Drainage Area: 3.43 acres (pre; 3.40 acres post)
2-Year Rainfall: 2.74 in

Total Site Area: 1.77 acres (pre; 1.74 acres post)
Protected Site Area: N/A acres
Managed Site Area: 1.77 acres (pre; 1.74 acres post)

Existing Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[3] (ft^3)
Meadow	B	59,677	1.37	58	7.24	1.45	0.20	972
Meadow	D	4,356	0.10	78	2.82	0.56	0.95	344
Impervious	-	7,405	0.17	98	0.20	0.04	2.51	1,549
Impervious - 20% as meadow	D	1,742	0.04	78	2.82	0.56	0.95	138
Woods	B	0	0.00	55	8.18	1.64	0.13	0
Woods	D	3,920	0.09	77	2.99	0.60	0.89	292
TOTAL:		**77,101**	**1.77**					**3,295**

Developed Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[3] (ft^3)
Meadow	B	50,965	1.17	58	7.24	1.45	0.20	830
Meadow	D	8,276	0.19	78	2.82	0.56	0.95	654
Impervious	-	9,148	0.21	98	0.20	0.04	2.51	1,913
Impervious - Gravel	B	7,405	0.17	85	1.76	0.35	1.37	847
Impervious - Gravel	D	0	0.00	91	0.99	0.20	1.83	0
TOTAL:		**75,794**	**1.74**					**4,244**

2-Year Volume Increase (ft^3):	**949**

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = Q = (P - 0.2S)2 / (P+ 0.8S) where
   P = 2-Year Rainfall (in)
   S = (1000/CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12
   Q = Runoff (in)
   Area = Land use area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.
The use of a weighted CN value for volume calculations is not acceptable.

Worksheet 5. Structural BMP Volume Credits

PROJECT: Shade Valley
SUB-BASIN:

Required Control Volume (ft^3) - *from Worksheet 4:* 949

Non-structural Volume Credit (ft^3) - *from Worksheet 3:* N/A
(maximum is 25% of required volume)

Structural Volume Reqmt (ft^3) 949
(Required Control Volume minus Non-structural Credit)

Proposed BMPs from PA Stormwater Best Management Practices Manual Chapter 6		Area (ft^2)	Volume Reduction Permanently Removed (ft^3)
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well/Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm	1,423	1,642
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-Use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond/Retention Basin		
6.7.1	Riparian Buffer/Riparian Forest Buffer Restoration		
6.7.2	Landscape Restoration/Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other:			
		Total Structural Volume (ft^3):	**1,642**
		Structural Volume Requirement (ft^3):	**949**
		DIFFERENCE:	**-693**

VOLUME CREDIT DETERMINATION - BERM A

1	Detained area runoff volume from Hydraflow	=	1,001	cf
2a	Storage volume of the BMP	=	2,704	cf
2b	Infiltrated volume within 2 hours after the 2-yr/24-hr event (Infiltration Rate/12) x Infiltration Area x 2 hrs	=	911	cf
2 (total)	2a + 2b	=	3,615	cf

VOLUME CREDIT DETERMINATION - BERM B

1	Detained area runoff volume from Hydraflow	=	641	cf
2a	Storage volume of the BMP	=	2,530	cf
2b	Infiltrated volume within 2 hours after the 2-yr/24-hr event (Infiltration Rate/12) x Infiltration Area x 2 hrs	=	321	cf
2 (total)	2a + 2b	=	2,851	cf

WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers		
NS BMP 5.5.4 - Cluster Uses at Each Site		
NS BMP 5.6.1 - Minimize Total Disturbed Area	X	
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native Species)	X	
NS BMP 5.9.1 - Street Sweeping / Vacuuming		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		

SECONDARY BMPs FOR NITRATE:

NS BMP 5.4.1 - Protect Sensitive / Special Value Features		
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features		
NS BMP 5.6.2 - Minimize Soil Compaction	X	
Structural BMP 6.4.5 - Rain Garden / Bioretention		
Structural BMP 6.4.8 - Vegetated Swale		
Structural BMP 6.4.9 - Vegetated Filter Strip		
Structural BMP 6.6.1 - Constructed Wetland		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		
Structural BMP 6.7.3 - Soils Amendment/Restoration	X	

TIME OF CONCENTRATION ADJUSTMENT - BERM A

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 9.7 MIN

STRUCTURAL VOLUME PROVIDED BY BMP 1,001 CF FOR 2-YR/24-HR EVENT
2,079 CF FOR 10-YR/24-HR EVENT
2,704 CF FOR ALL OTHER STORM EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.431
10 YR/24 HR	0.909
50 YR/24 HR	1.598
100 YR/24 HR	1.975

ADDITIONAL RESIDENCE TIME (MIN) = (STRUCTURAL VOLUME PROVIDED BY BMP / RATE OF RUNOFF TO BMP) / 60

Storm Event	Q (CFS)	Additional Residence Time (min.)
2 YR/24 HR	0.431	38.708
10 YR/24 HR	0.909	38.119
50 YR/24 HR	1.598	28.202
100 YR/24 HR	1.975	22.819

ADJUSTED TC = POST CONSTRUCTION TC TO BMP BEFORE ADJUSTMENT + ADDITIONAL RESIDENCE TIME

Storm Event	Q (CFS)	Additional Residence Time (min.)	Adjusted Time of Concentration (min.)
2 YR/24 HR	0.431	38.708	48.408
10 YR/24 HR	0.909	38.119	47.819
50 YR/24 HR	1.598	28.202	37.902
100 YR/24 HR	1.975	22.819	32.519

TIME OF CONCENTRATION ADJUSTMENT - BERM B

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 3.4 MIN

STRUCTURAL VOLUME PROVIDED BY BMP 641 CF FOR 2-YR/24-HR EVENT
1,642 CF FOR 10-YR/24-HR EVENT
2,530 CF FOR ALL OTHER EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.268
10 YR/24 HR	0.804
50 YR/24 HR	1.641
100 YR/24 HR	2.115

ADDITIONAL RESIDENCE TIME (MIN) = (STRUCTURAL VOLUME PROVIDED BY BMP / RATE OF RUNOFF TO BMP) / 60

Storm Event	Q (CFS)	Additional Residence Time (min.)
2 YR/24 HR	0.268	39.863
10 YR/24 HR	0.804	34.038
50 YR/24 HR	1.641	25.696
100 YR/24 HR	2.115	19.937

ADJUSTED TC = POST CONSTRUCTION TC TO BMP BEFORE ADJUSTMENT + ADDITIONAL RESIDENCE TIME

Storm Event	Q (CFS)	Additional Residence Time (min.)	Adjusted Time of Concentration (min.)
2 YR/24 HR	0.268	39.863	43.263
10 YR/24 HR	0.804	34.038	37.438
50 YR/24 HR	1.641	25.696	29.096
100 YR/24 HR	2.115	19.937	23.337

INFILTRATION BERM DEWATERING CALCULATION SITE NAME: Shade Valley

BERM A DA 2

STORAGE VOLUME	2,704	CF	
DESIGN INFILTRATION RATE	2.3	IN/HR	BASED ON IT-02 AND IT-A
INFILTRATION AREA	2,376	SF	

DEWATERING TIME = STORAGE VOLUME / ((DESIGN INFILTRATION RATE /12) * INFILTRATION AREA)

DEWATERING TIME = 5.9 HOURS

INFILTRATION BERM DEWATERING CALCULATION SITE NAME: Shade Valley

BERM B DA 2

STORAGE VOLUME	2,530	CF	
DESIGN INFILTRATION RATE	0.9	IN/HR	BASED ON IT-01 AND IT-B
INFILTRATION AREA	2,142	SF	

DEWATERING TIME = STORAGE VOLUME / ((DESIGN INFILTRATION RATE /12) * INFILTRATION AREA)

DEWATERING TIME = 15.7 HOURS

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.06000	ft/ft
Normal Depth	0.25	ft
Diameter	0.25	ft
Discharge	0.23	ft³/s

Results

Discharge	0.23	ft³/s
Normal Depth	0.25	ft
Flow Area	0.05	ft²
Wetted Perimeter	0.79	ft
Hydraulic Radius	0.06	ft
Top Width	0.00	ft
Critical Depth	0.25	ft
Percent Full	100.0	%
Critical Slope	0.05379	ft/ft
Velocity	4.78	ft/s
Velocity Head	0.35	ft
Specific Energy	0.60	ft
Froude Number	0.00	
Maximum Discharge	0.25	ft³/s
Discharge Full	0.23	ft³/s
Slope Full	0.06000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

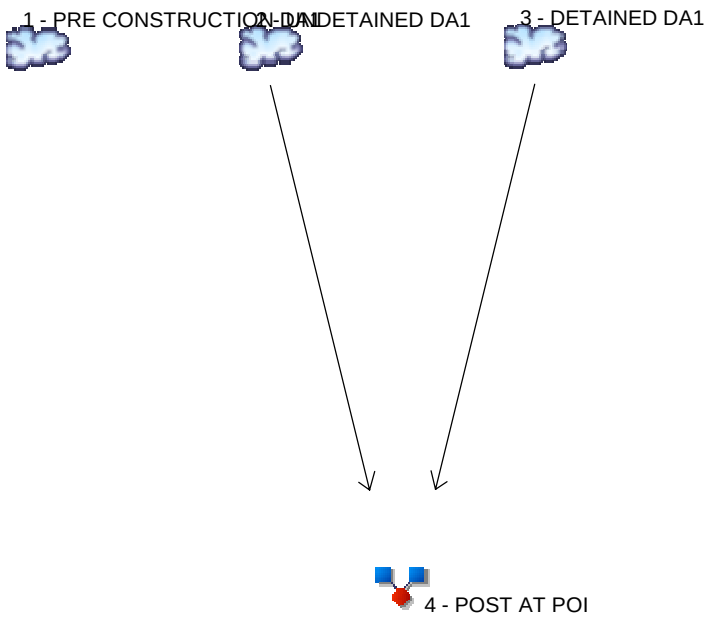
Worksheet for Circular Pipe - 1

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.25	ft
Channel Slope	0.06000	ft/ft
Critical Slope	0.05379	ft/ft

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA1
2	SCS Runoff	UNDETAINED DA1
3	SCS Runoff	DETAINED DA1
4	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	1.210	-------	-------	3.035	-------	5.782	7.344	PRE CONSTRUCTION DA1
2	SCS Runoff	------	-------	0.970	-------	-------	2.432	-------	4.632	5.884	UNDETAINED DA1
3	SCS Runoff	------	-------	0.259	-------	-------	0.698	-------	1.368	1.743	DETAINED DA1
4	Combine	2, 3	-------	1.144	-------	-------	2.974	-------	5.745	7.292	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	1.210	2	722	3,571	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	0.970	2	722	2,861	------	------	------	UNDETAINED DA1
3	SCS Runoff	0.259	2	718	580	------	------	------	DETAINED DA1
4	Combine	1.144	2	720	3,441	2, 3	------	------	POST AT POI

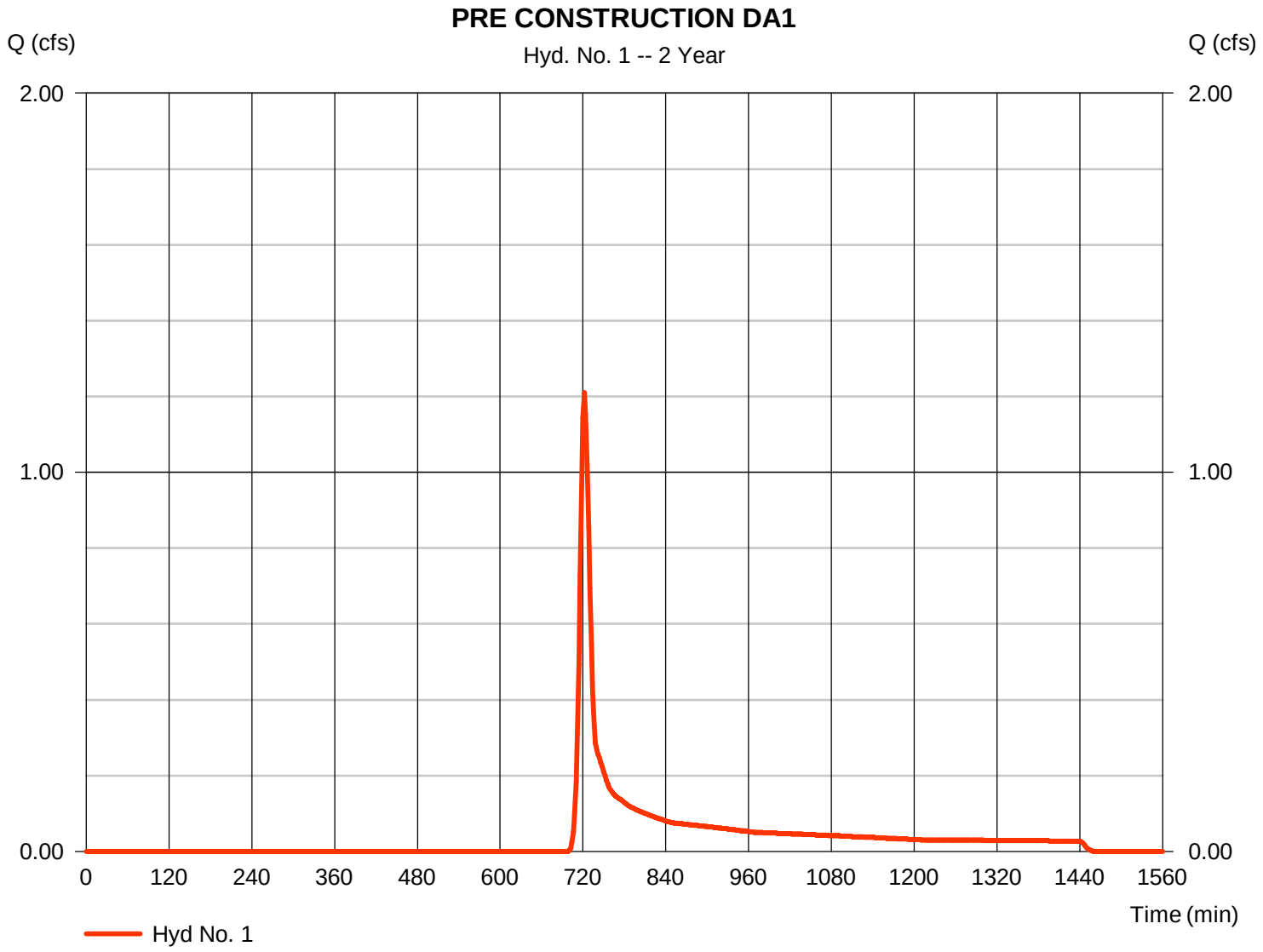
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.210 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 3,571 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 8.86**	**+**	**0.00**	**+**	**0.00**	**=**	**8.86**
Shallow Concentrated Flow							
Flow length (ft)	= 572.00		0.00		0.00		
Watercourse slope (%)	= 7.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.33		0.00		0.00		
Travel Time (min)	**= 2.20**	**+**	**0.00**	**+**	**0.00**	**=**	**2.20**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.000		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.10 min

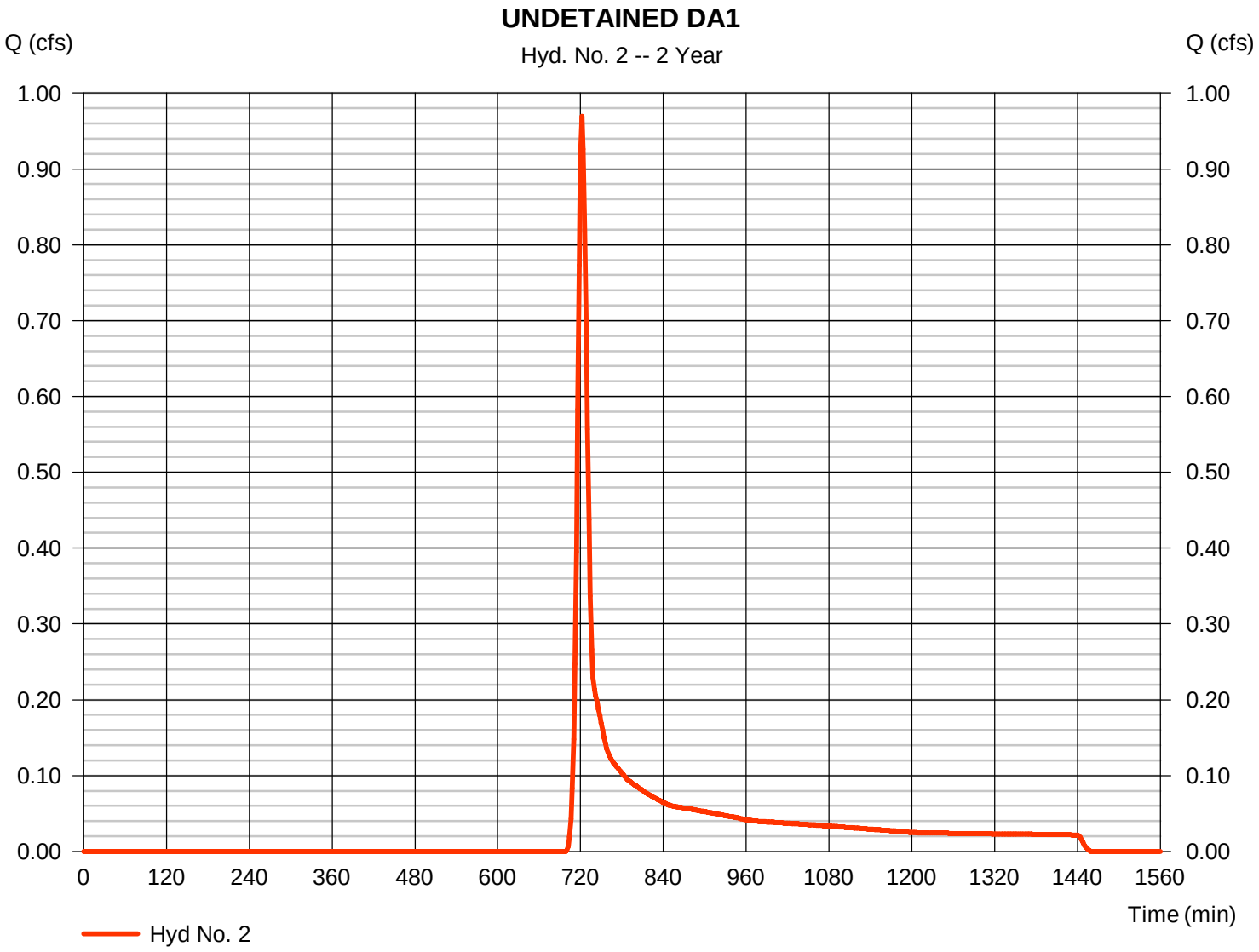
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.970 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 2,861 cuft
Drainage area	= 1.330 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.30 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



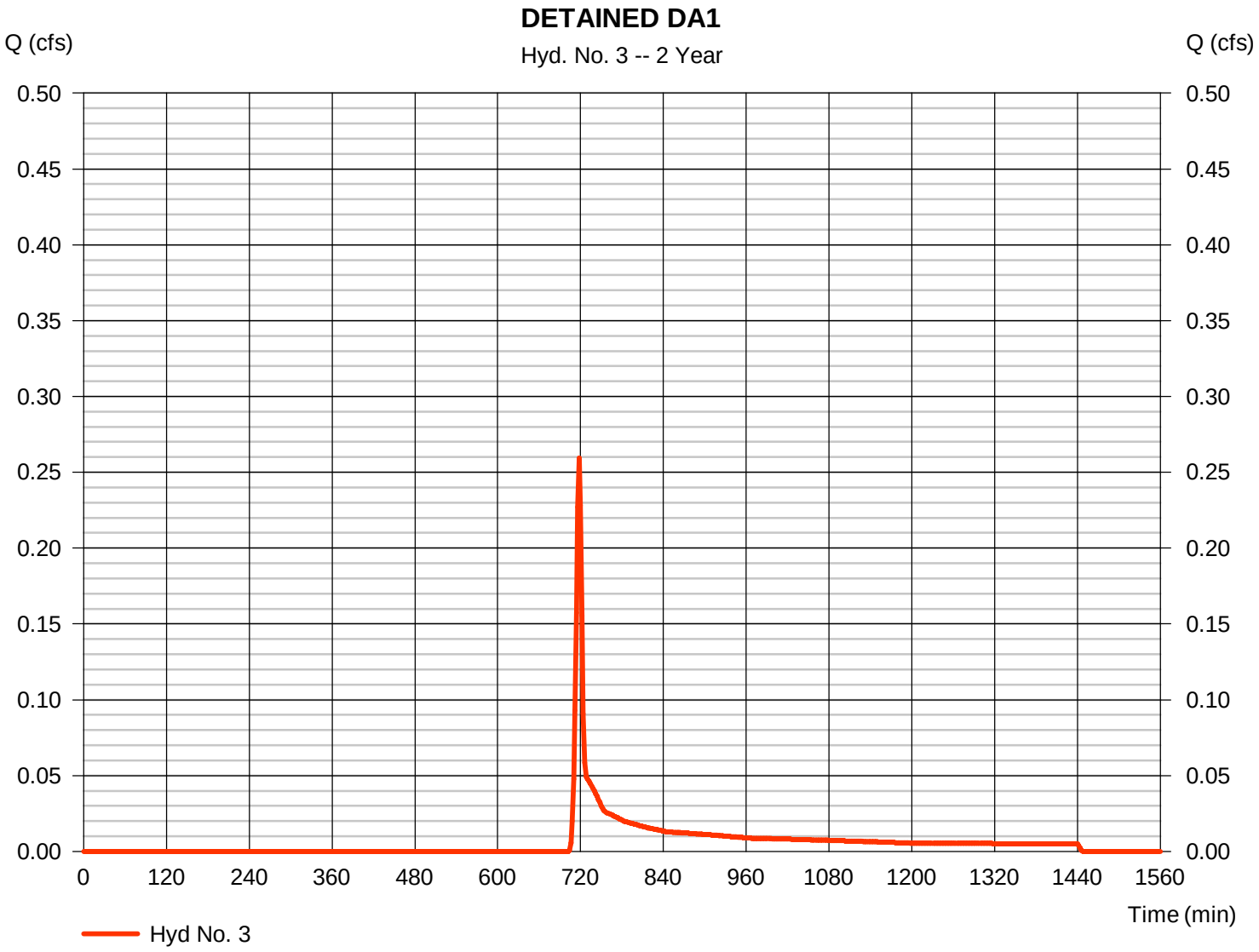
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.259 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 580 cuft
Drainage area	= 0.370 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 4.20 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370



TR55 Tc Worksheet

Hyd. No. 3

DETAINED DA1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 18.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 5.60		0.00		0.00		
Travel Time (min)	**= 2.59**	**+**	**0.00**	**+**	**0.00**	**=**	**2.59**
Shallow Concentrated Flow							
Flow length (ft)	= 421.00		0.00		0.00		
Watercourse slope (%)	= 4.80		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=4.45		0.00		0.00		
Travel Time (min)	**= 1.58**	**+**	**0.00**	**+**	**0.00**	**=**	**1.58**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

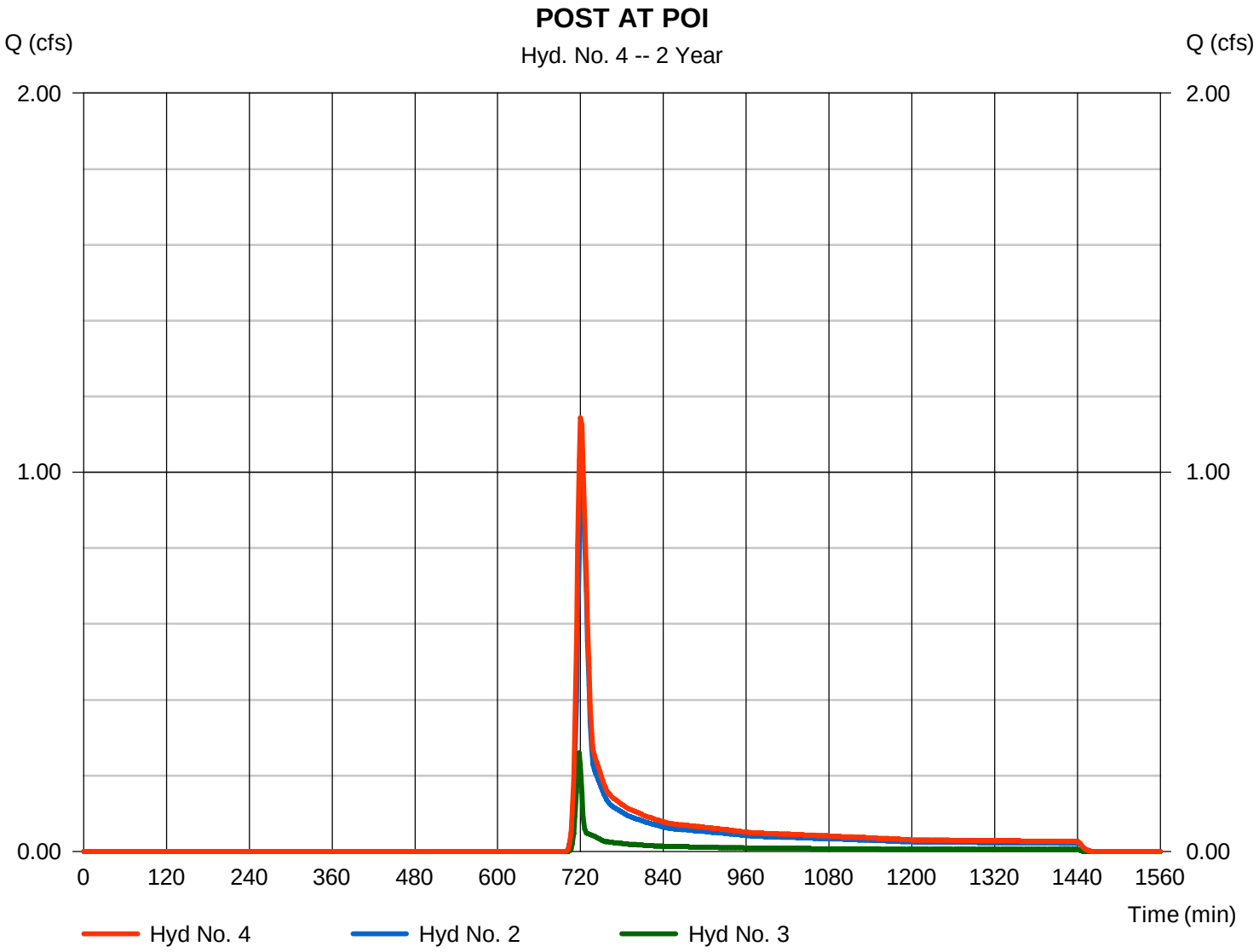
Total Travel Time, Tc ..... 4.20 min

Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	1.144 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	3,441 cuft
Inflow hyds.	=	2, 3	Contrib. drain. area	=	1.700 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	3.035	2	722	8,097	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	2.432	2	722	6,488	------	------	------	UNDETAINED DA1
3	SCS Runoff	0.698	2	718	1,411	------	------	------	DETAINED DA1
4	Combine	2.974	2	720	7,898	2, 3	------	------	POST AT POI

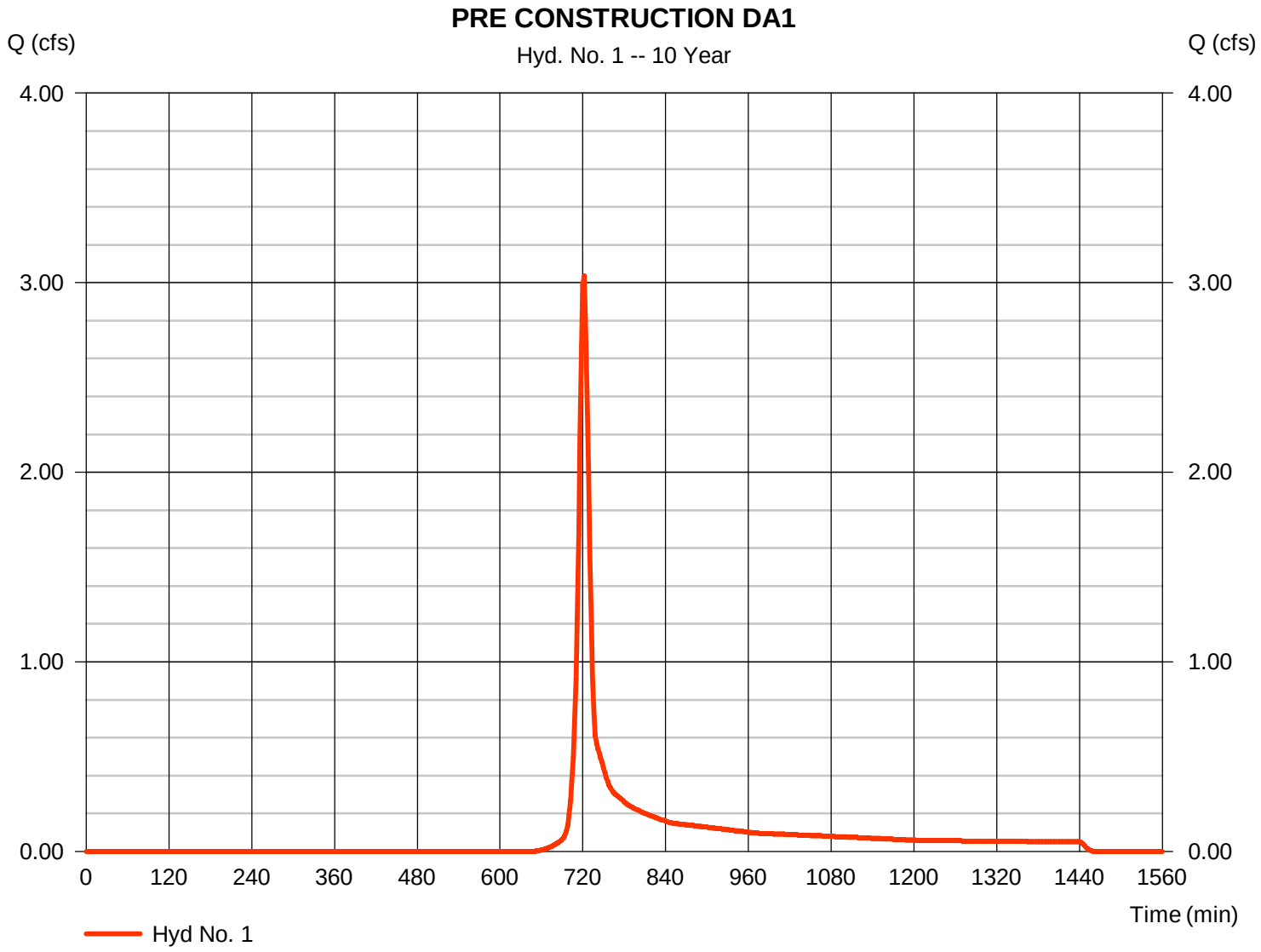
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.035 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 8,097 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 3.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



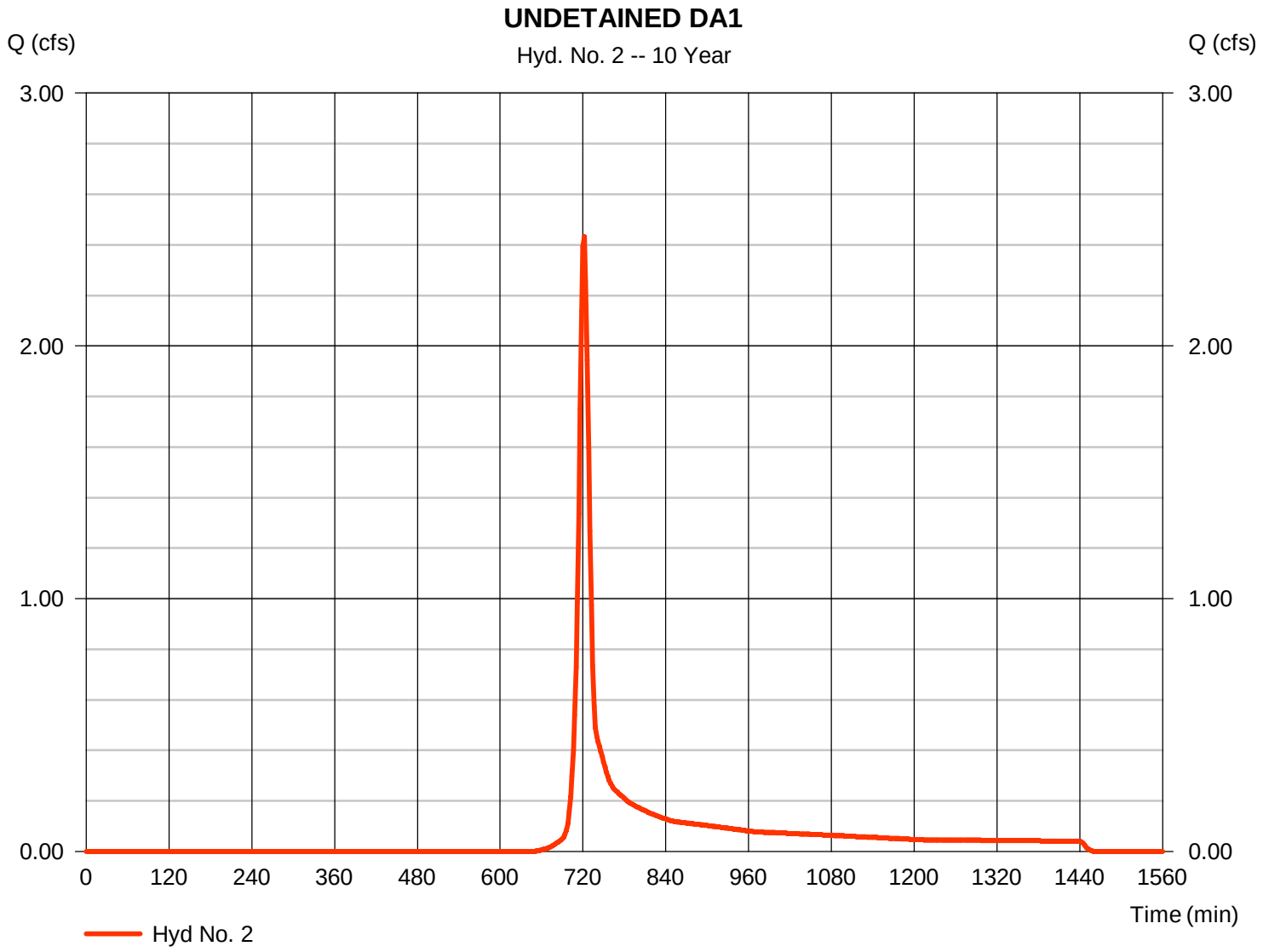
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.432 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	6,488 cuft
Drainage area	=	1.330 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.30 min
Total precip.	=	3.96 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



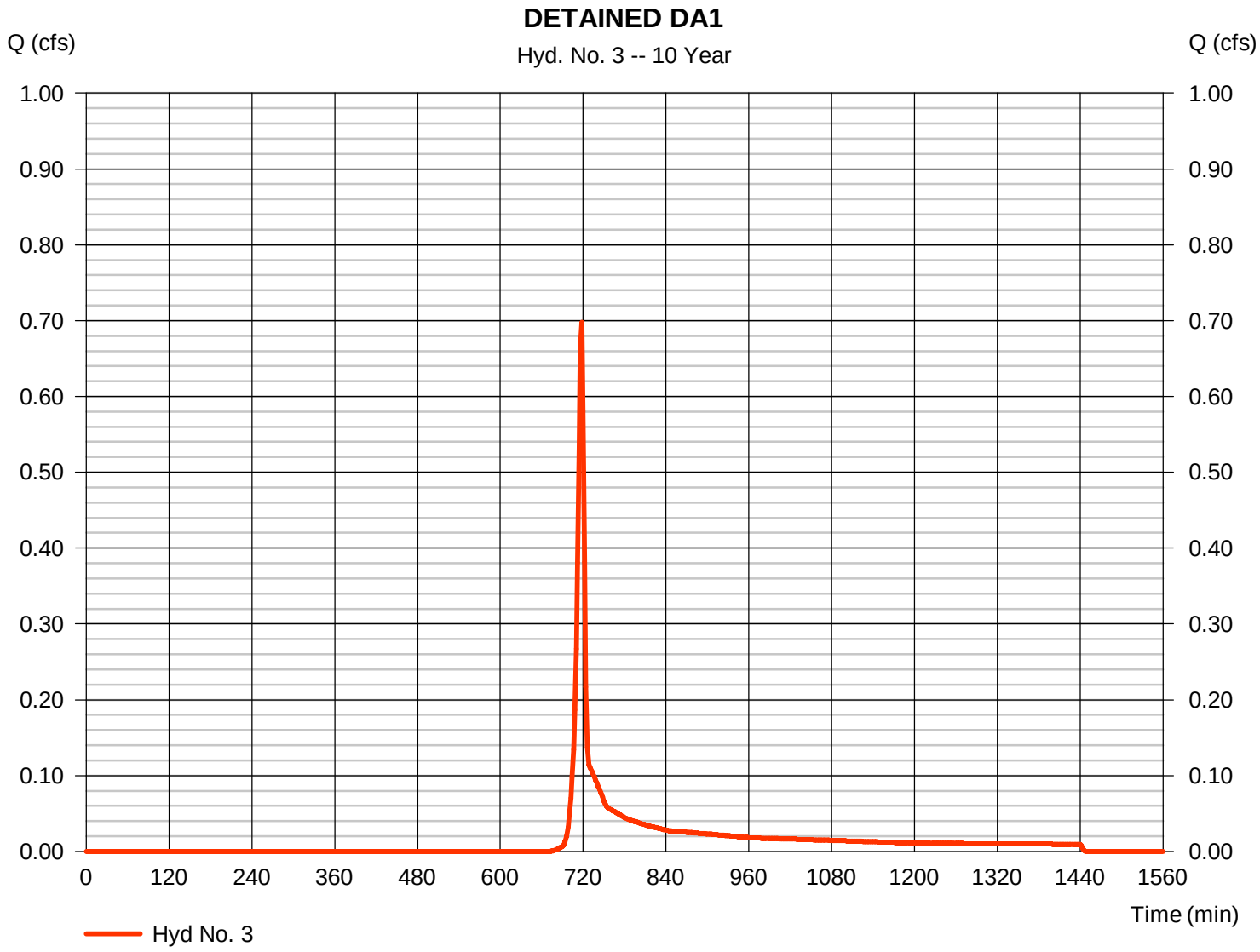
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.698 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	1,411 cuft
Drainage area	=	0.370 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.20 min
Total precip.	=	3.96 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370

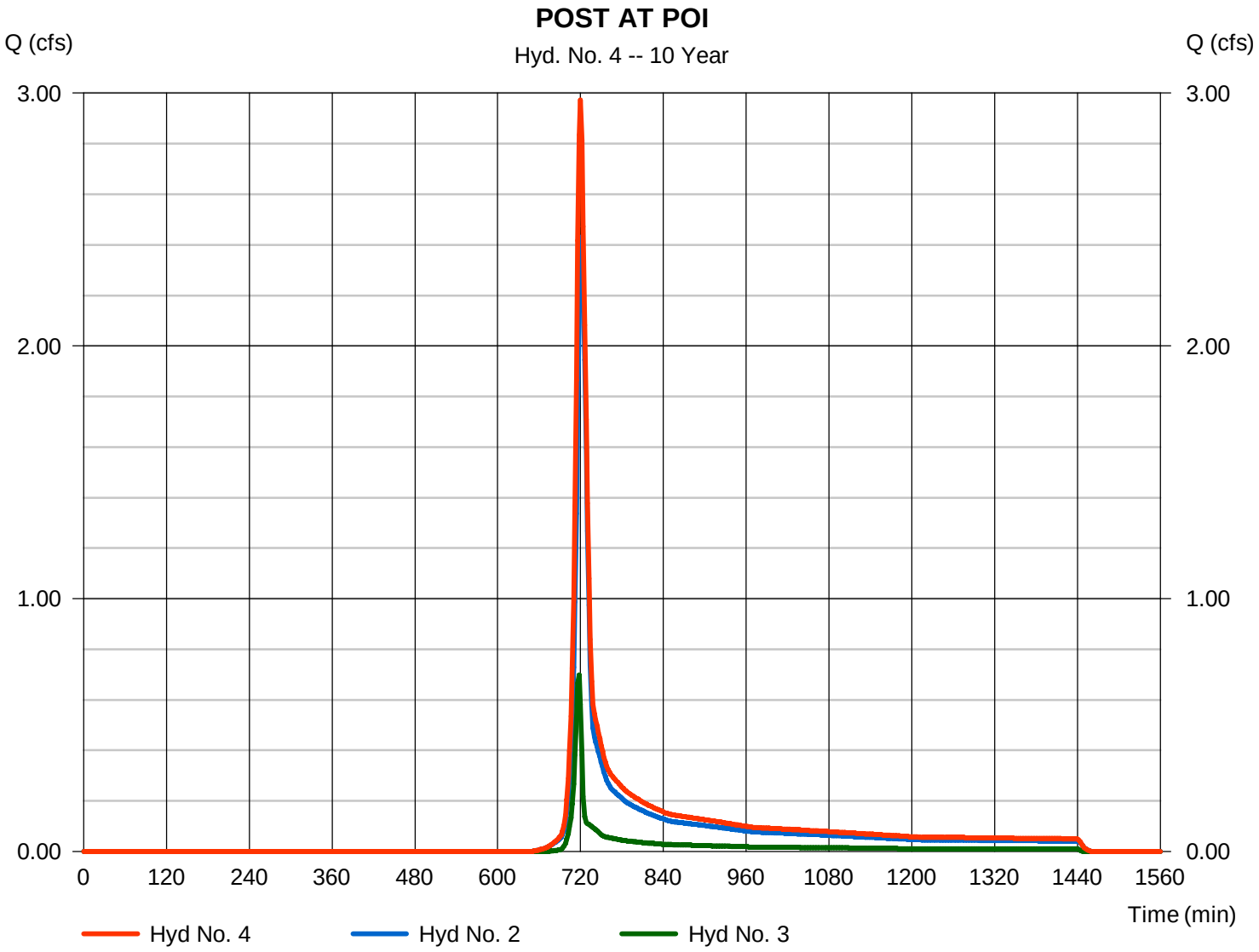


Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	2.974 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	7,898 cuft
Inflow hyds.	=	2, 3	Contrib. drain. area	=	1.700 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	5.782	2	720	15,098	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	4.632	2	720	12,097	------	------	------	UNDETAINED DA1
3	SCS Runoff	1.368	2	718	2,737	------	------	------	DETAINED DA1
4	Combine	5.745	2	720	14,834	2, 3	------	------	POST AT POI

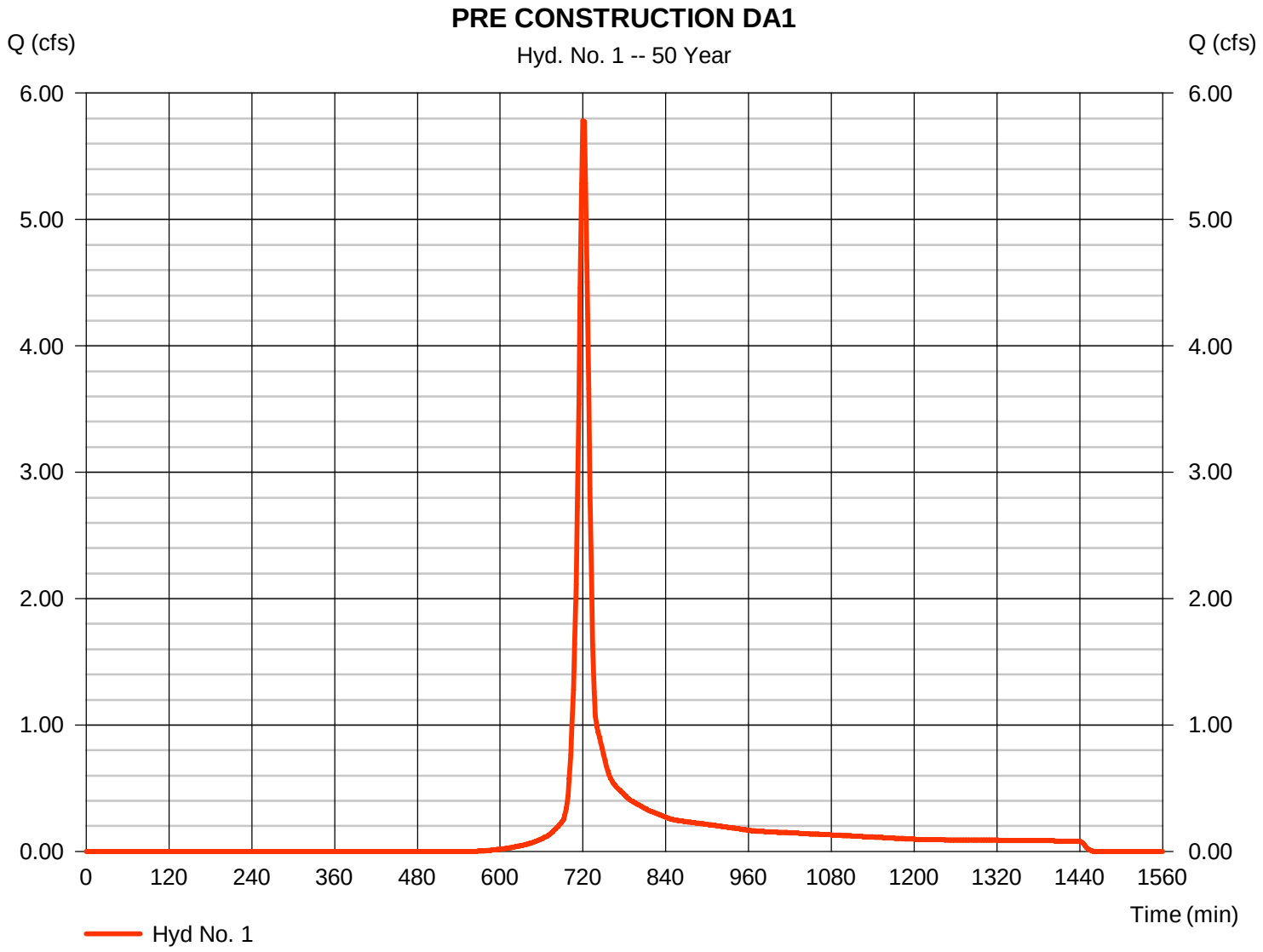
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 5.782 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 15,098 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 5.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



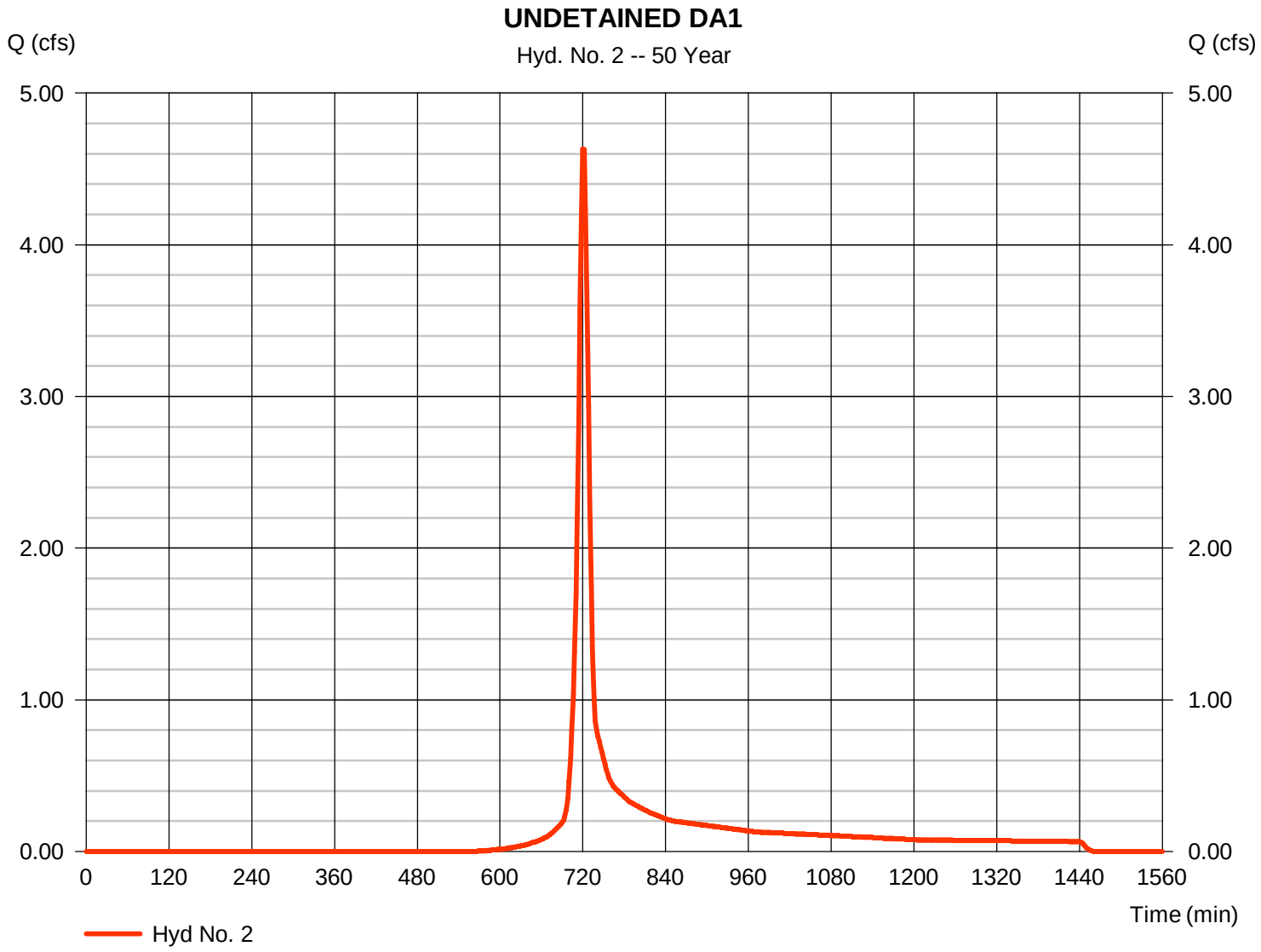
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.632 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	12,097 cuft
Drainage area	=	1.330 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.30 min
Total precip.	=	5.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



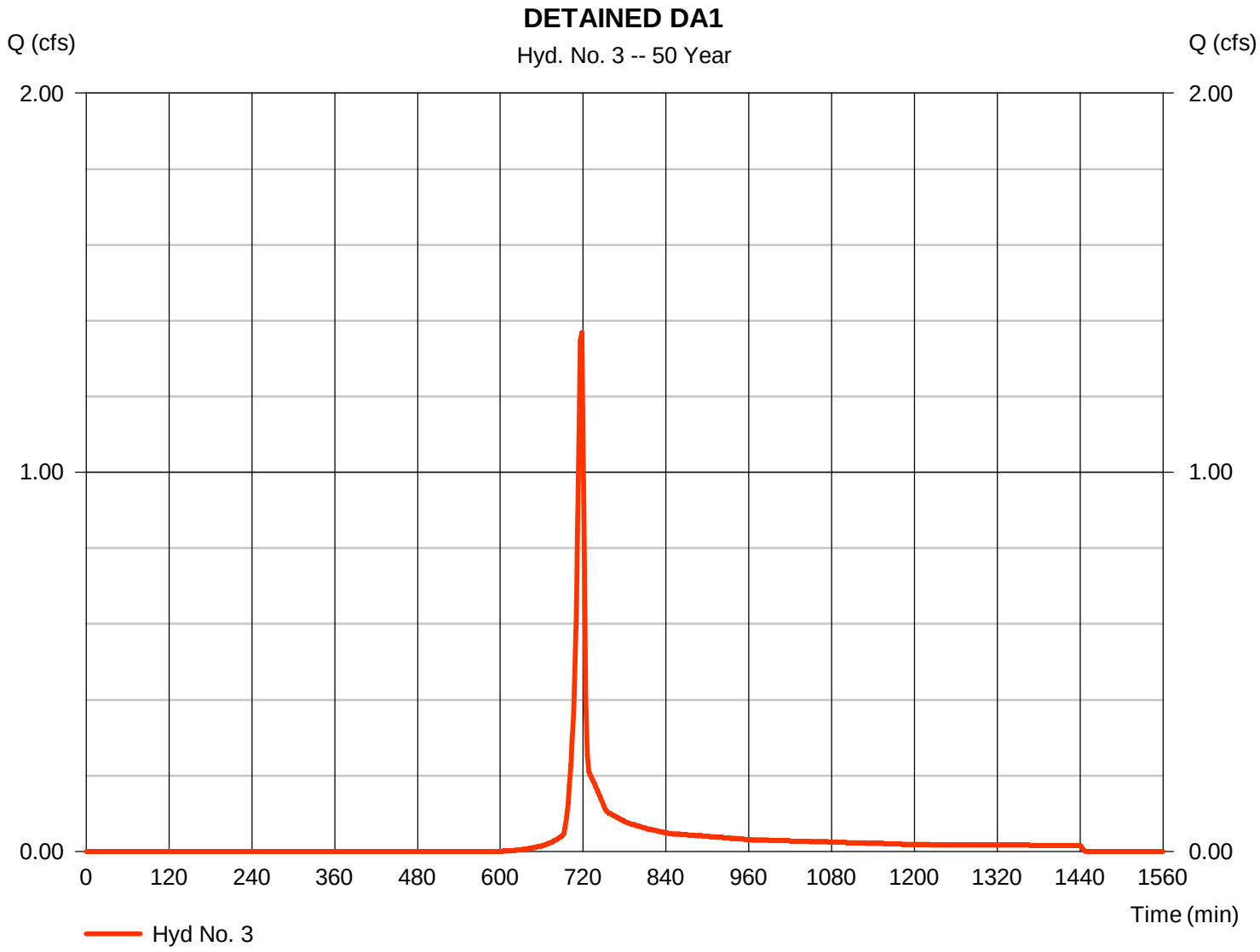
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.368 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	2,737 cuft
Drainage area	=	0.370 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.20 min
Total precip.	=	5.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370

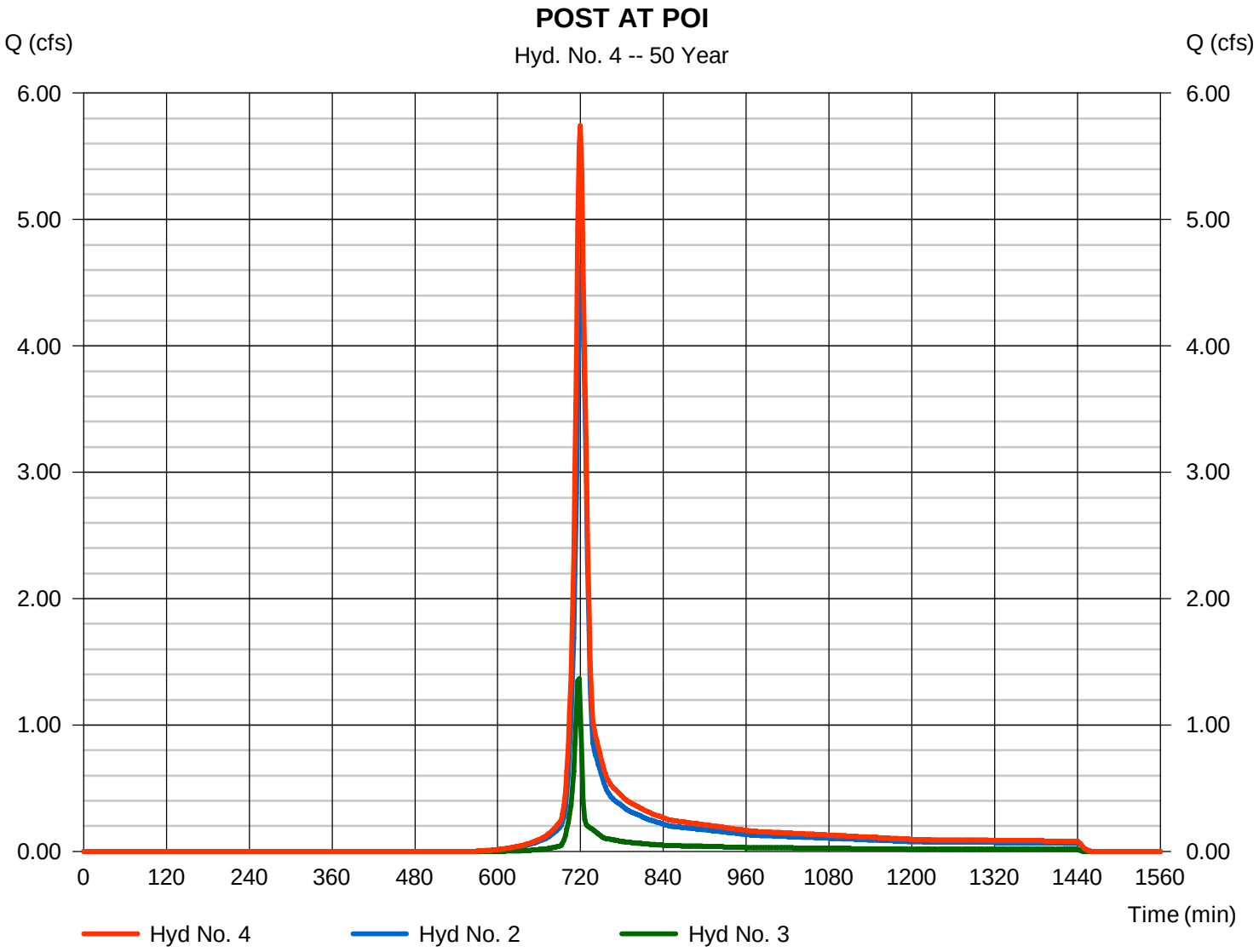


Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 5.745 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 14,834 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 1.700 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	7.344	2	720	19,073	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	5.884	2	720	15,281	------	------	------	UNDETAINED DA1
3	SCS Runoff	1.743	2	718	3,503	------	------	------	DETAINED DA1
4	Combine	7.292	2	720	18,784	2, 3	------	------	POST AT POI

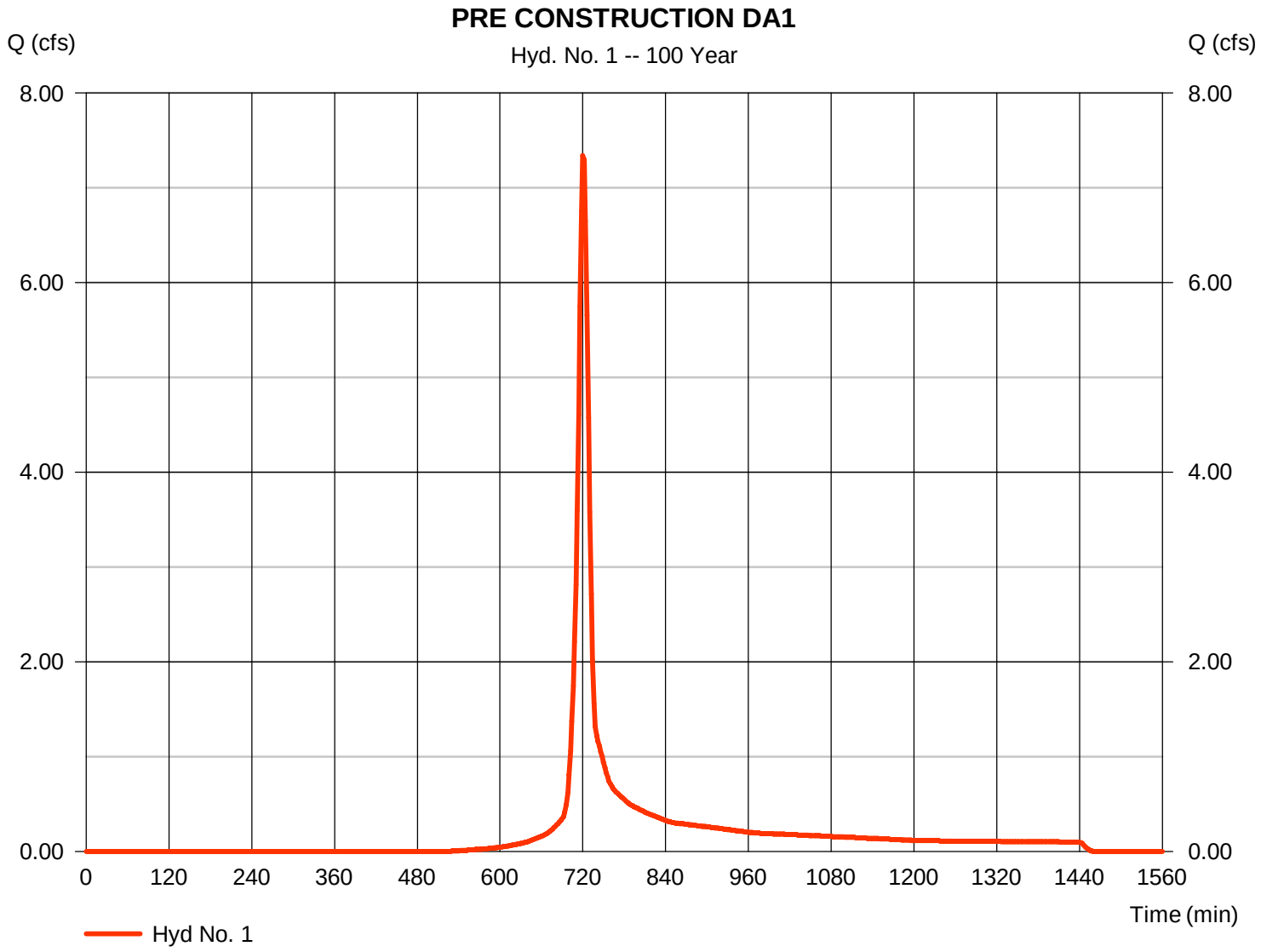
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 7.344 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 19,073 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



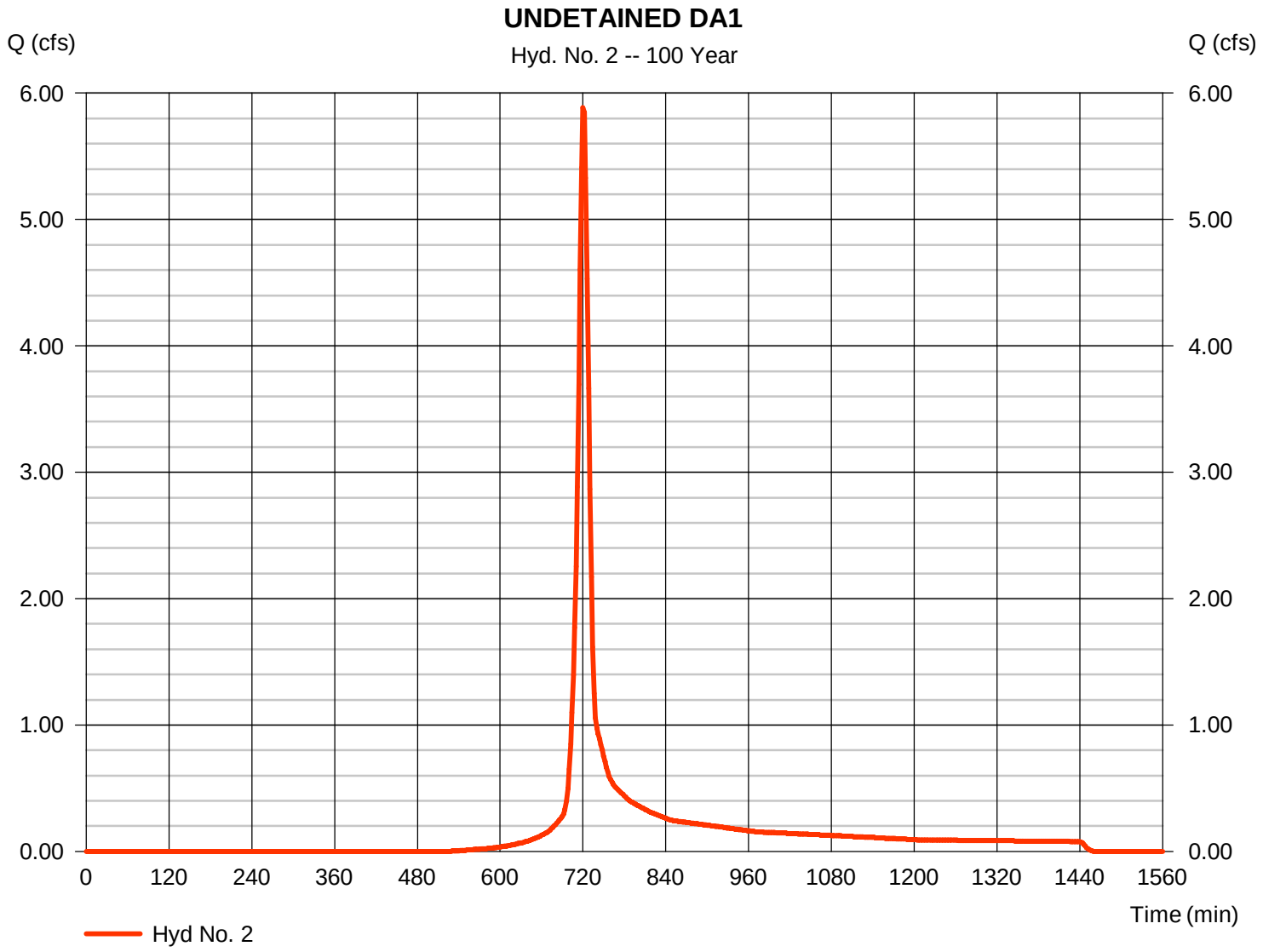
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.884 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	15,281 cuft
Drainage area	=	1.330 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.30 min
Total precip.	=	6.33 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



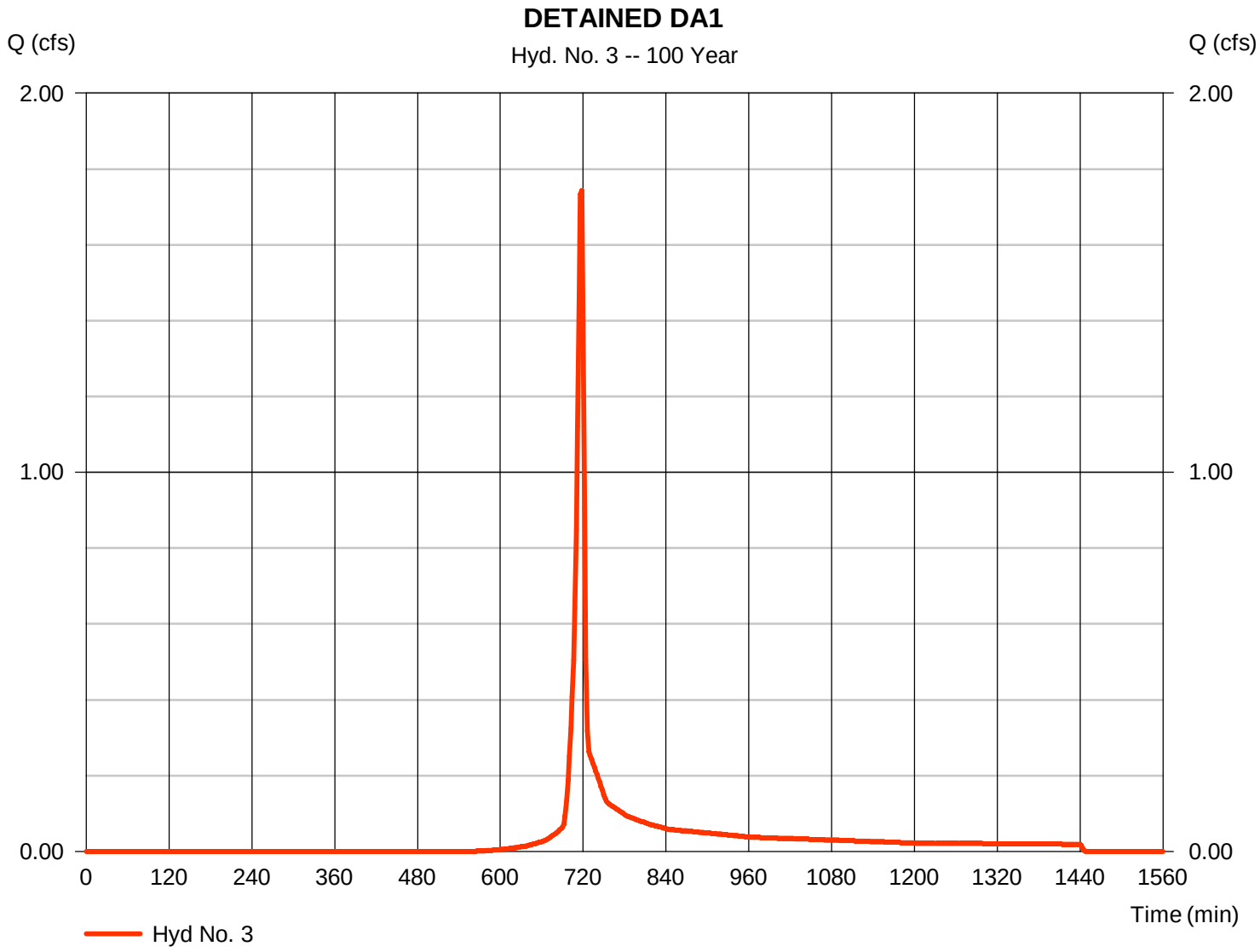
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.743 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	3,503 cuft
Drainage area	=	0.370 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.20 min
Total precip.	=	6.33 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370

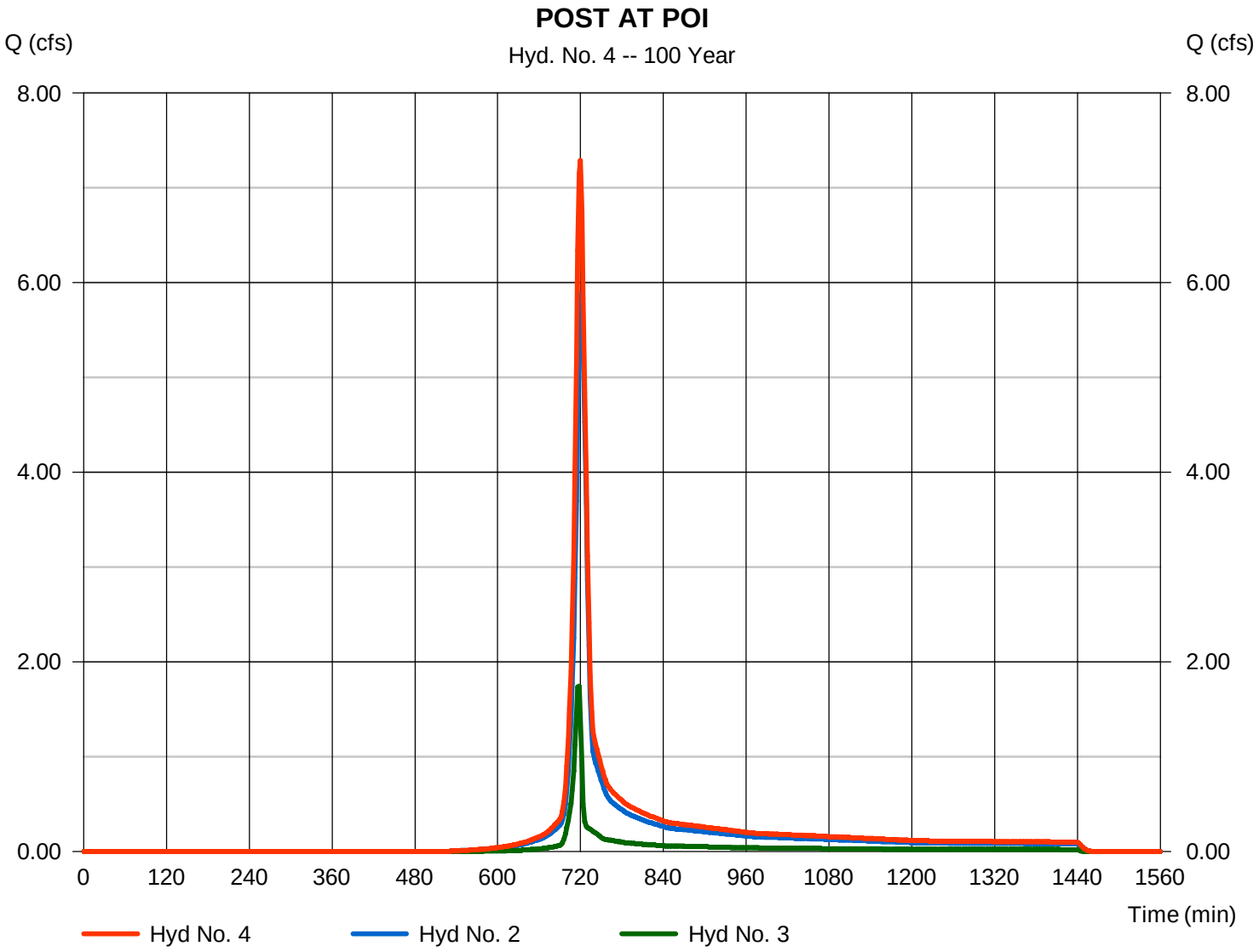


Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 7.292 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 18,784 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 1.700 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

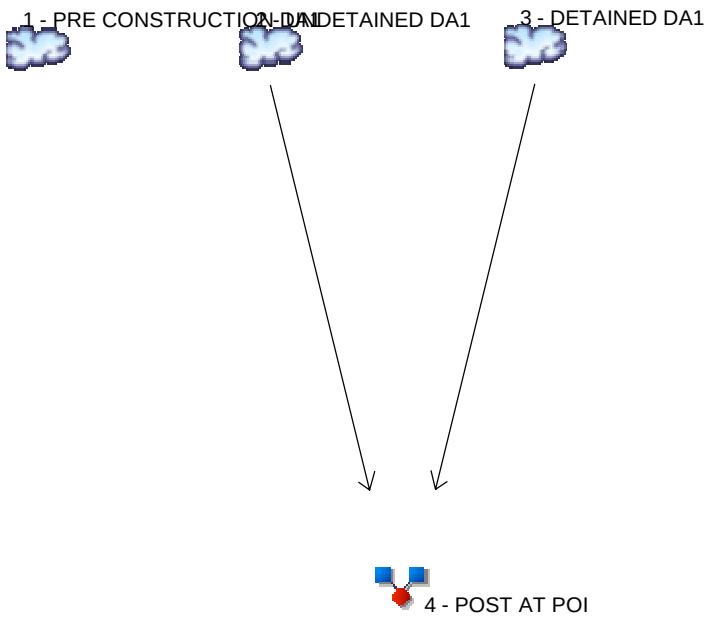
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA1
2	SCS Runoff	UNDETAINED DA1
3	SCS Runoff	DETAINED DA1
4	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	1.210	-------	-------	-------	-------	-------	-------	PRE CONSTRUCTION DA1
2	SCS Runoff	------	-------	0.970	-------	-------	-------	-------	-------	-------	UNDETAINED DA1
3	SCS Runoff	------	-------	0.085	-------	-------	-------	-------	-------	-------	DETAINED DA1
4	Combine	2, 3	-------	0.997	-------	-------	-------	-------	-------	-------	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	1.210	2	722	3,571	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	0.970	2	722	2,861	------	------	------	UNDETAINED DA1
3	SCS Runoff	0.085	2	742	625	------	------	------	DETAINED DA1
4	Combine	0.997	2	722	3,486	2, 3	------	------	POST AT POI

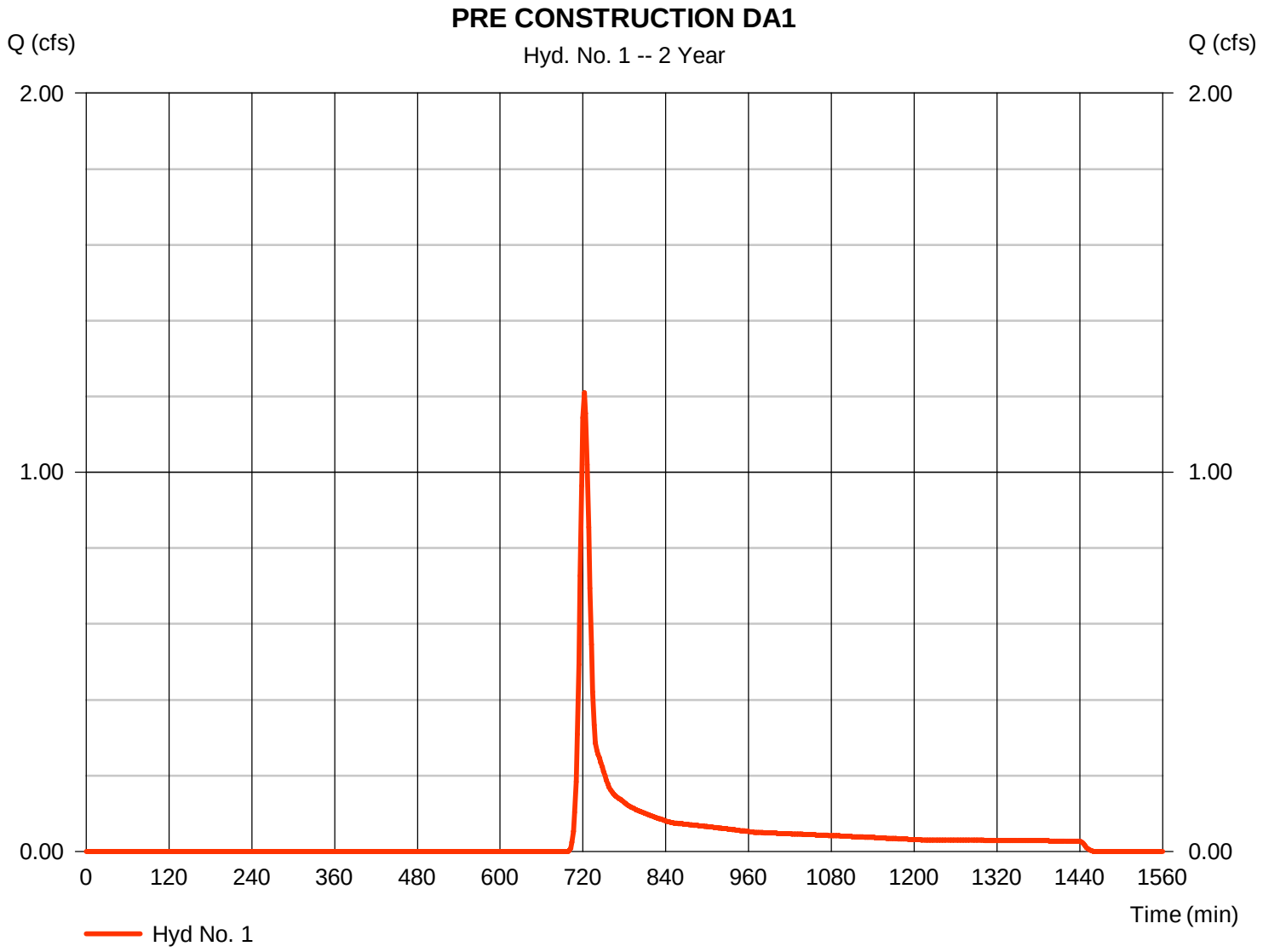
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.210 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 3,571 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 8.86**	**+**	**0.00**	**+**	**0.00**	**=**	**8.86**
Shallow Concentrated Flow							
Flow length (ft)	= 572.00		0.00		0.00		
Watercourse slope (%)	= 7.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.33		0.00		0.00		
Travel Time (min)	**= 2.20**	**+**	**0.00**	**+**	**0.00**	**=**	**2.20**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.000		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.10 min

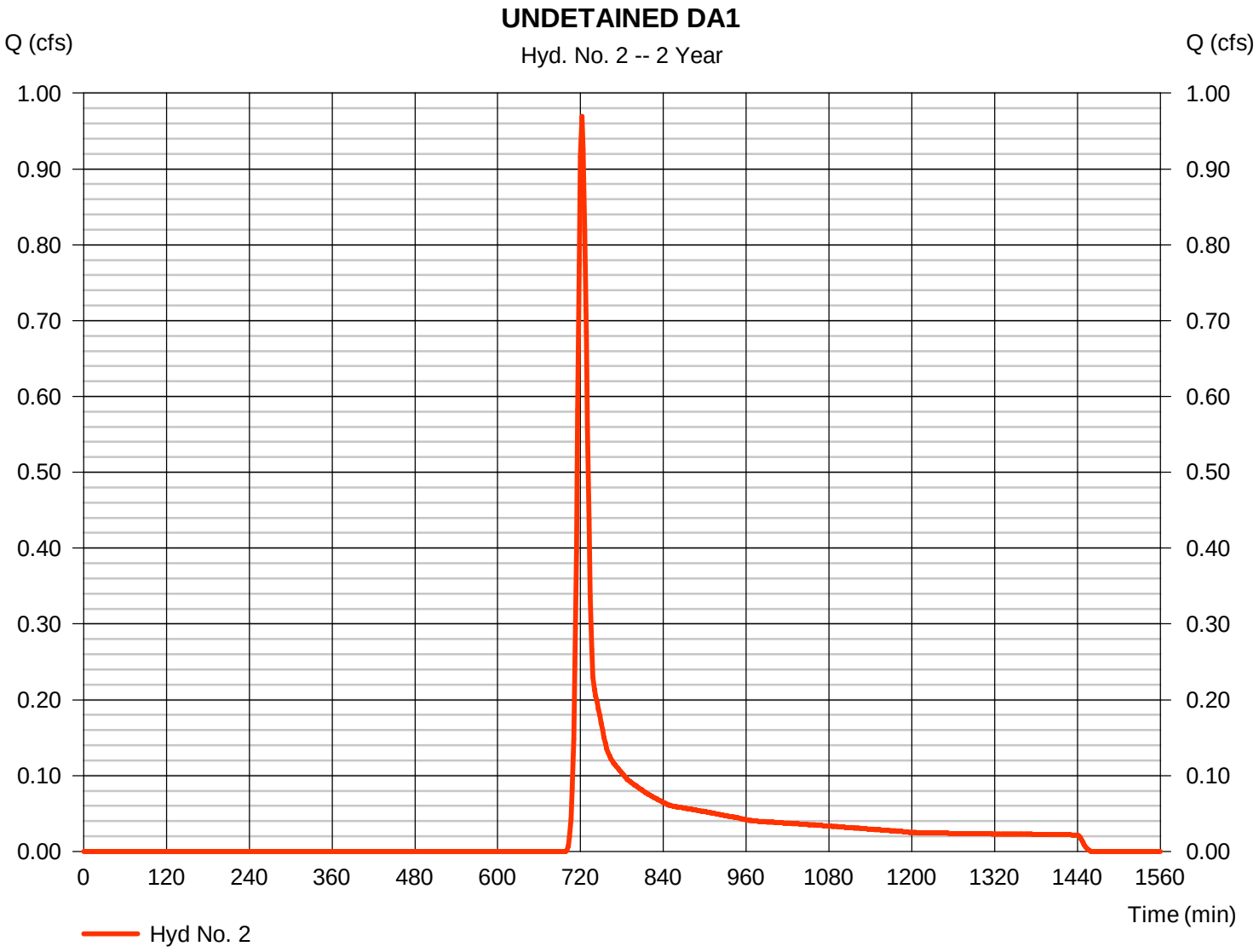
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.970 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 2,861 cuft
Drainage area	= 1.330 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.30 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



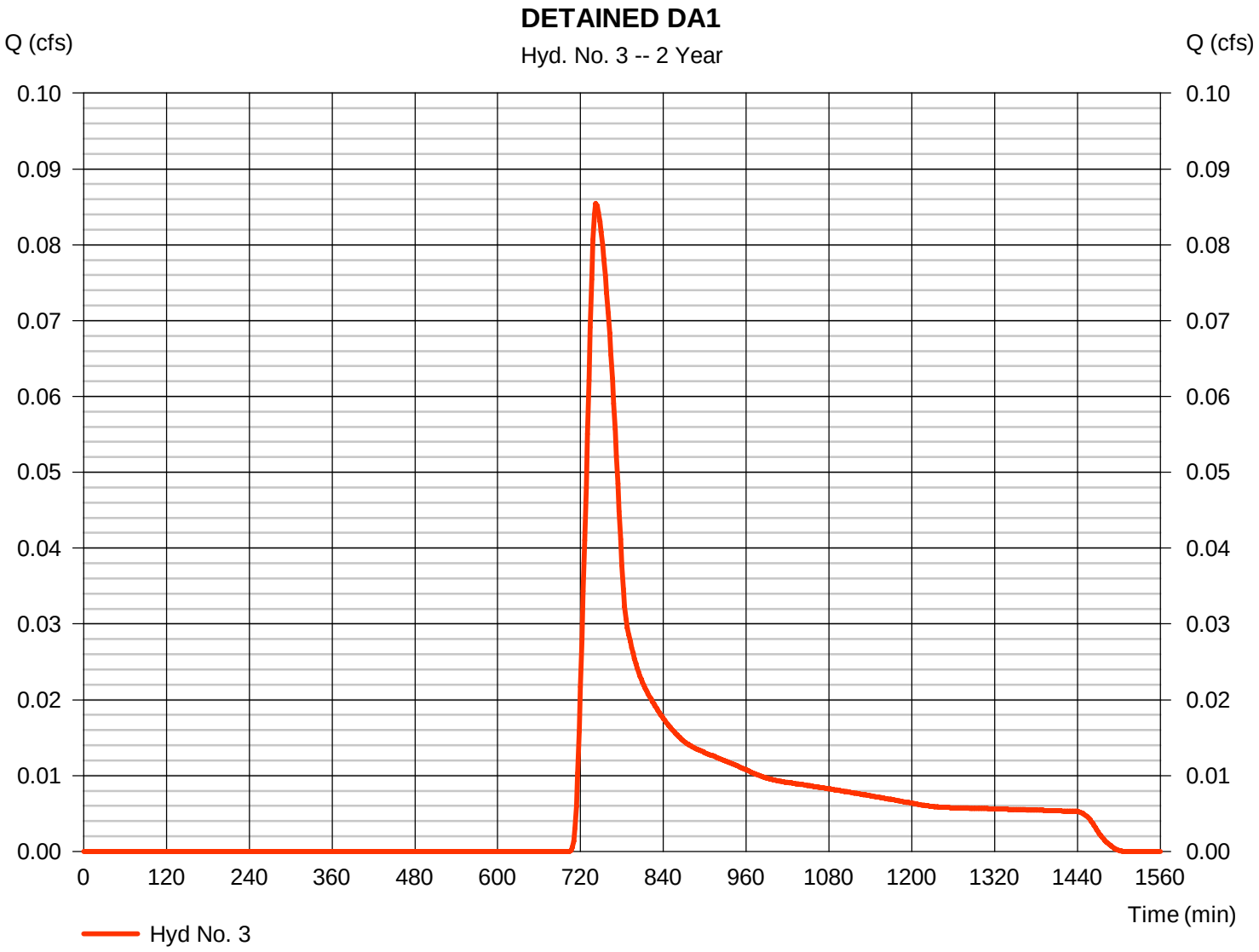
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.085 cfs
Storm frequency	= 2 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 625 cuft
Drainage area	= 0.370 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 41.52 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370

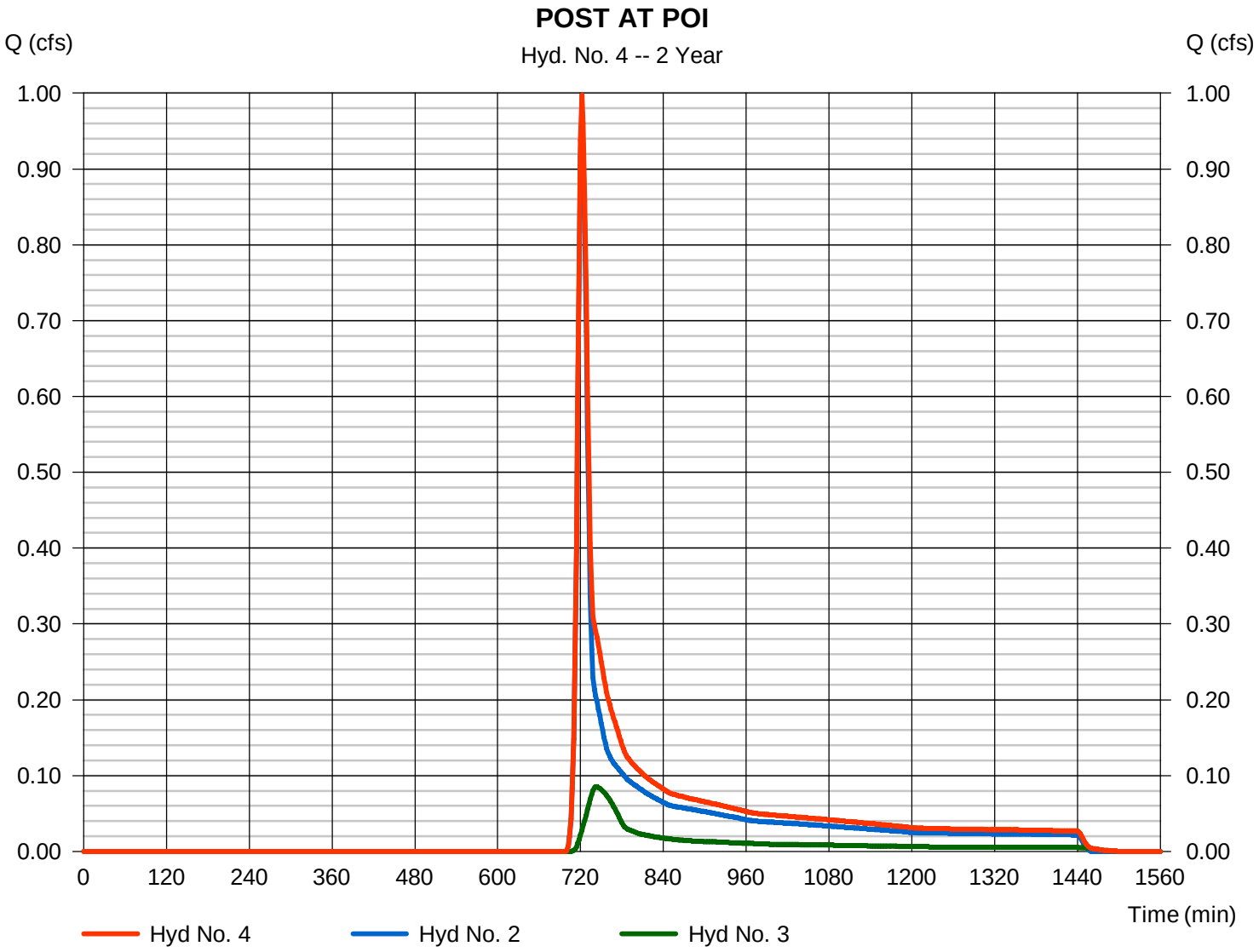


Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 0.997 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 3,486 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 1.700 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

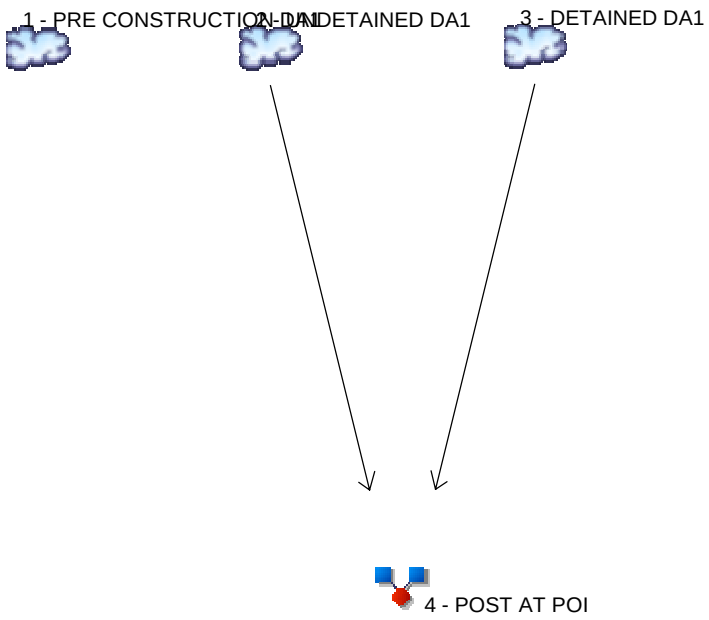
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA1
2	SCS Runoff	UNDETAINED DA1
3	SCS Runoff	DETAINED DA1
4	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	-------	-------	-------	3.035	-------	-------	-------	PRE CONSTRUCTION DA1
2	SCS Runoff	------	-------	-------	-------	-------	2.432	-------	-------	-------	UNDETAINED DA1
3	SCS Runoff	------	-------	-------	-------	-------	0.277	-------	-------	-------	DETAINED DA1
4	Combine	2, 3	-------	-------	-------	-------	2.569	-------	-------	-------	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	3.035	2	722	8,097	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	2.432	2	722	6,488	------	------	------	UNDETAINED DA1
3	SCS Runoff	0.277	2	738	1,505	------	------	------	DETAINED DA1
4	Combine	2.569	2	722	7,992	2, 3	------	------	POST AT POI

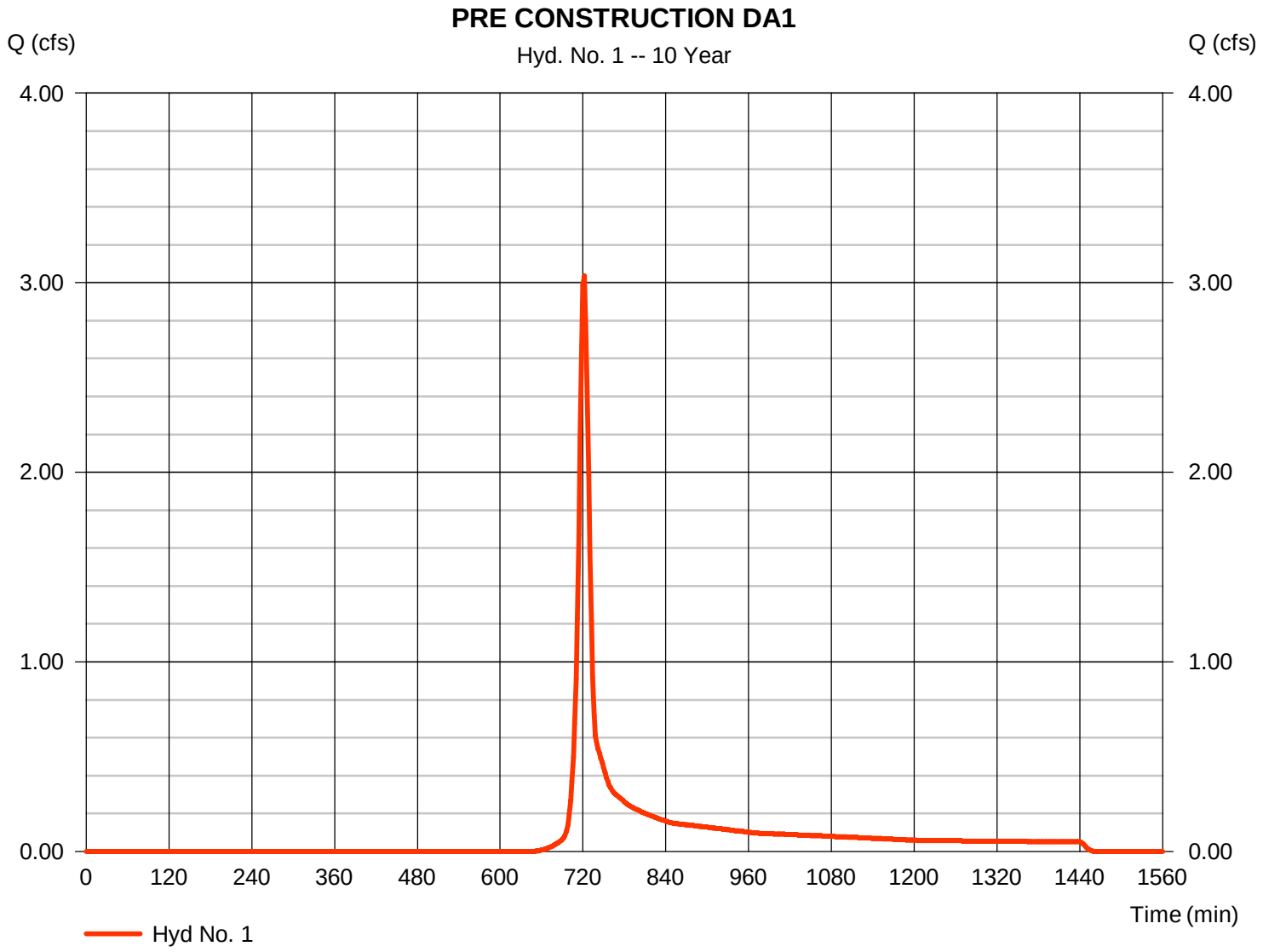
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.035 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 8,097 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 3.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 8.86**	**+**	**0.00**	**+**	**0.00**	**=**	**8.86**
Shallow Concentrated Flow							
Flow length (ft)	= 572.00		0.00		0.00		
Watercourse slope (%)	= 7.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.33		0.00		0.00		
Travel Time (min)	**= 2.20**	**+**	**0.00**	**+**	**0.00**	**=**	**2.20**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.000		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.10 min

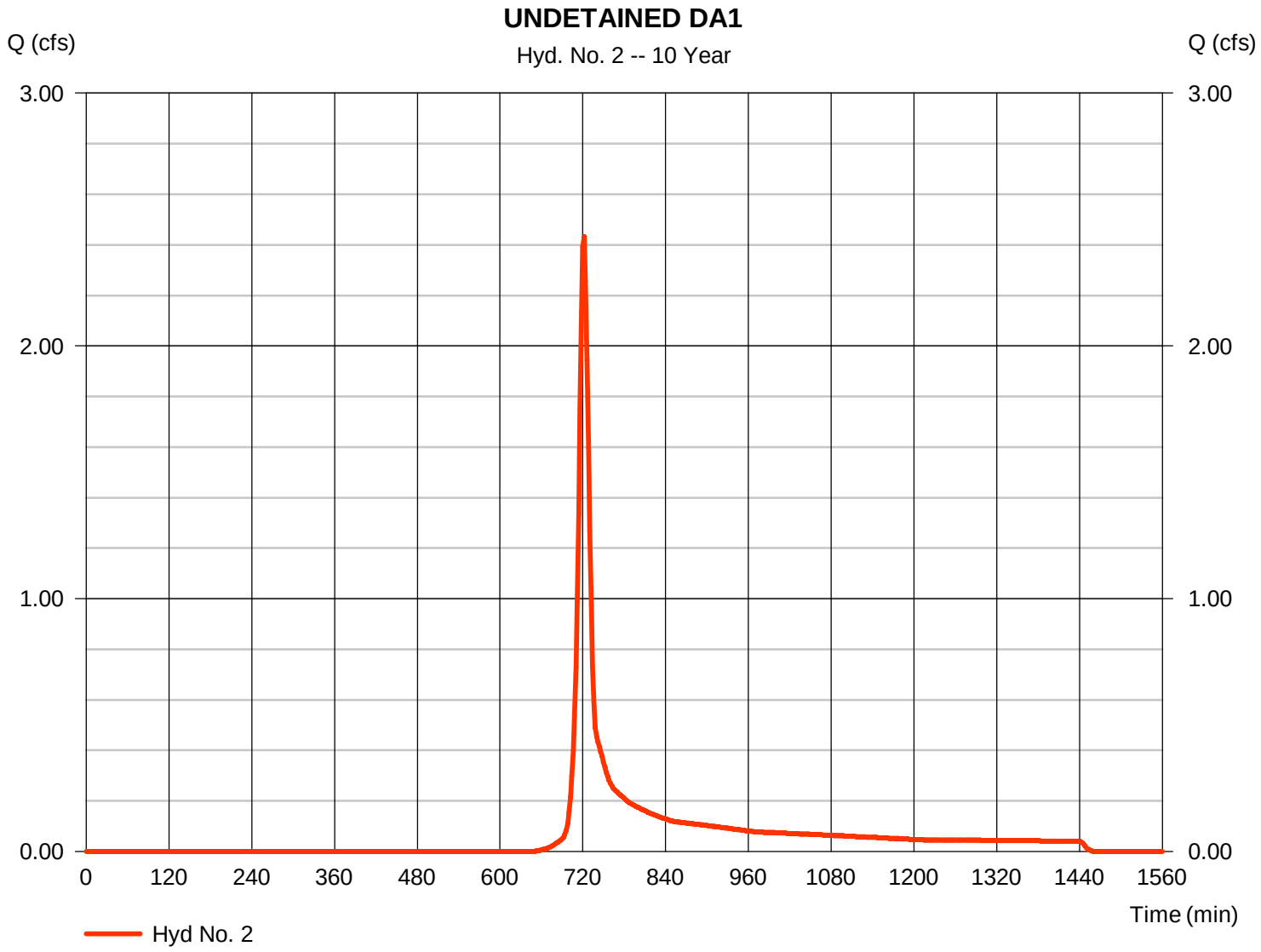
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.432 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	6,488 cuft
Drainage area	=	1.330 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.30 min
Total precip.	=	3.96 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



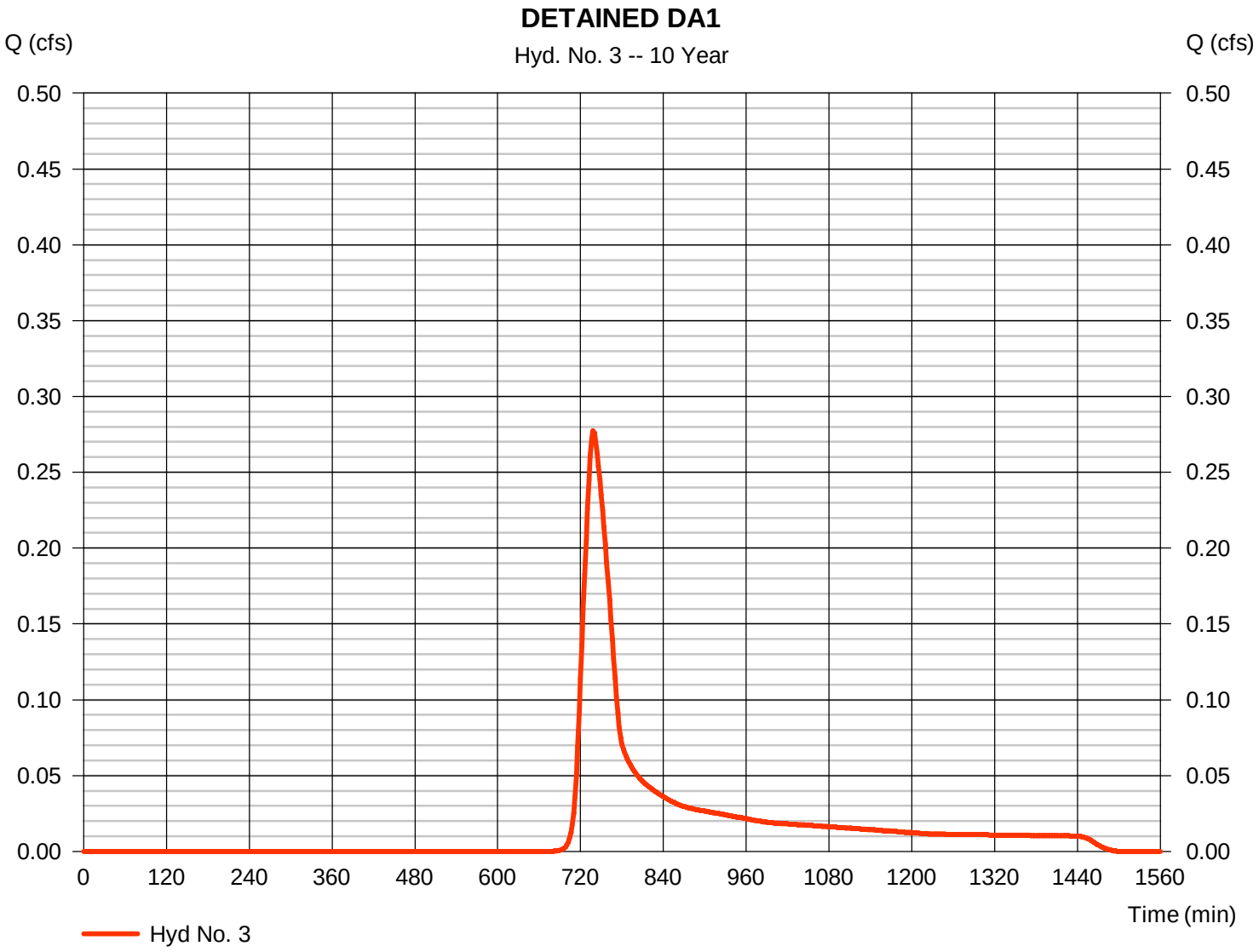
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.277 cfs
Storm frequency	= 10 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 1,505 cuft
Drainage area	= 0.370 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.89 min
Total precip.	= 3.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370

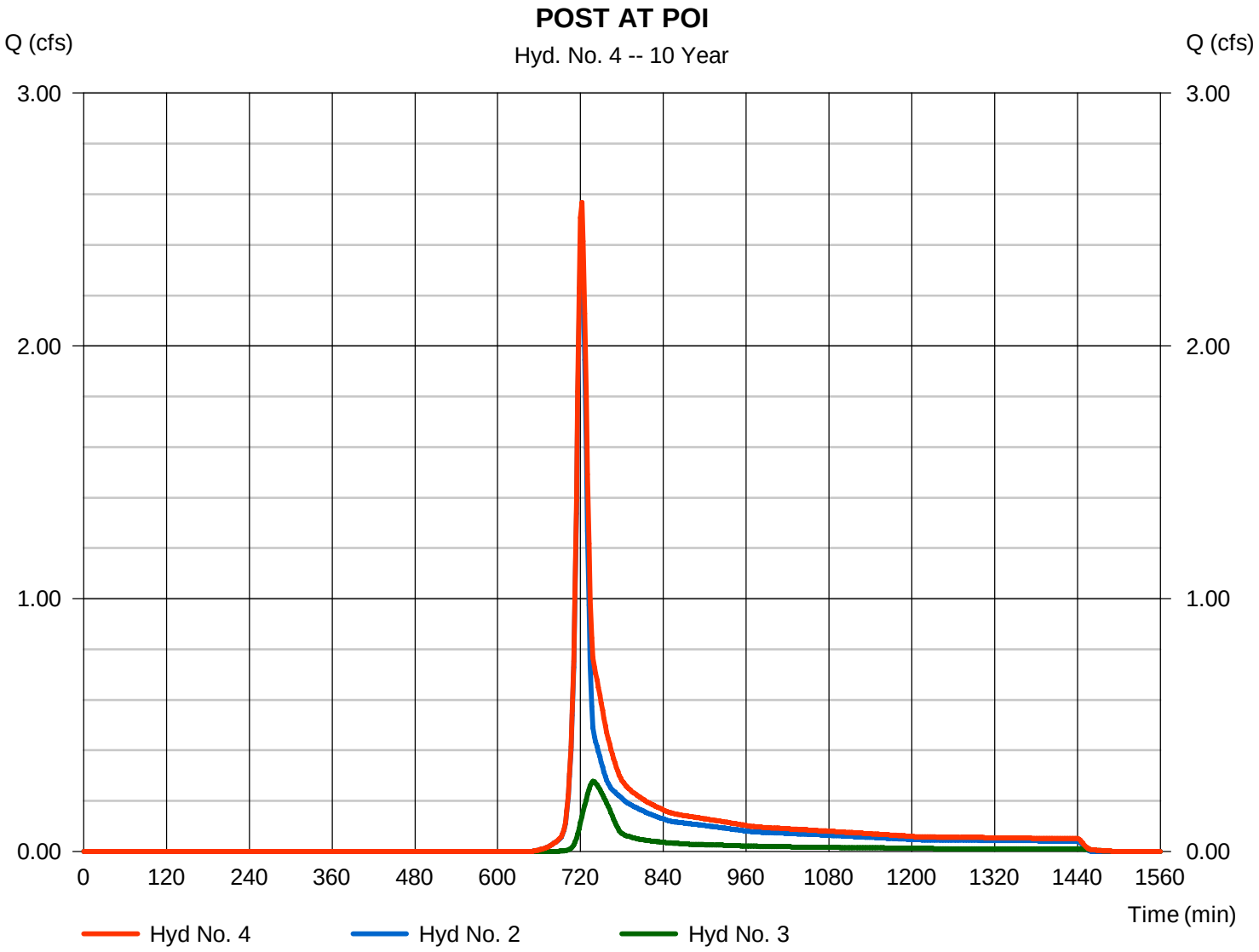


Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	2.569 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	7,992 cuft
Inflow hyds.	=	2, 3	Contrib. drain. area	=	1.700 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

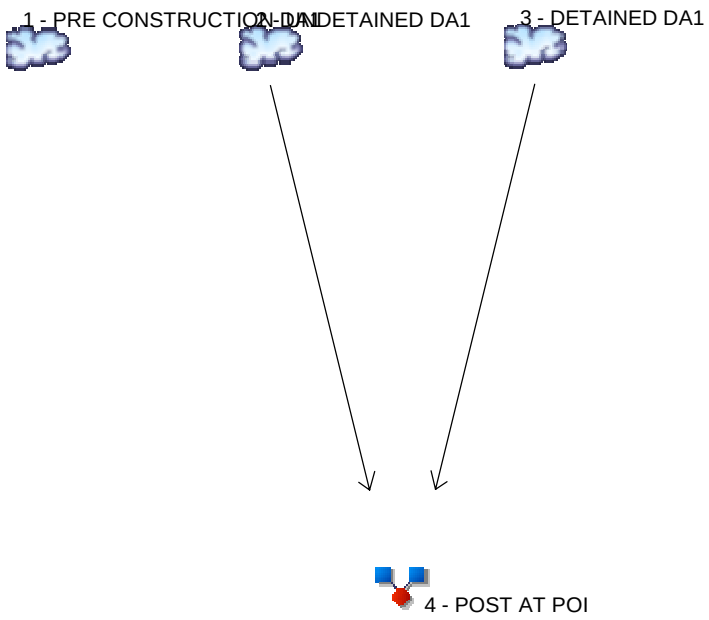
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA1
2	SCS Runoff	UNDETAINED DA1
3	SCS Runoff	DETAINED DA1
4	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	-------	-------	-------	-------	-------	5.782	-------	PRE CONSTRUCTION DA1
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	4.632	-------	UNDETAINED DA1
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	0.582	-------	DETAINED DA1
4	Combine	2, 3	-------	-------	-------	-------	-------	-------	4.955	-------	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	5.782	2	720	15,098	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	4.632	2	720	12,097	------	------	------	UNDETAINED DA1
3	SCS Runoff	0.582	2	738	2,920	------	------	------	DETAINED DA1
4	Combine	4.955	2	722	15,017	2, 3	------	------	POST AT POI

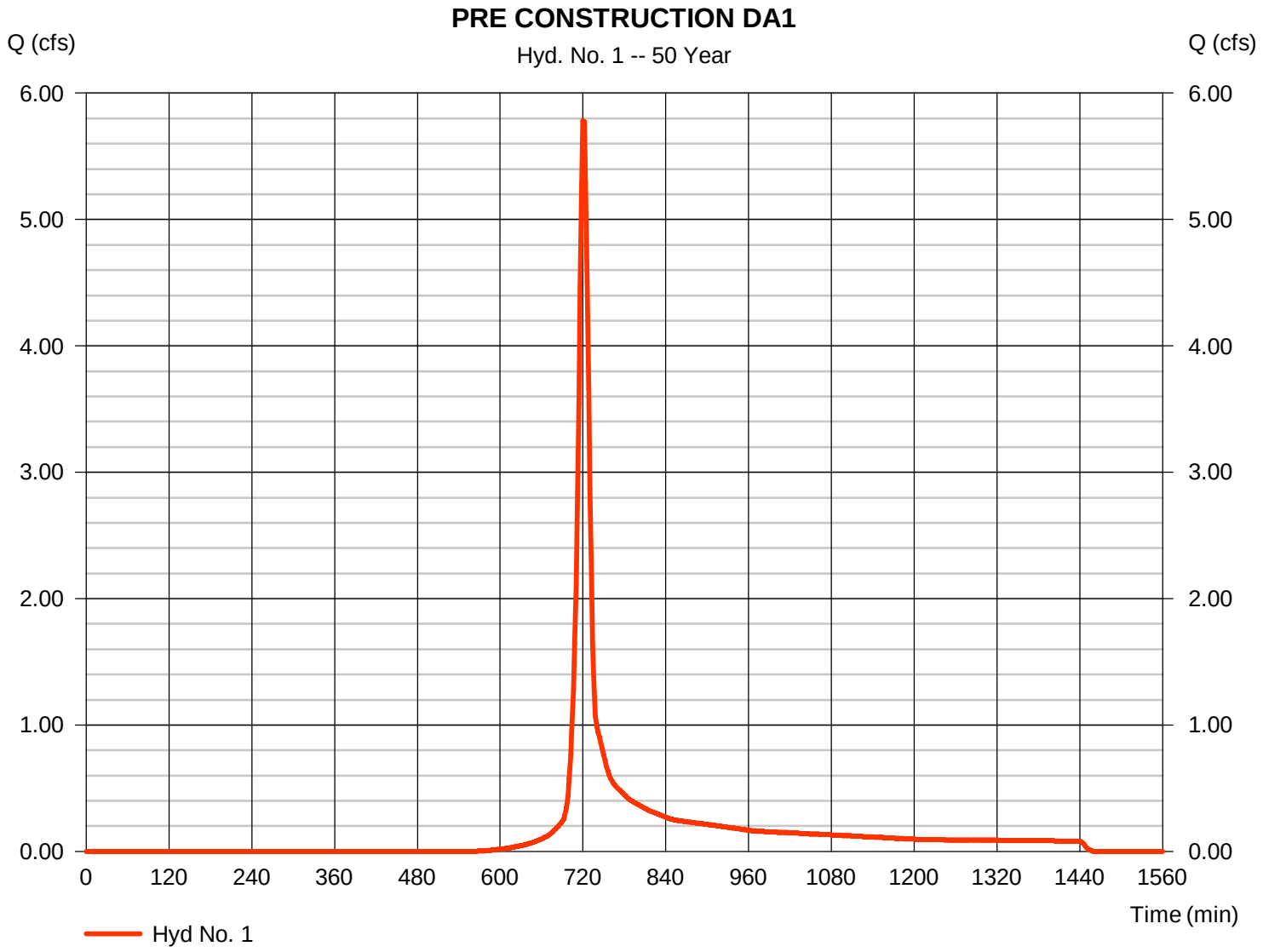
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 5.782 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 15,098 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 5.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 8.86**	**+**	**0.00**	**+**	**0.00**	**=**	**8.86**
Shallow Concentrated Flow							
Flow length (ft)	= 572.00		0.00		0.00		
Watercourse slope (%)	= 7.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.33		0.00		0.00		
Travel Time (min)	**= 2.20**	**+**	**0.00**	**+**	**0.00**	**=**	**2.20**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.000		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.10 min

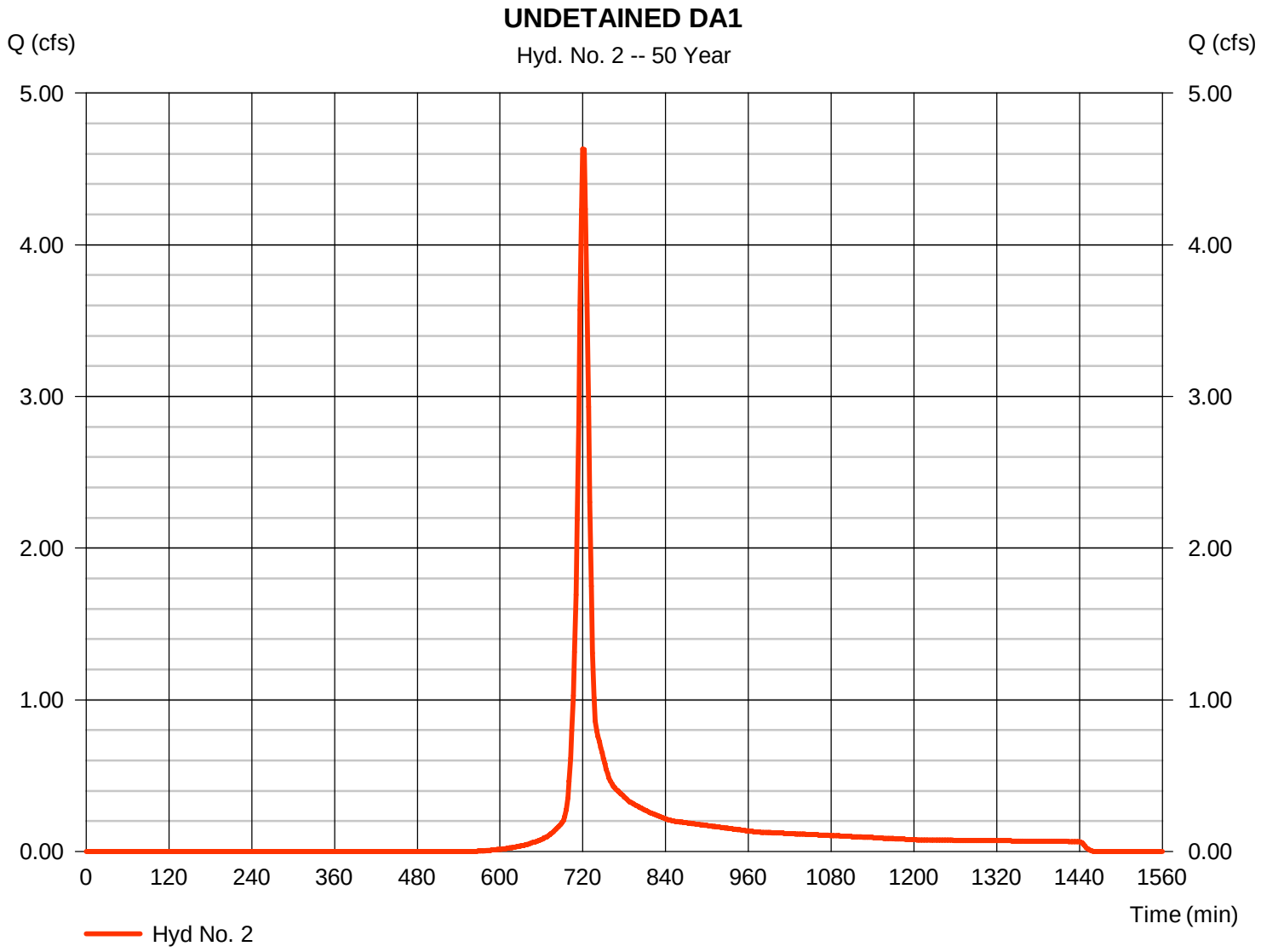
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.632 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	12,097 cuft
Drainage area	=	1.330 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.30 min
Total precip.	=	5.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



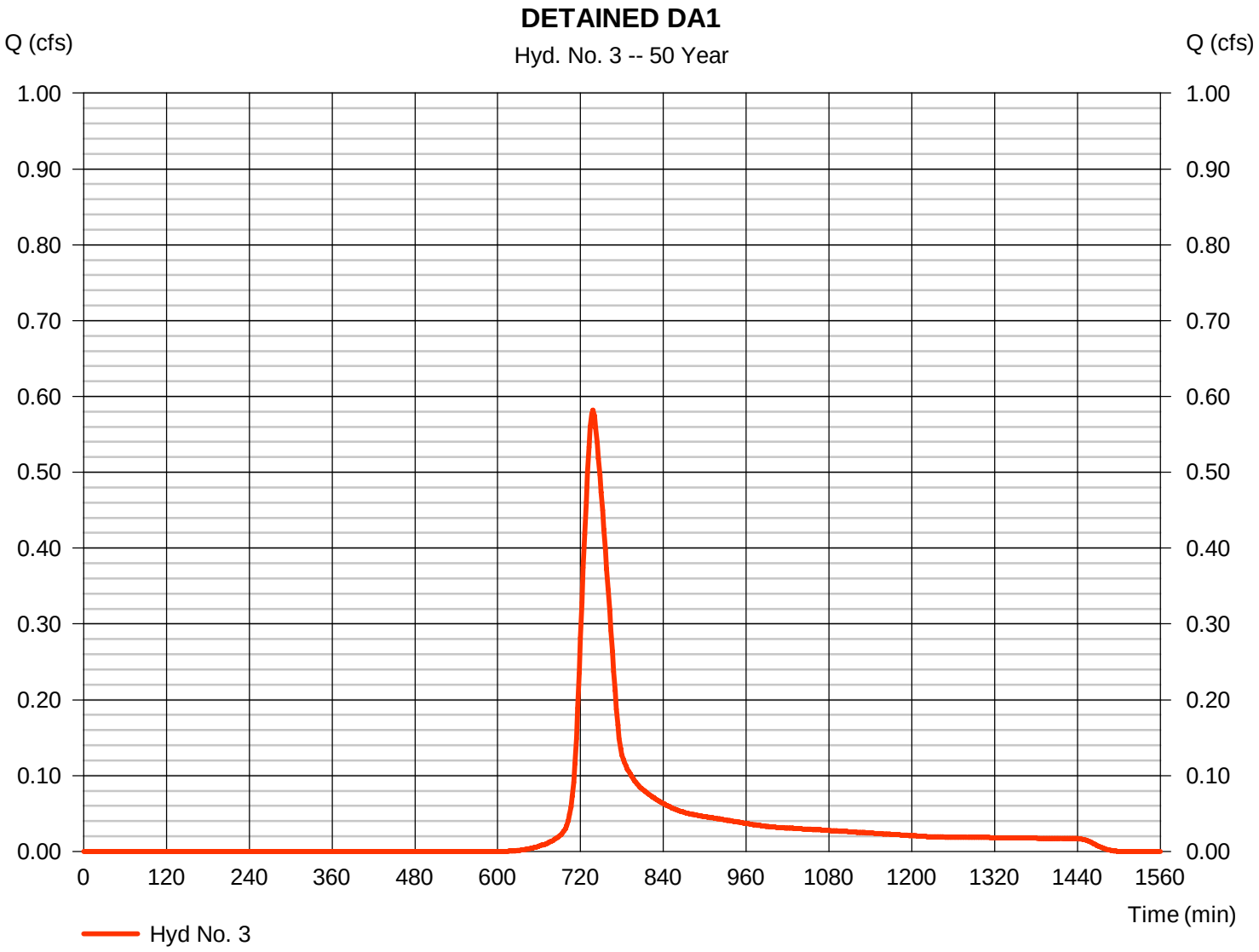
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.582 cfs
Storm frequency	=	50 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	2,920 cuft
Drainage area	=	0.370 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	37.55 min
Total precip.	=	5.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370

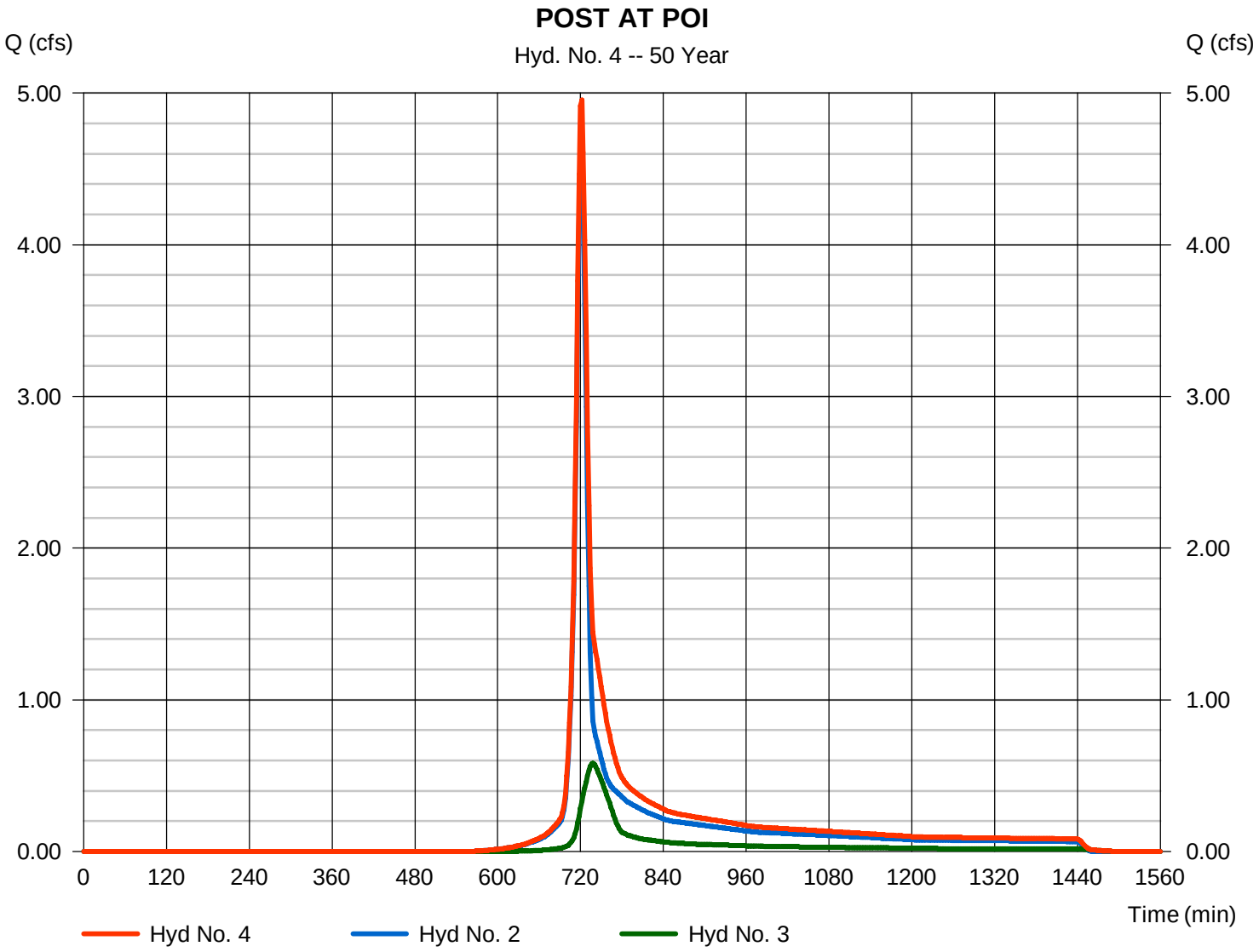


Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 4.955 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 15,017 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 1.700 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

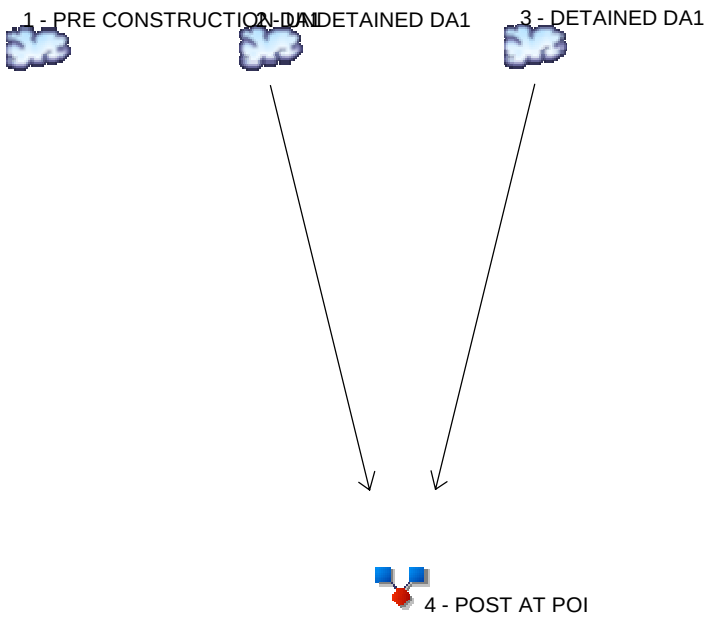
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA1
2	SCS Runoff	UNDETAINED DA1
3	SCS Runoff	DETAINED DA1
4	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	-------	-------	-------	-------	-------	-------	7.344	PRE CONSTRUCTION DA1
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	5.884	UNDETAINED DA1
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	0.860	DETAINED DA1
4	Combine	2, 3	-------	-------	-------	-------	-------	-------	-------	6.434	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	7.344	2	720	19,073	------	------	------	PRE CONSTRUCTION DA1
2	SCS Runoff	5.884	2	720	15,281	------	------	------	UNDETAINED DA1
3	SCS Runoff	0.860	2	734	3,783	------	------	------	DETAINED DA1
4	Combine	6.434	2	722	19,064	2, 3	------	------	POST AT POI

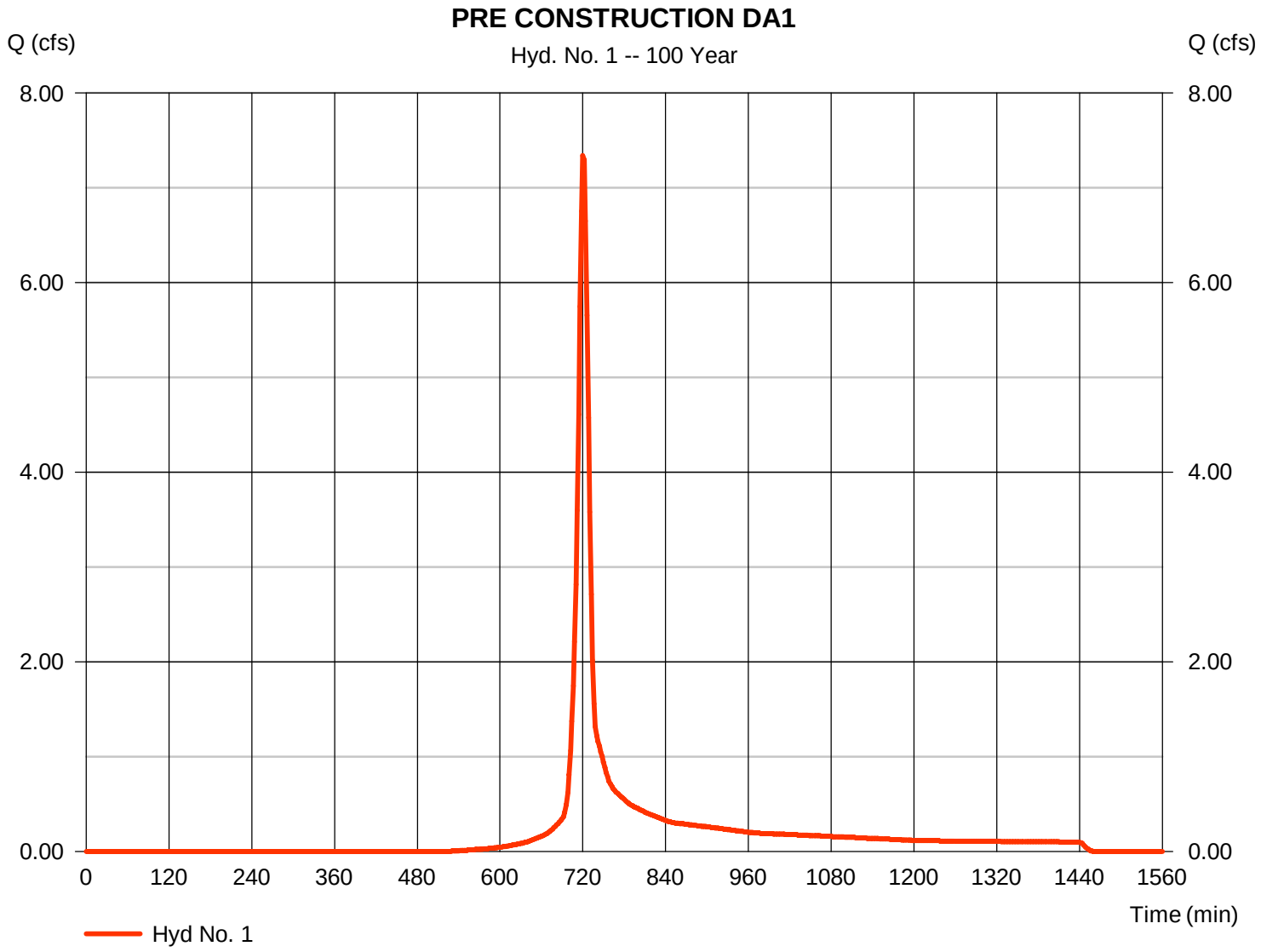
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA1

Hydrograph type	= SCS Runoff	Peak discharge	= 7.344 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 19,073 cuft
Drainage area	= 1.660 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.10 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.320 x 77) + (0.890 x 58) + (0.170 x 78) + (0.280 x 98)] / 1.660



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 8.86**	**+**	**0.00**	**+**	**0.00**	**=**	**8.86**
Shallow Concentrated Flow							
Flow length (ft)	= 572.00		0.00		0.00		
Watercourse slope (%)	= 7.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.33		0.00		0.00		
Travel Time (min)	**= 2.20**	**+**	**0.00**	**+**	**0.00**	**=**	**2.20**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.000		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.10 min

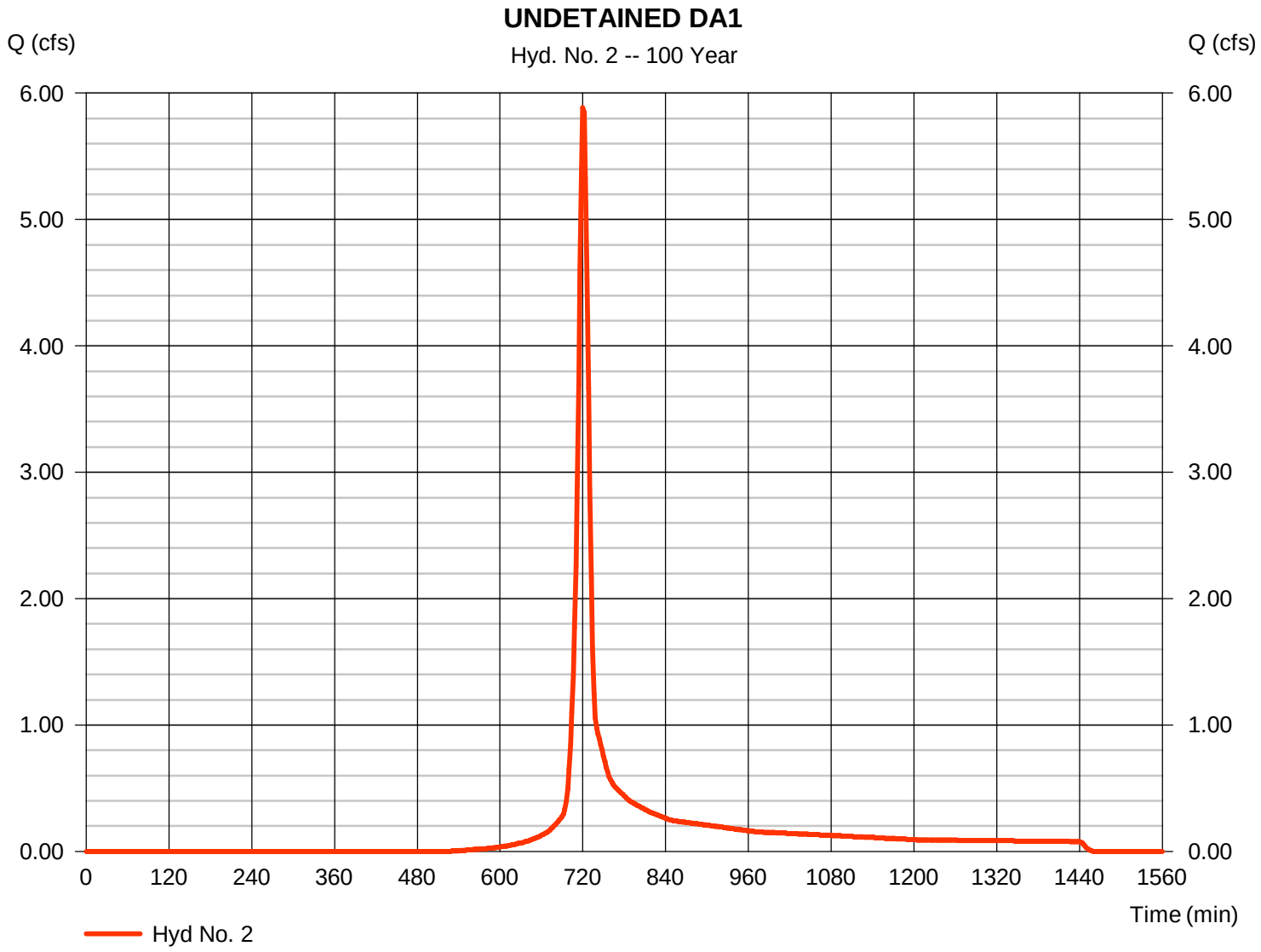
Hydrograph Report

Hyd. No. 2

UNDETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.884 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	15,281 cuft
Drainage area	=	1.330 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.30 min
Total precip.	=	6.33 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.580 x 58) + (0.190 x 78) + (0.270 x 98) + (0.010 x 85) + (0.010 x 91) + (0.270 x 77)] / 1.330



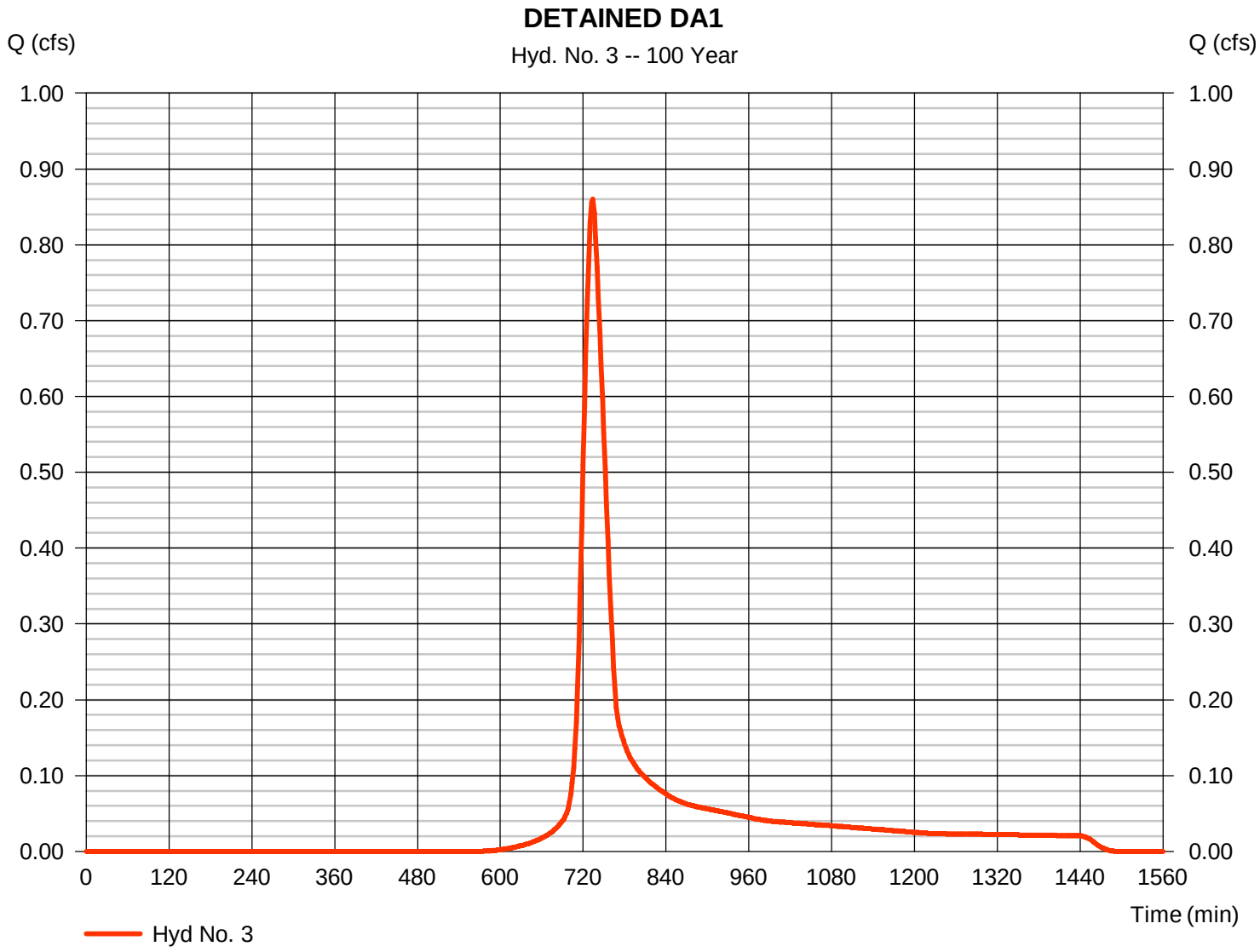
Hydrograph Report

Hyd. No. 3

DETAINED DA1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.860 cfs
Storm frequency	=	100 yrs	Time to peak	=	734 min
Time interval	=	2 min	Hyd. volume	=	3,783 cuft
Drainage area	=	0.370 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	33.66 min
Total precip.	=	6.33 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.120 x 85) + (0.250 x 58)] / 0.370

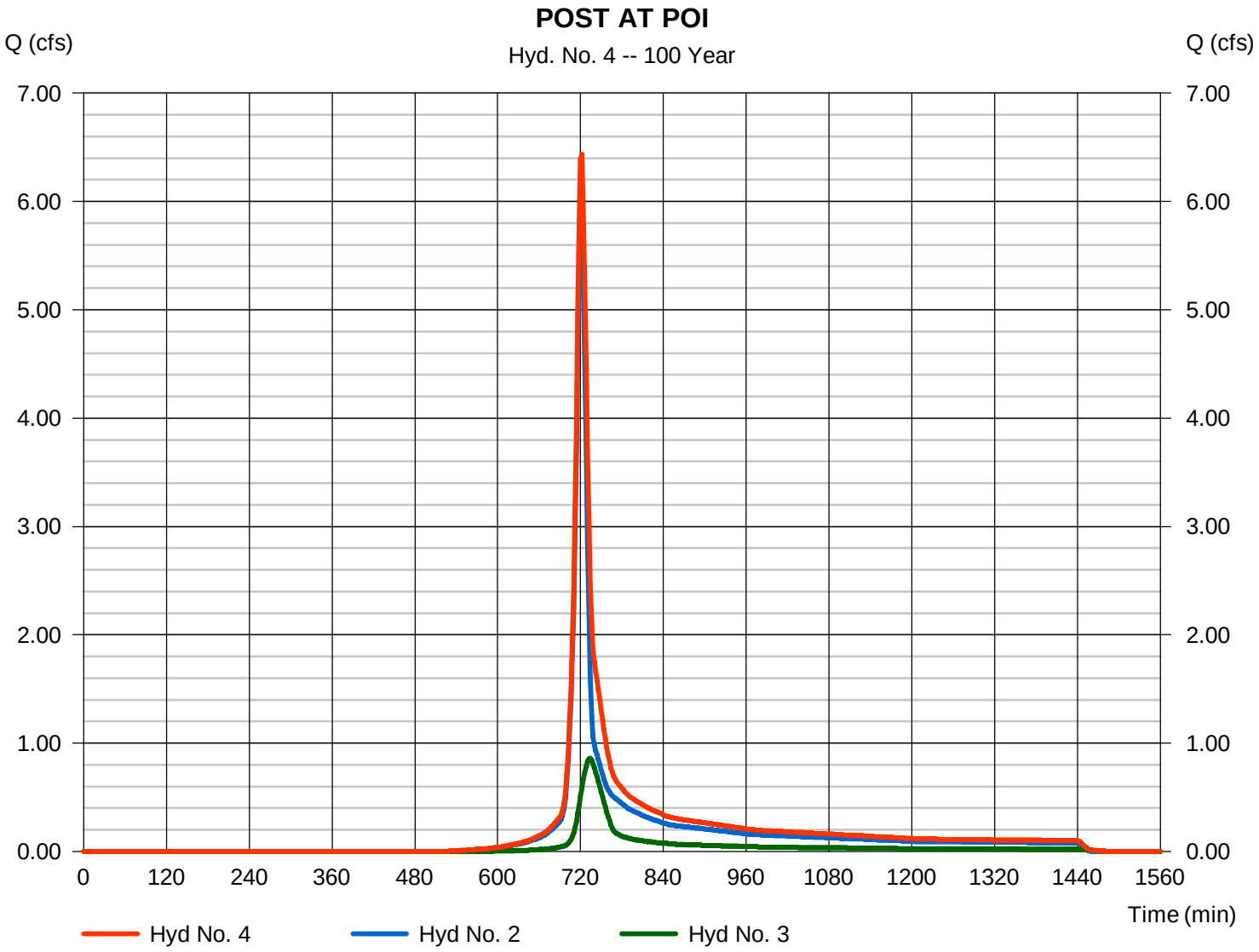


Hydrograph Report

Hyd. No. 4

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	6.434 cfs
Storm frequency	=	100 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	19,064 cuft
Inflow hyds.	=	2, 3	Contrib. drain. area	=	1.700 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

Tc = time in minutes. Values may exceed 60.

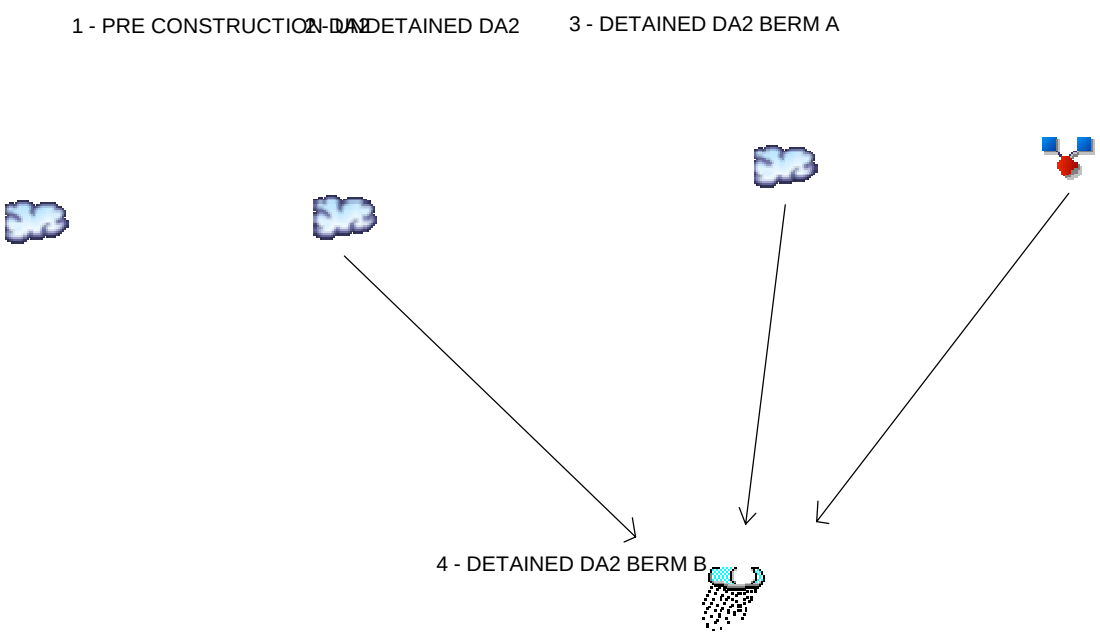
SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

5 - POST AT POI



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA2
2	SCS Runoff	UNDETAINED DA2
3	SCS Runoff	DETAINED DA2 BERM A
4	SCS Runoff	DETAINED DA2 BERM B
5	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	2.266	-------	-------	5.933	-------	11.50	14.68	PRE CONSTRUCTION DA2
2	SCS Runoff	------	-------	2.053	-------	-------	4.955	-------	9.295	11.74	UNDETAINED DA2
3	SCS Runoff	------	-------	0.431	-------	-------	0.909	-------	1.598	1.975	DETAINED DA2 BERM A
4	SCS Runoff	------	-------	0.268	-------	-------	0.804	-------	1.641	2.115	DETAINED DA2 BERM B
5	Combine	2, 3, 4	-------	2.629	-------	-------	6.475	-------	12.22	15.41	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	2.266	2	722	6,872	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	2.053	2	722	5,922	------	------	------	UNDETAINED DA2
3	SCS Runoff	0.431	2	720	1,010	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	0.268	2	718	641	------	------	------	DETAINED DA2 BERM B
5	Combine	2.629	2	720	7,574	2, 3, 4	------	------	POST AT POI

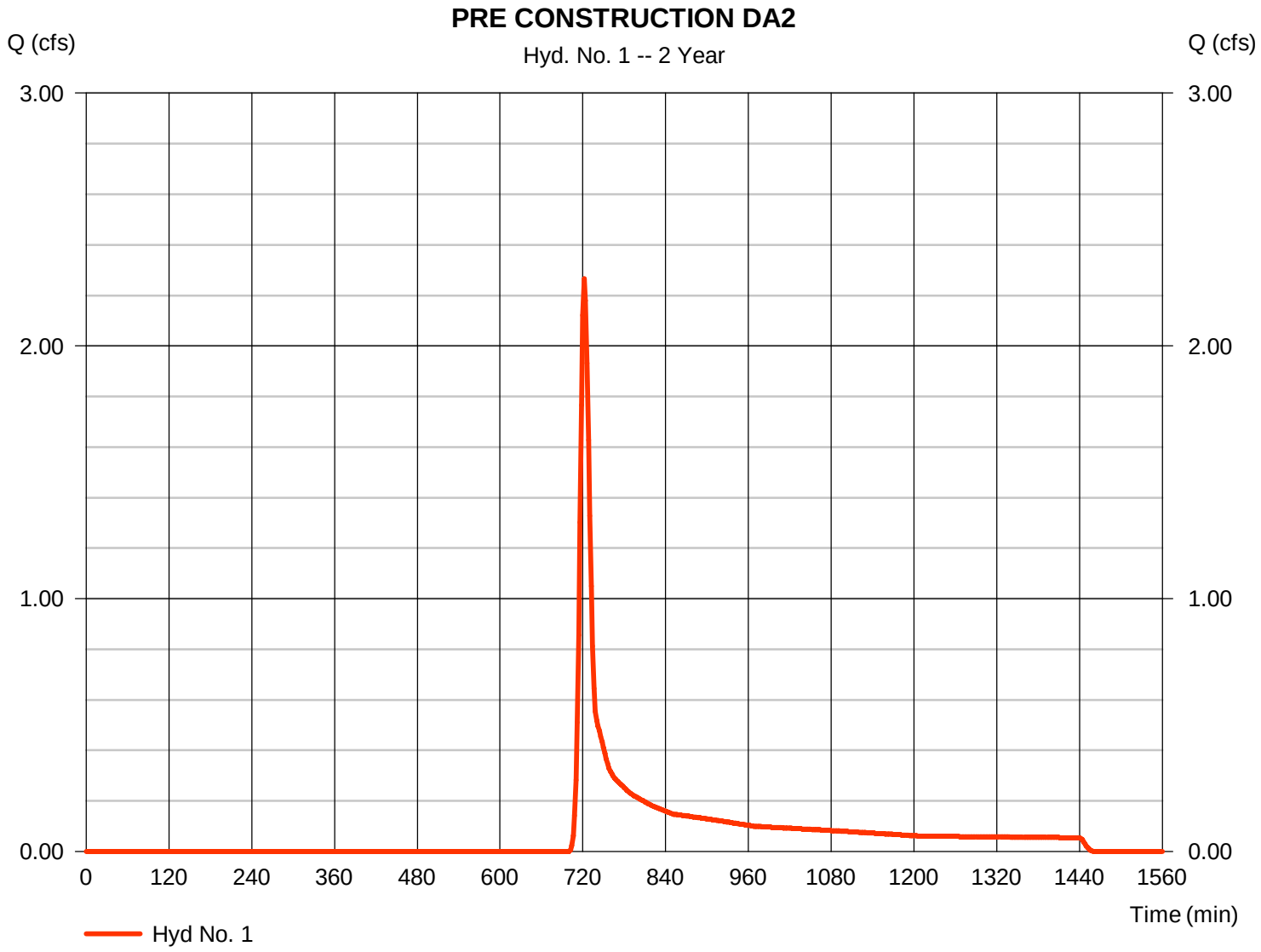
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.266 cfs
Storm frequency	=	2 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	6,872 cuft
Drainage area	=	3.430 ac	Curve number	=	69*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	2.74 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

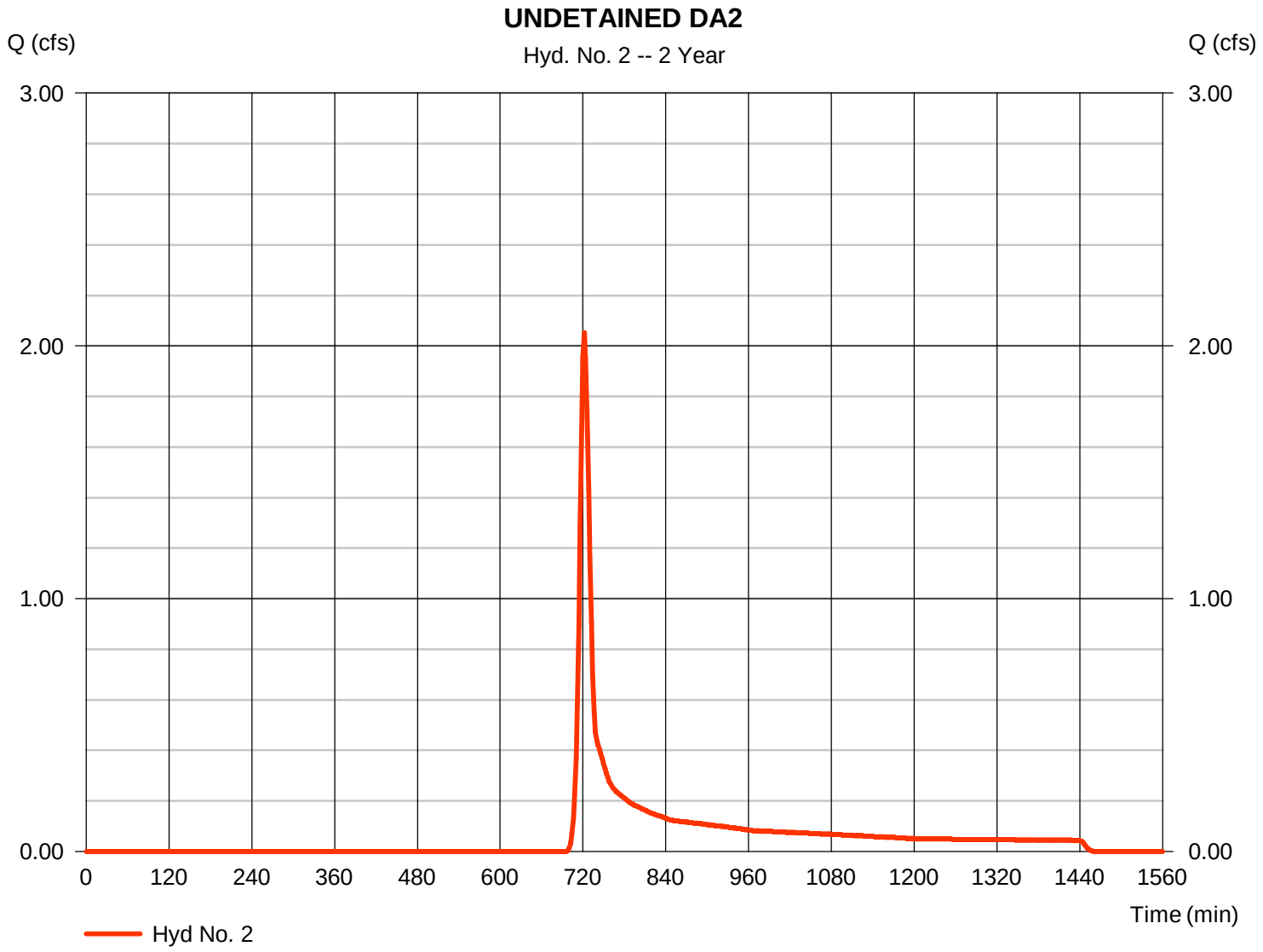
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.053 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 5,922 cuft
Drainage area	= 2.570 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



TR55 Tc Worksheet

Hyd. No. 2

UNDETAINED DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

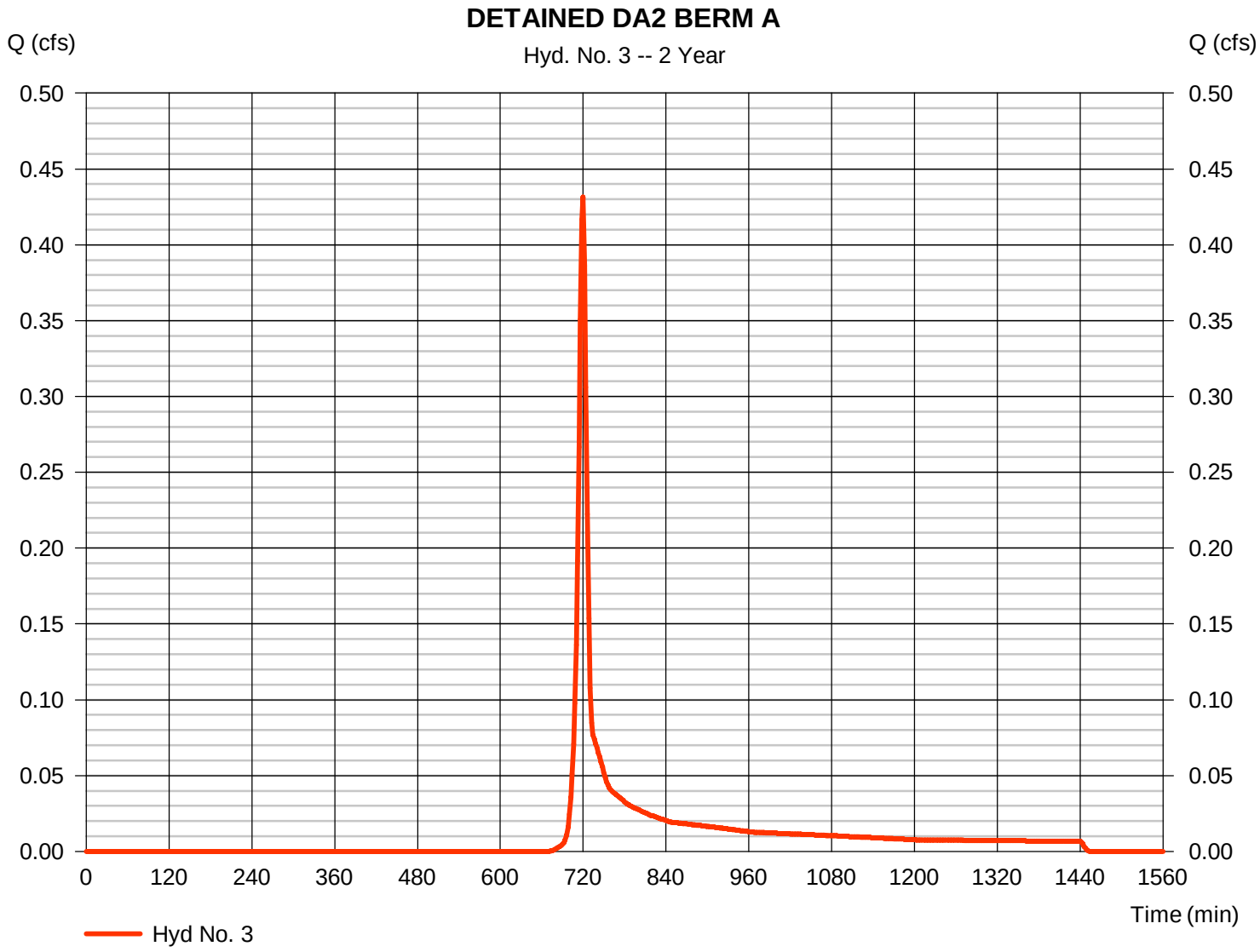
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.431 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 1,010 cuft
Drainage area	= 0.350 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.70 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



TR55 Tc Worksheet

Hyd. No. 3

DETAINED DA2 BERM A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 8.86**	**+**	**0.00**	**+**	**0.00**	**=**	**8.86**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		77.00		0.00		
Watercourse slope (%)	= 3.50		7.80		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		5.68		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.23**	**+**	**0.00**	**=**	**0.70**
Channel Flow							
X sectional flow area (sqft)	= 0.05		0.00		0.00		
Wetted perimeter (ft)	= 0.79		0.00		0.00		
Channel slope (%)	= 6.00		0.00		0.00		
Manning's n-value	= 0.012		0.015		0.015		
Velocity (ft/s)	=4.79						
			0.00				
					0.00		
Flow length (ft)	({0})50.0		0.0		0.0		
Travel Time (min)	**= 0.17**	**+**	**0.00**	**+**	**0.00**	**=**	**0.17**

Total Travel Time, Tc ..... 9.70 min

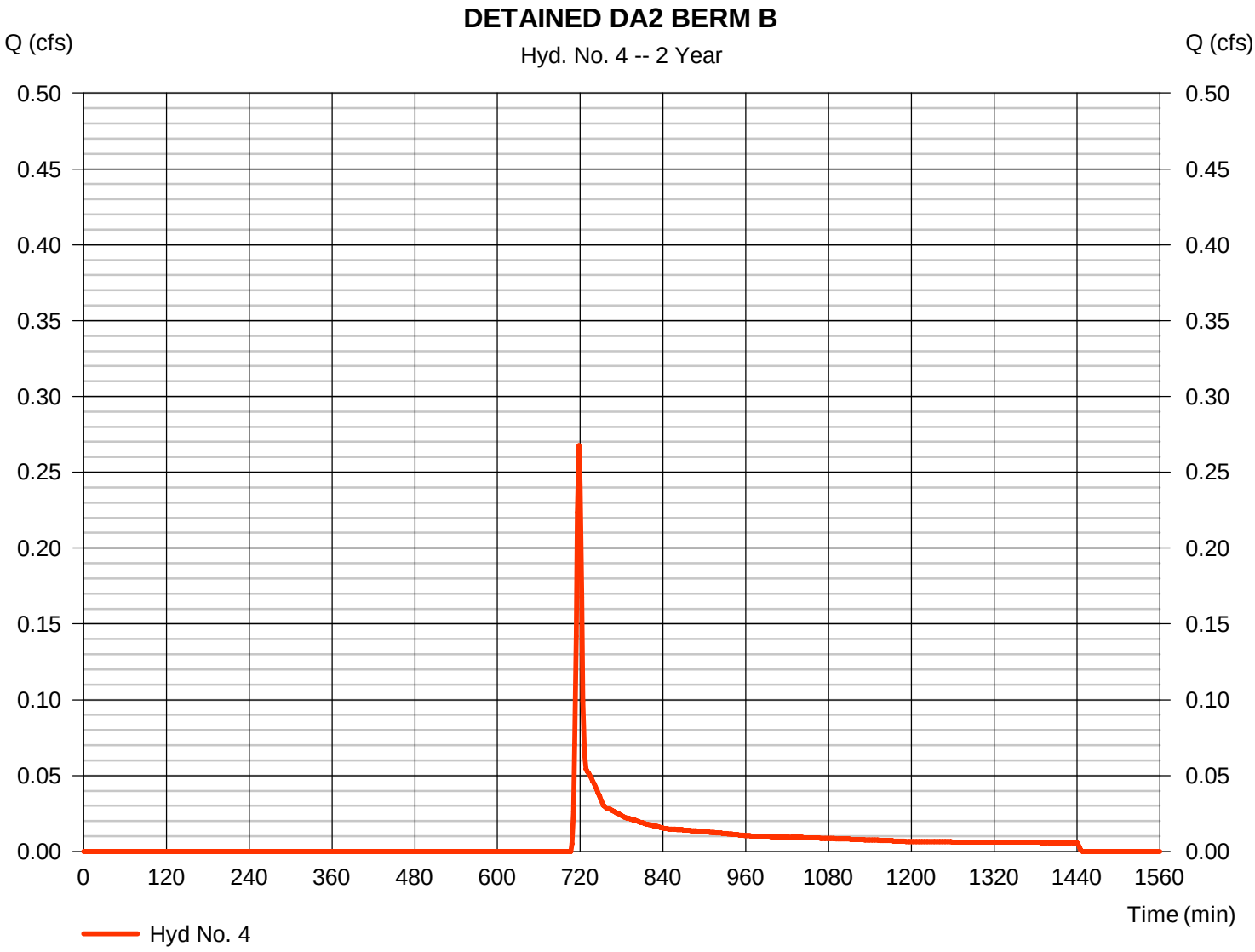
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.268 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 641 cuft
Drainage area	= 0.480 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 3.40 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480



TR55 Tc Worksheet

Hyd. No. 4

DETAINED DA2 BERM B

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 16.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 6.30		0.00		0.00		
Travel Time (min)	**= 2.25**	**+**	**0.00**	**+**	**0.00**	**=**	**2.25**
Shallow Concentrated Flow							
Flow length (ft)	= 243.00		33.00		0.00		
Watercourse slope (%)	= 4.10		3.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=4.12		2.79		0.00		
Travel Time (min)	**= 0.98**	**+**	**0.20**	**+**	**0.00**	**=**	**1.18**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.012		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

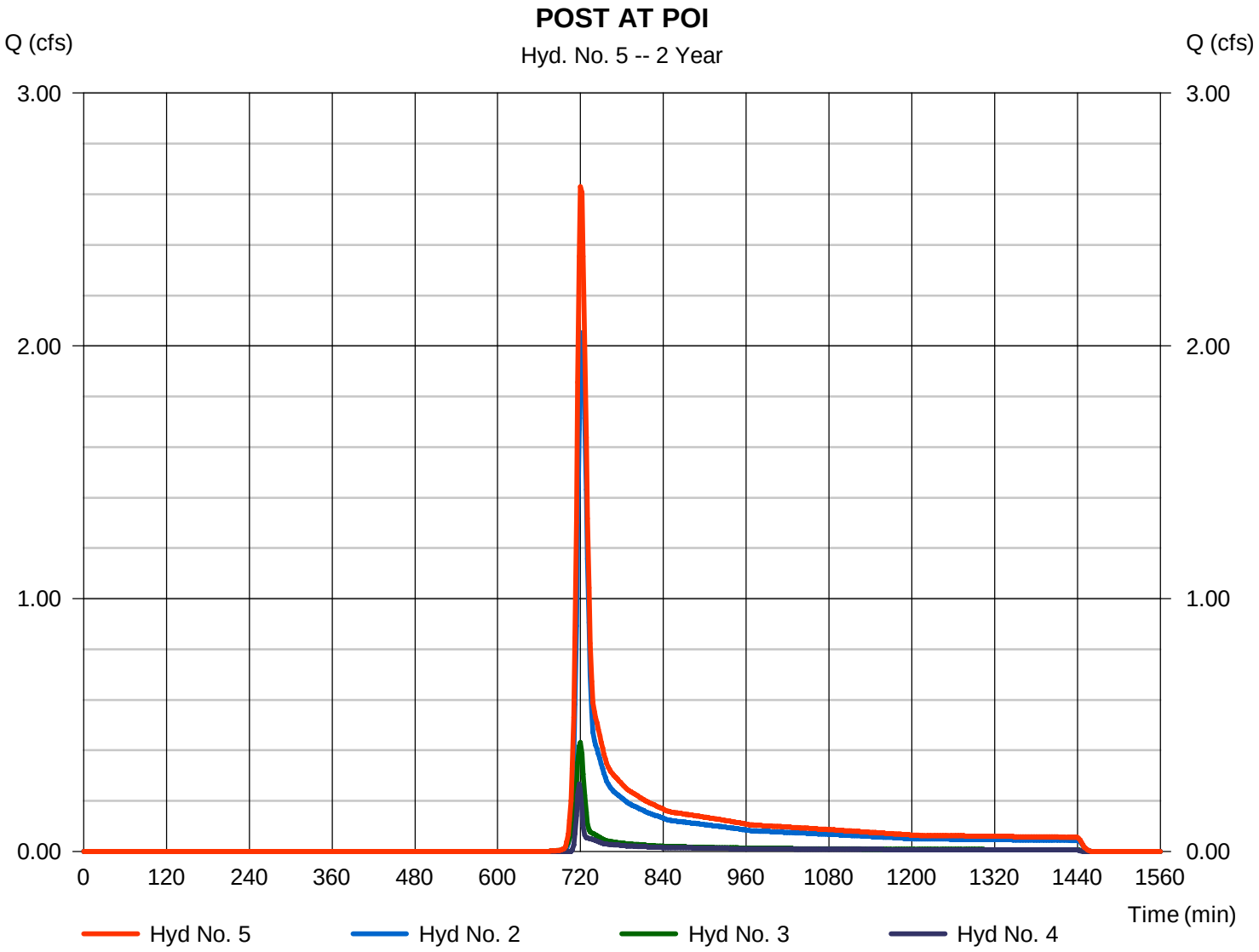
Total Travel Time, Tc ..... 3.40 min

Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 2.629 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 7,574 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	5.933	2	722	15,930	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	4.955	2	722	13,150	------	------	------	UNDETAINED DA2
3	SCS Runoff	0.909	2	720	2,079	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	0.804	2	718	1,642	------	------	------	DETAINED DA2 BERM B
5	Combine	6.475	2	720	16,872	2, 3, 4	------	------	POST AT POI

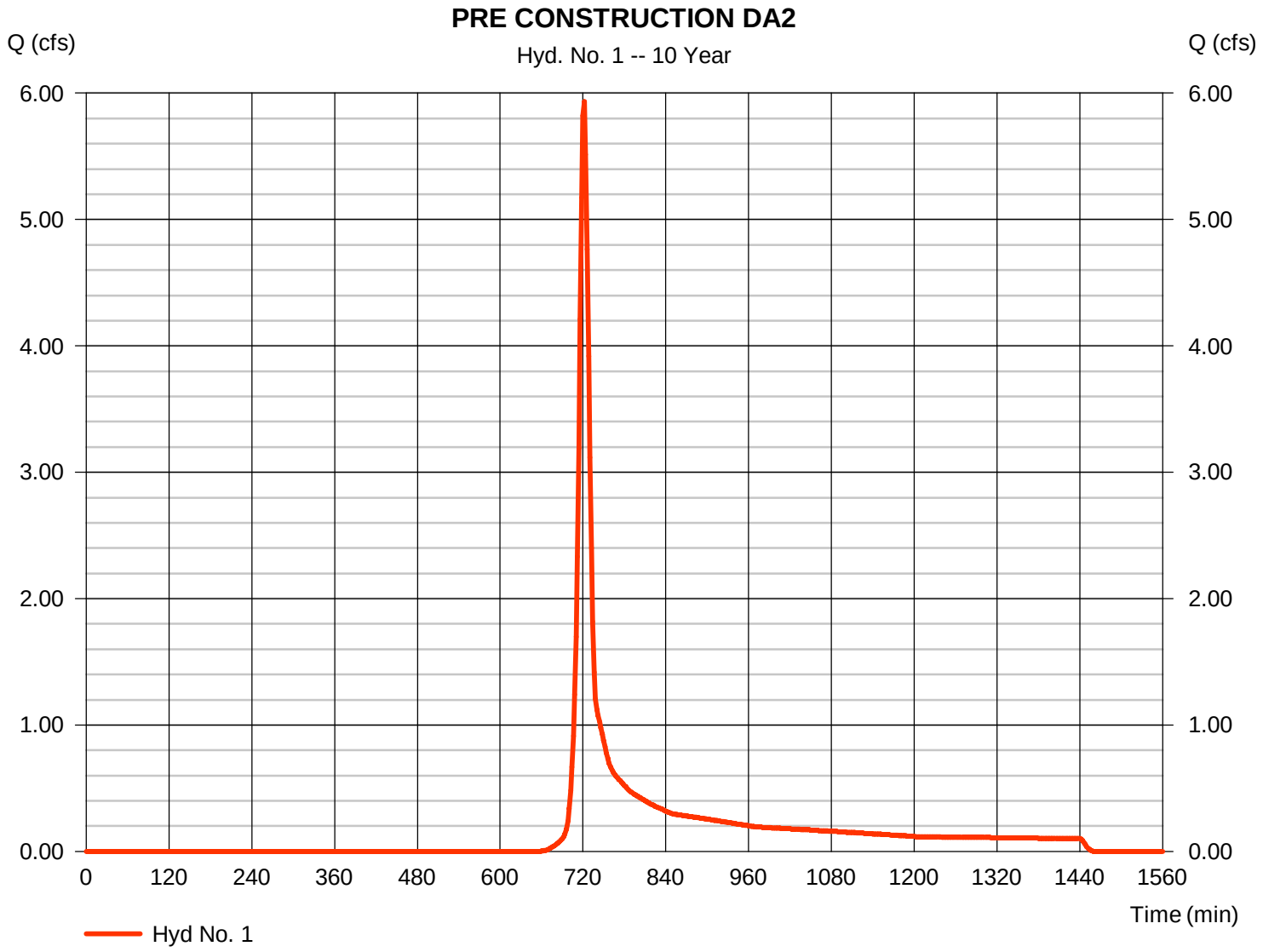
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.933 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	15,930 cuft
Drainage area	=	3.430 ac	Curve number	=	69*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	3.96 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



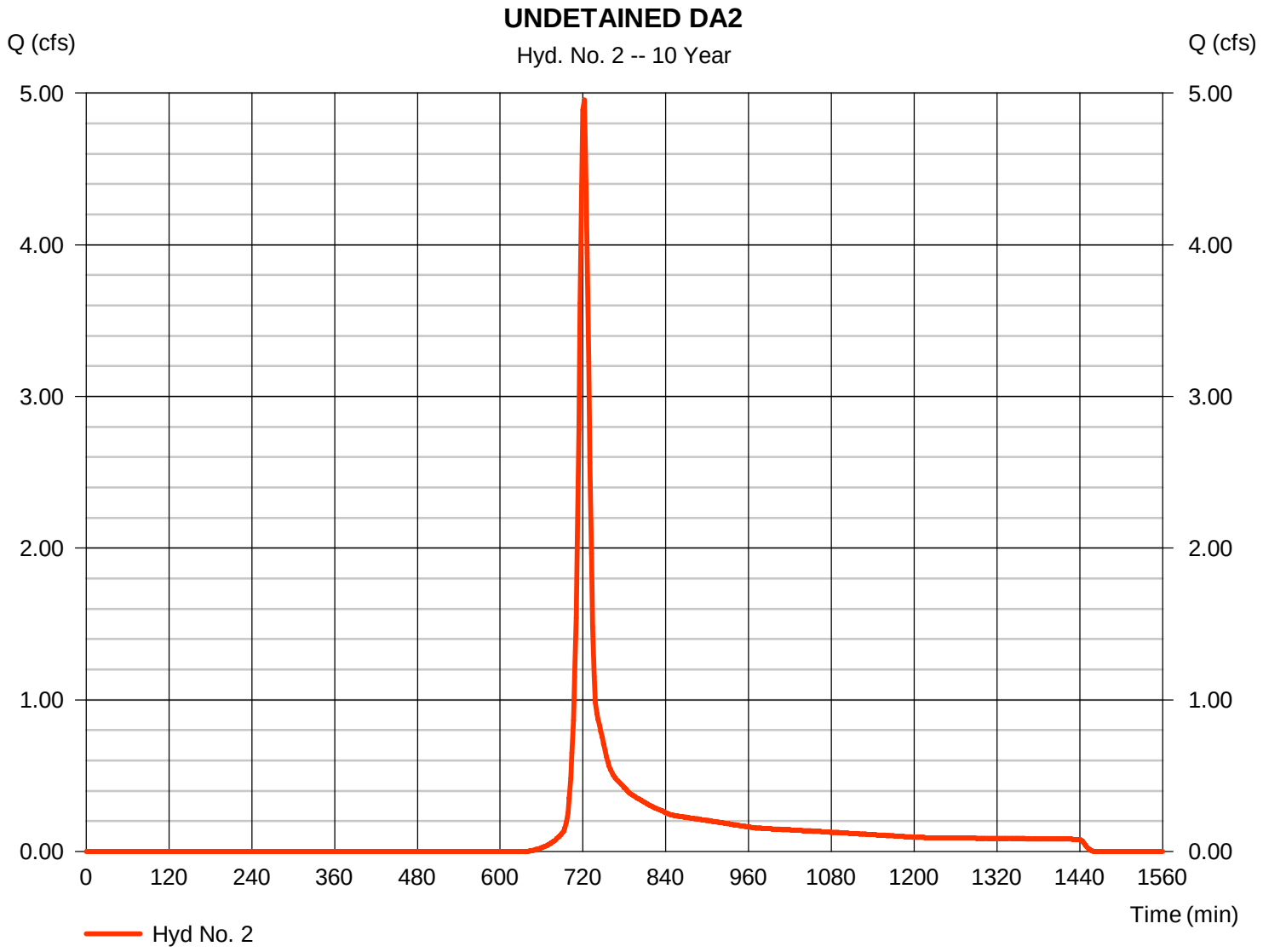
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.955 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	13,150 cuft
Drainage area	=	2.570 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	3.96 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



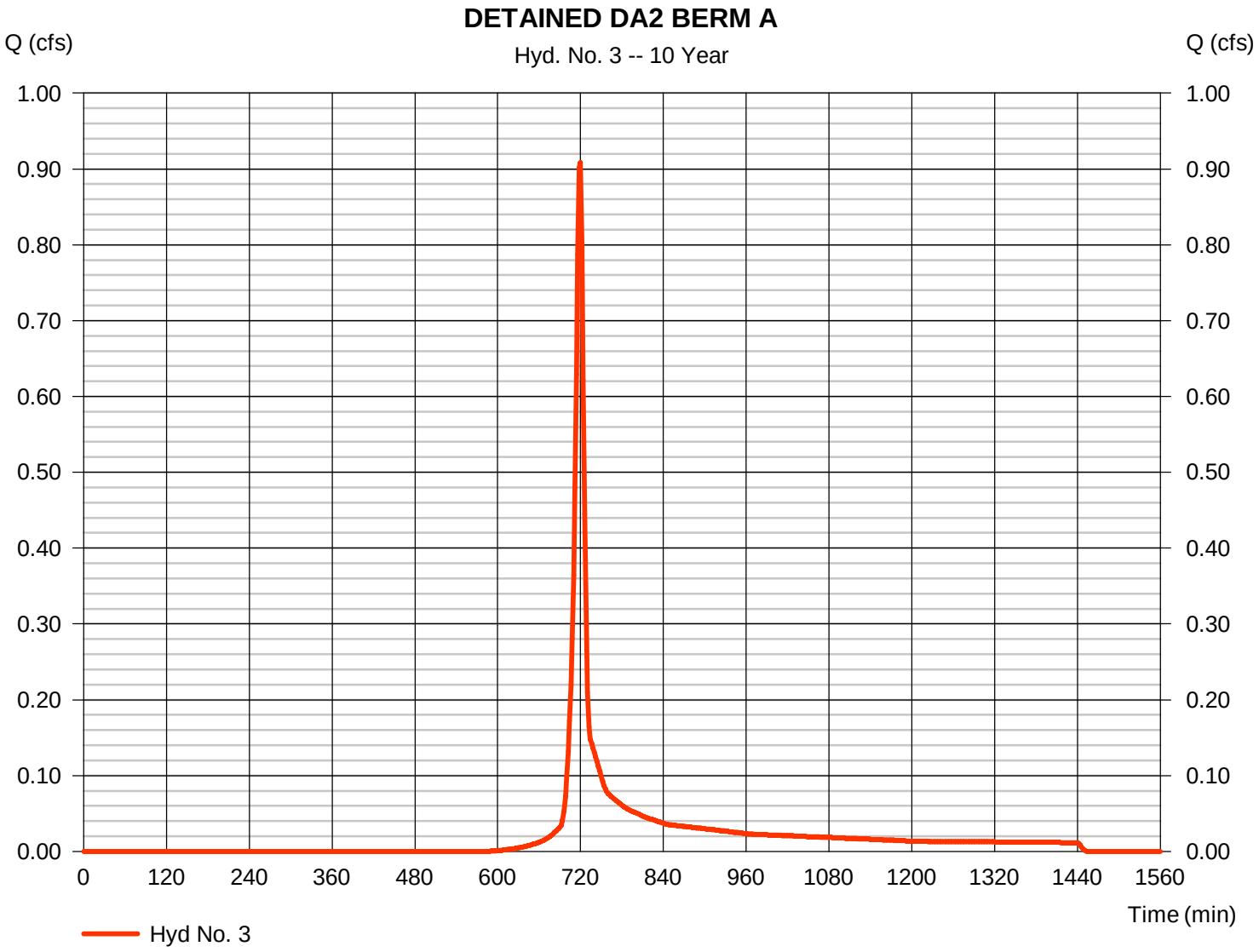
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.909 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,079 cuft
Drainage area	= 0.350 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.70 min
Total precip.	= 3.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



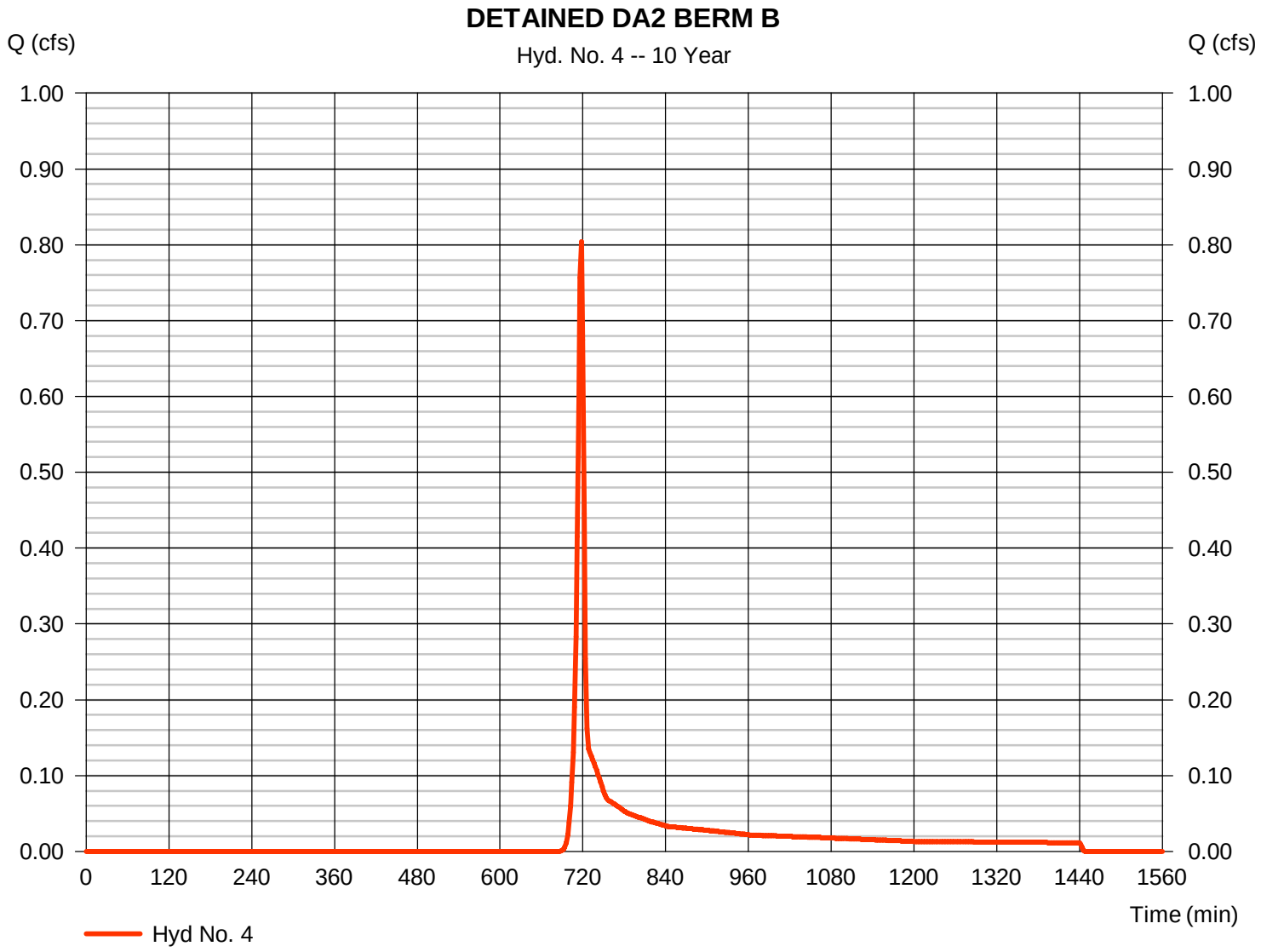
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.804 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,642 cuft
Drainage area	= 0.480 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 3.40 min
Total precip.	= 3.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480

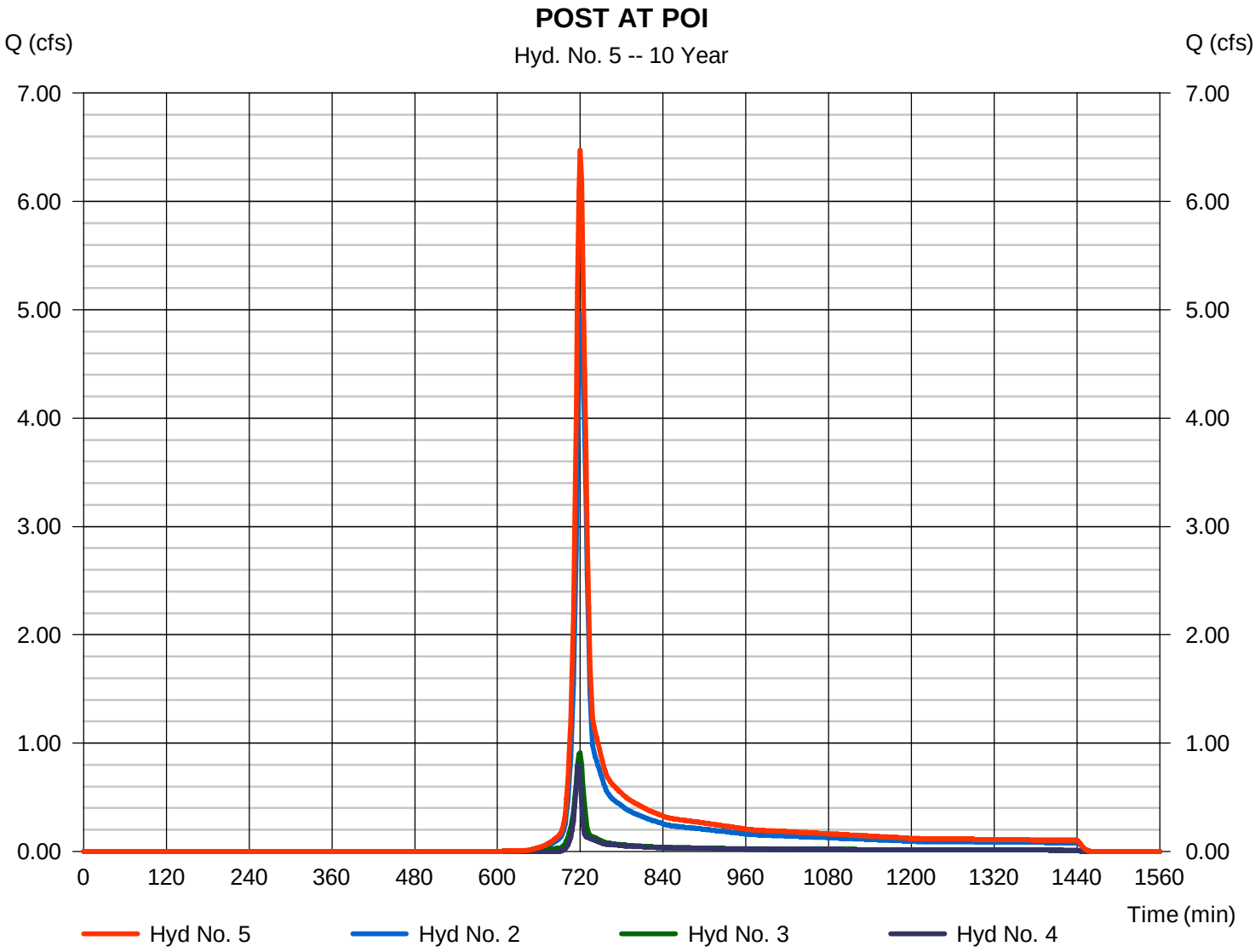


Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 6.475 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 16,872 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	11.50	2	722	30,089	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	9.295	2	720	24,216	------	------	------	UNDETAINED DA2
3	SCS Runoff	1.598	2	718	3,656	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	1.641	2	718	3,281	------	------	------	DETAINED DA2 BERM B
5	Combine	12.22	2	720	31,153	2, 3, 4	------	------	POST AT POI

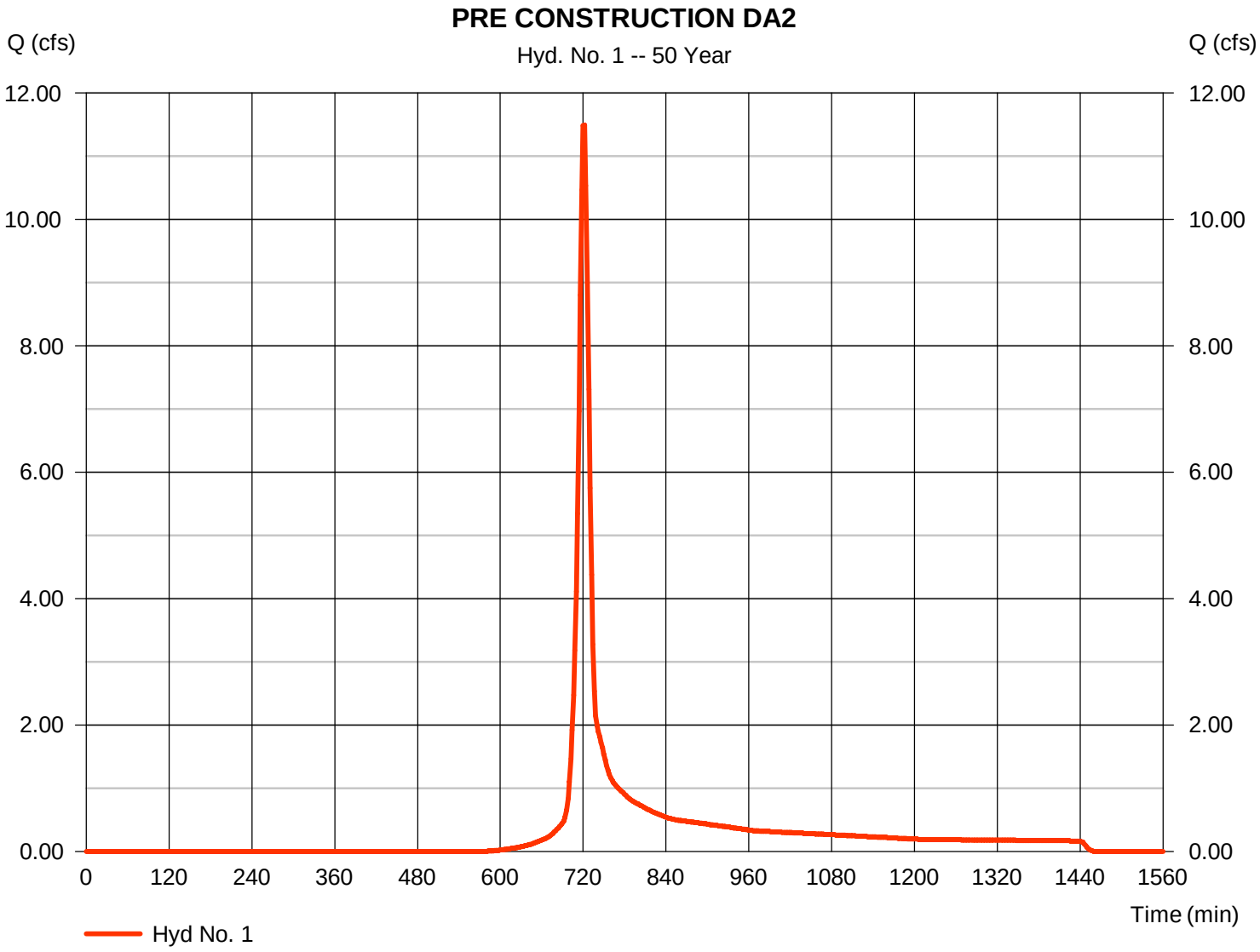
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 11.50 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 30,089 cuft
Drainage area	= 3.430 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 5.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



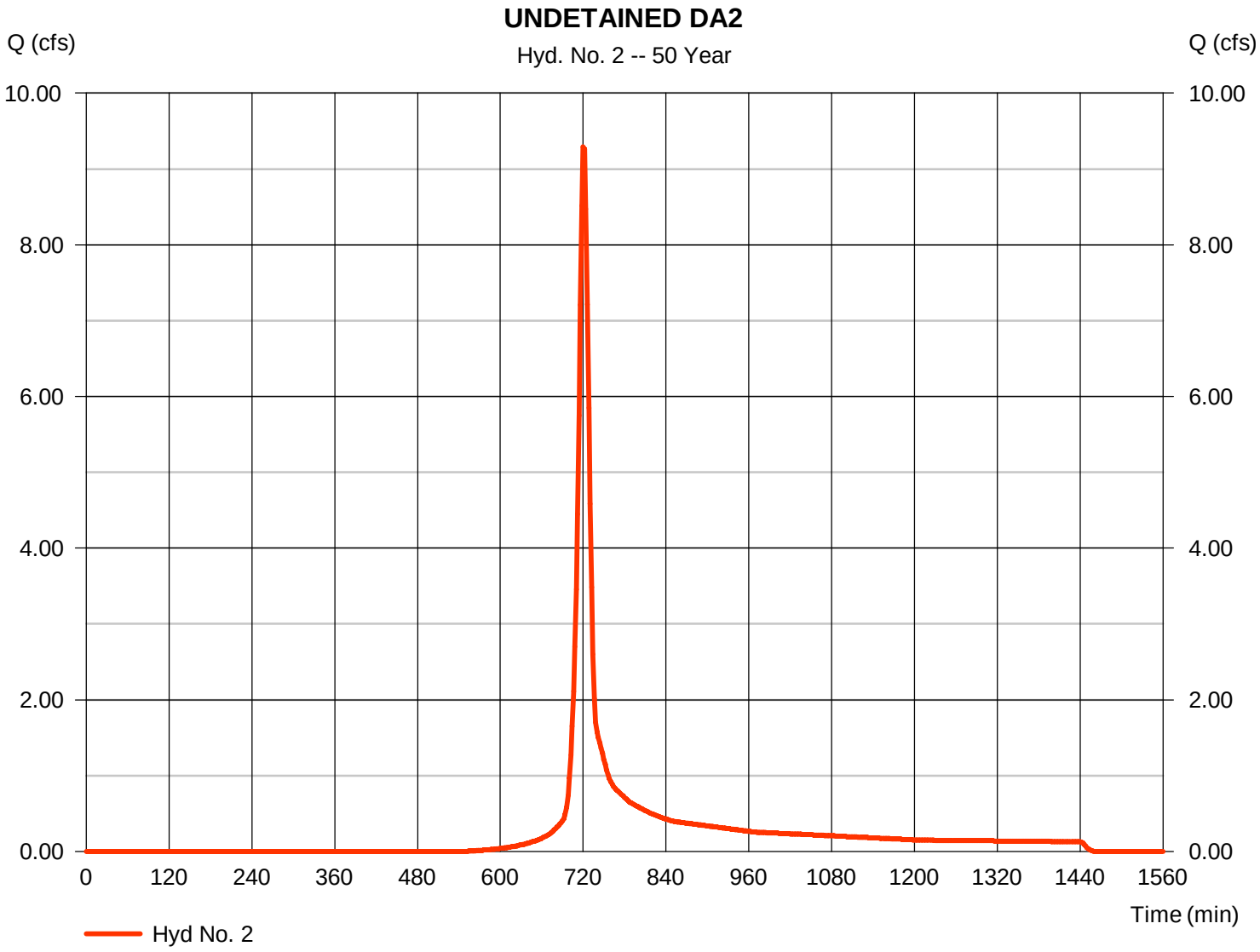
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.295 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	24,216 cuft
Drainage area	=	2.570 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	5.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



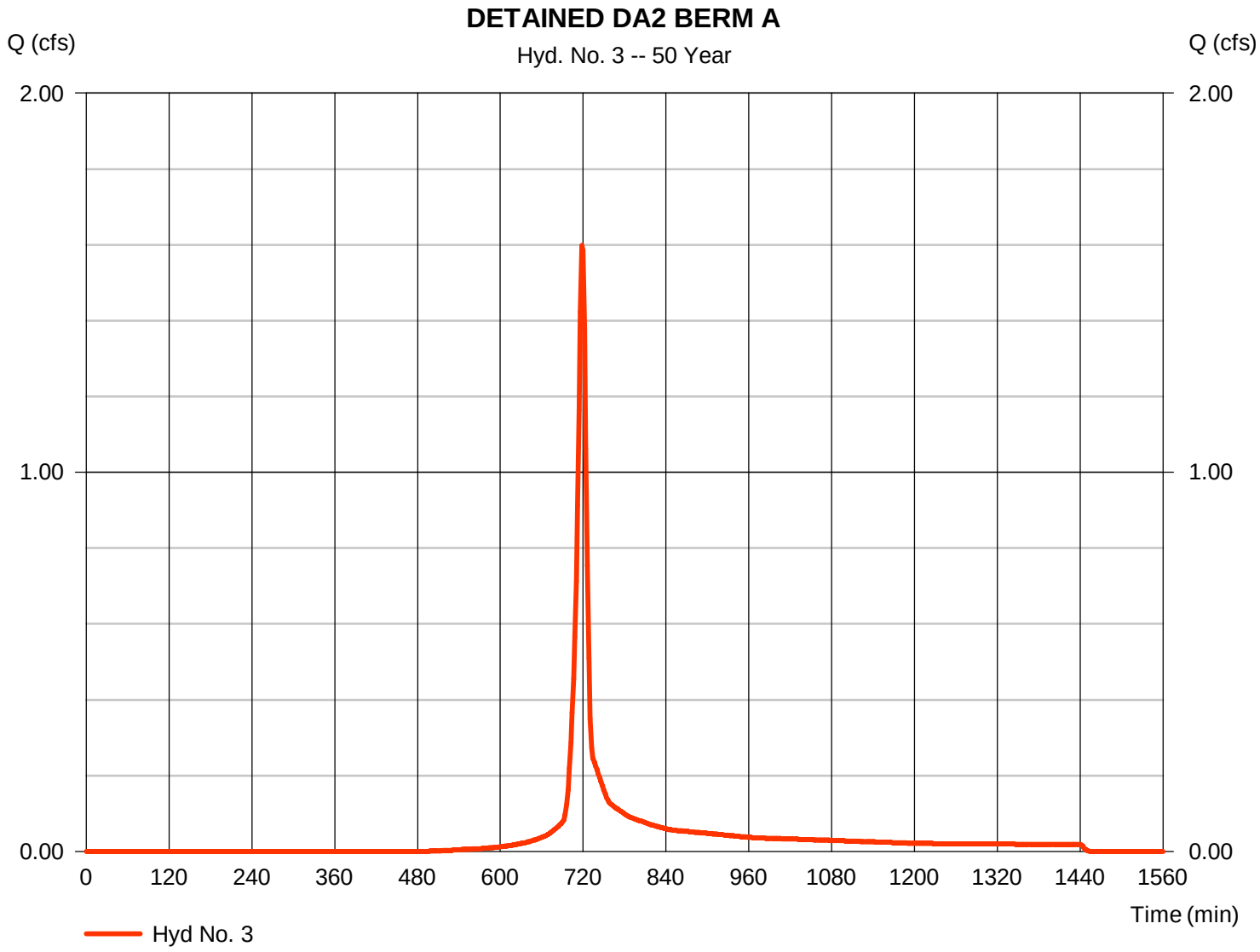
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.598 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	3,656 cuft
Drainage area	=	0.350 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	9.70 min
Total precip.	=	5.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



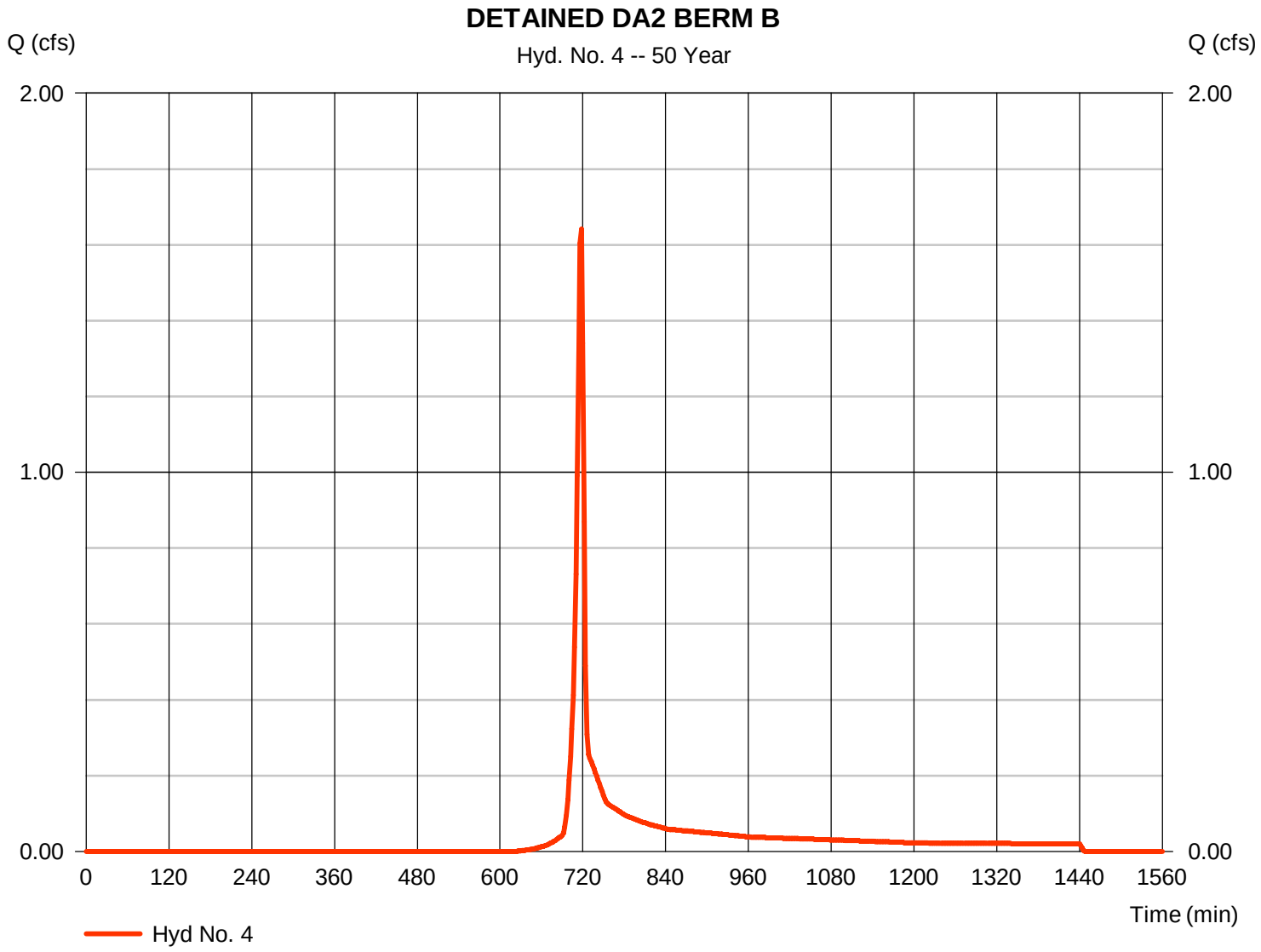
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.641 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	3,281 cuft
Drainage area	=	0.480 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	3.40 min
Total precip.	=	5.52 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480

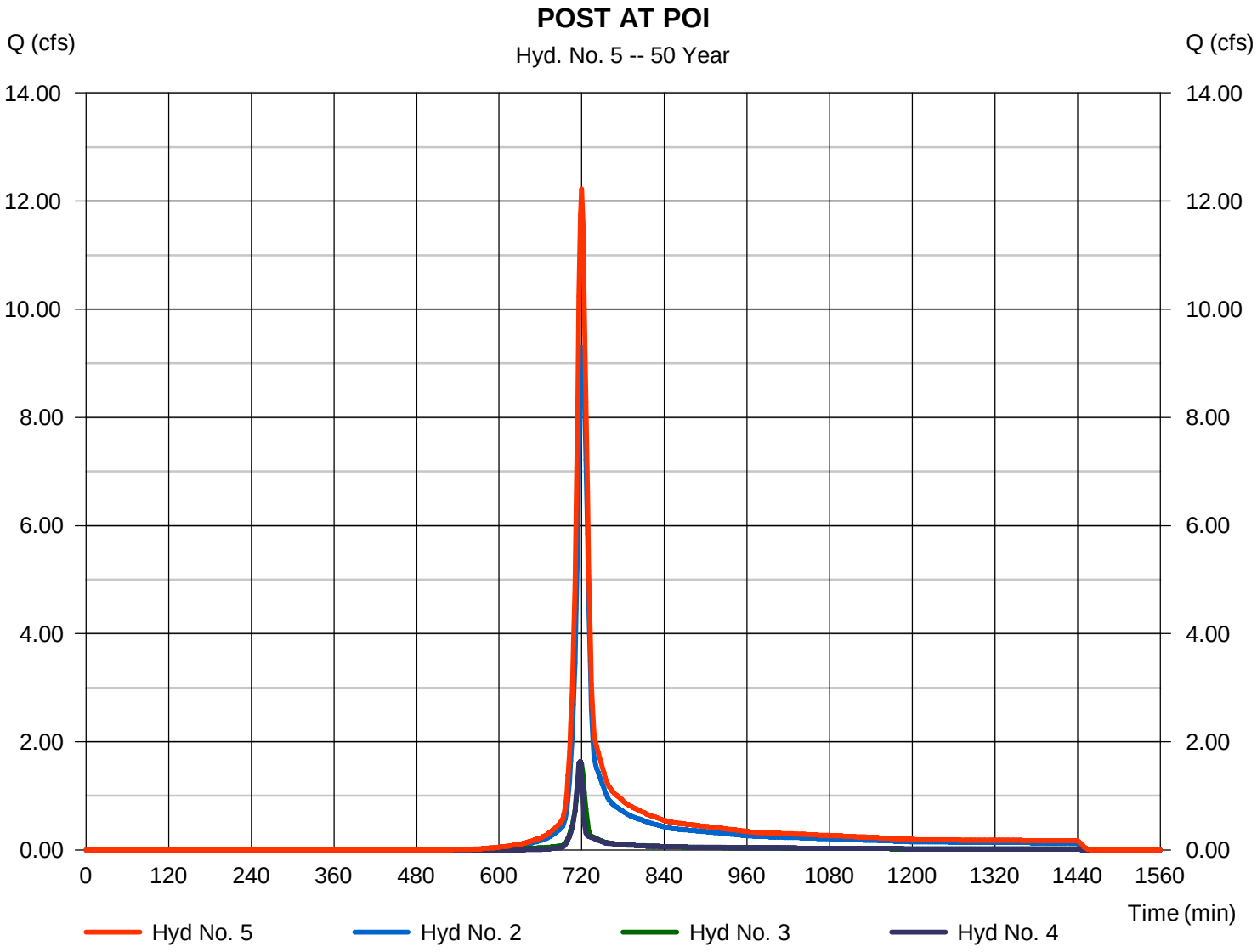


Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 12.22 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 31,153 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	14.68	2	720	38,168	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	11.74	2	720	30,467	------	------	------	UNDETAINED DA2
3	SCS Runoff	1.975	2	718	4,529	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	2.115	2	718	4,237	------	------	------	DETAINED DA2 BERM B
5	Combine	15.41	2	720	39,234	2, 3, 4	------	------	POST AT POI

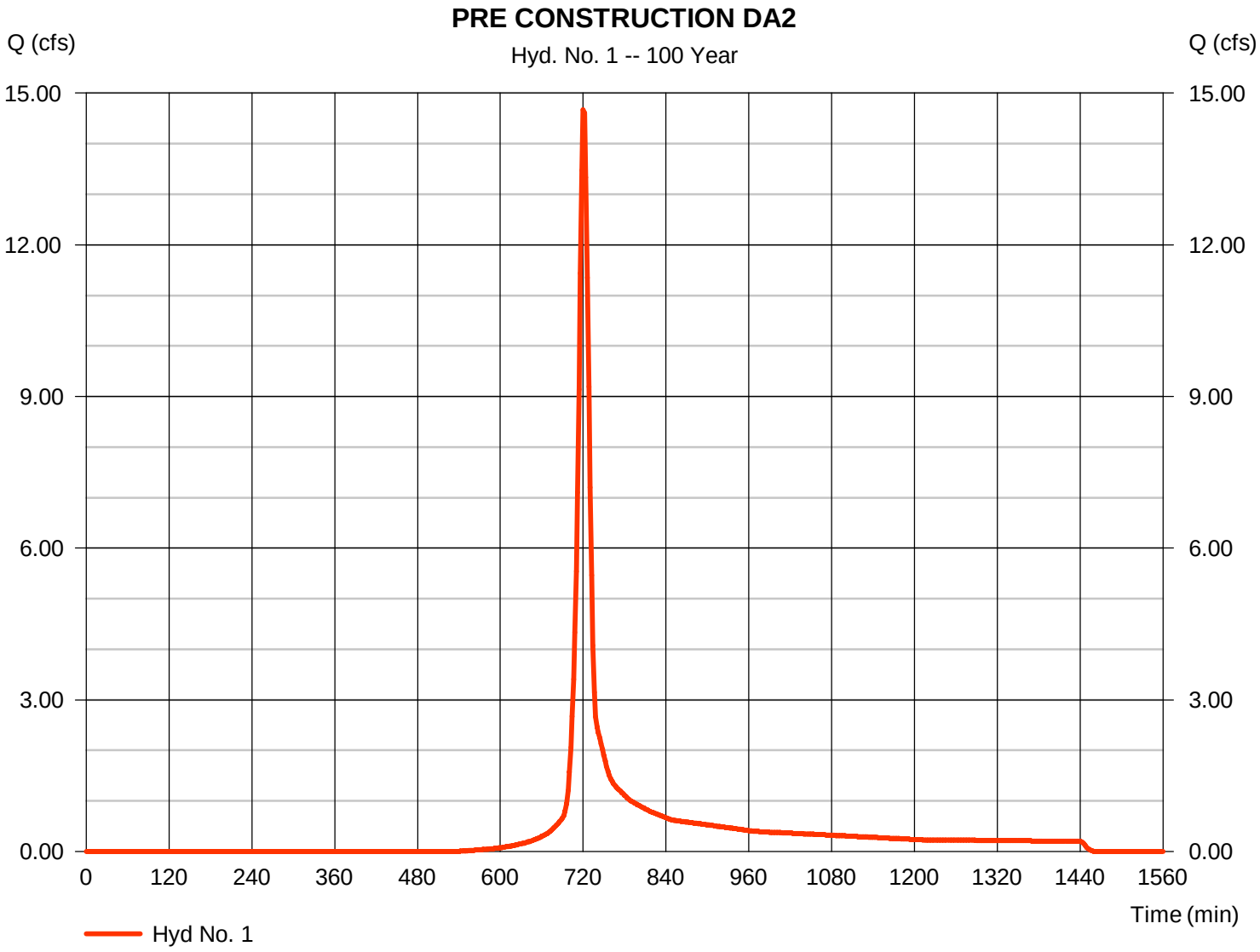
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 14.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 38,168 cuft
Drainage area	= 3.430 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



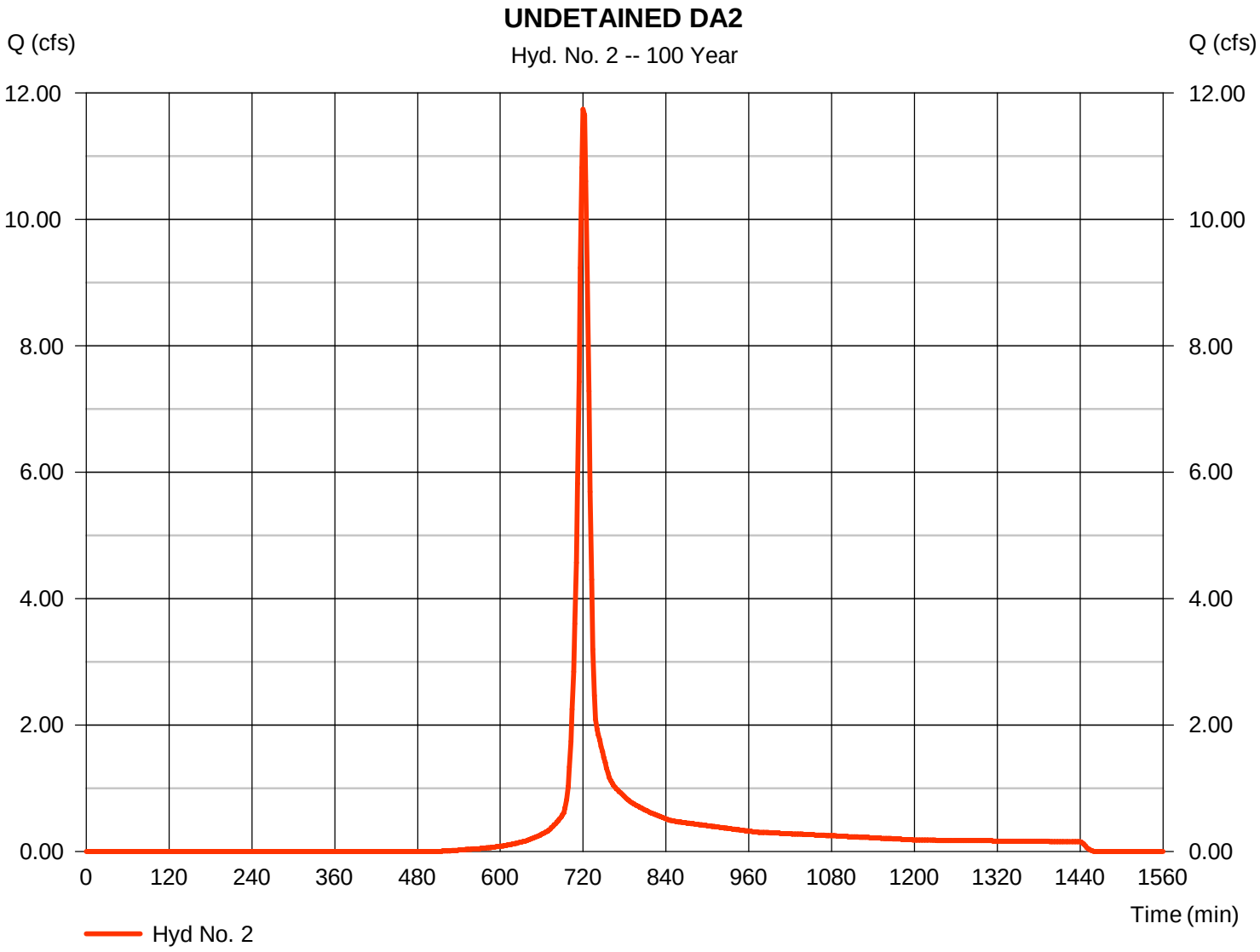
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 11.74 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 30,467 cuft
Drainage area	= 2.570 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



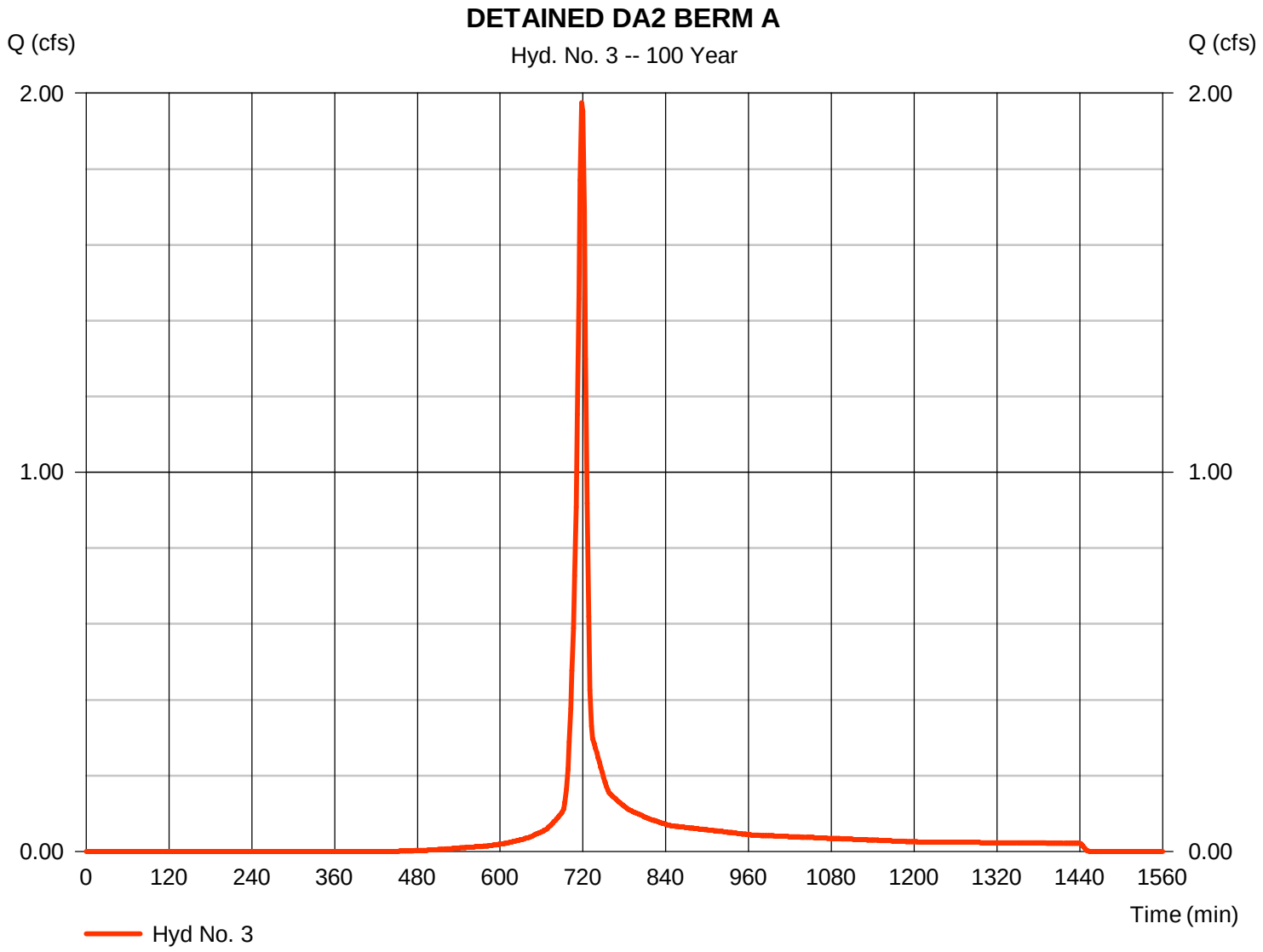
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	= SCS Runoff	Peak discharge	= 1.975 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 4,529 cuft
Drainage area	= 0.350 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.70 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



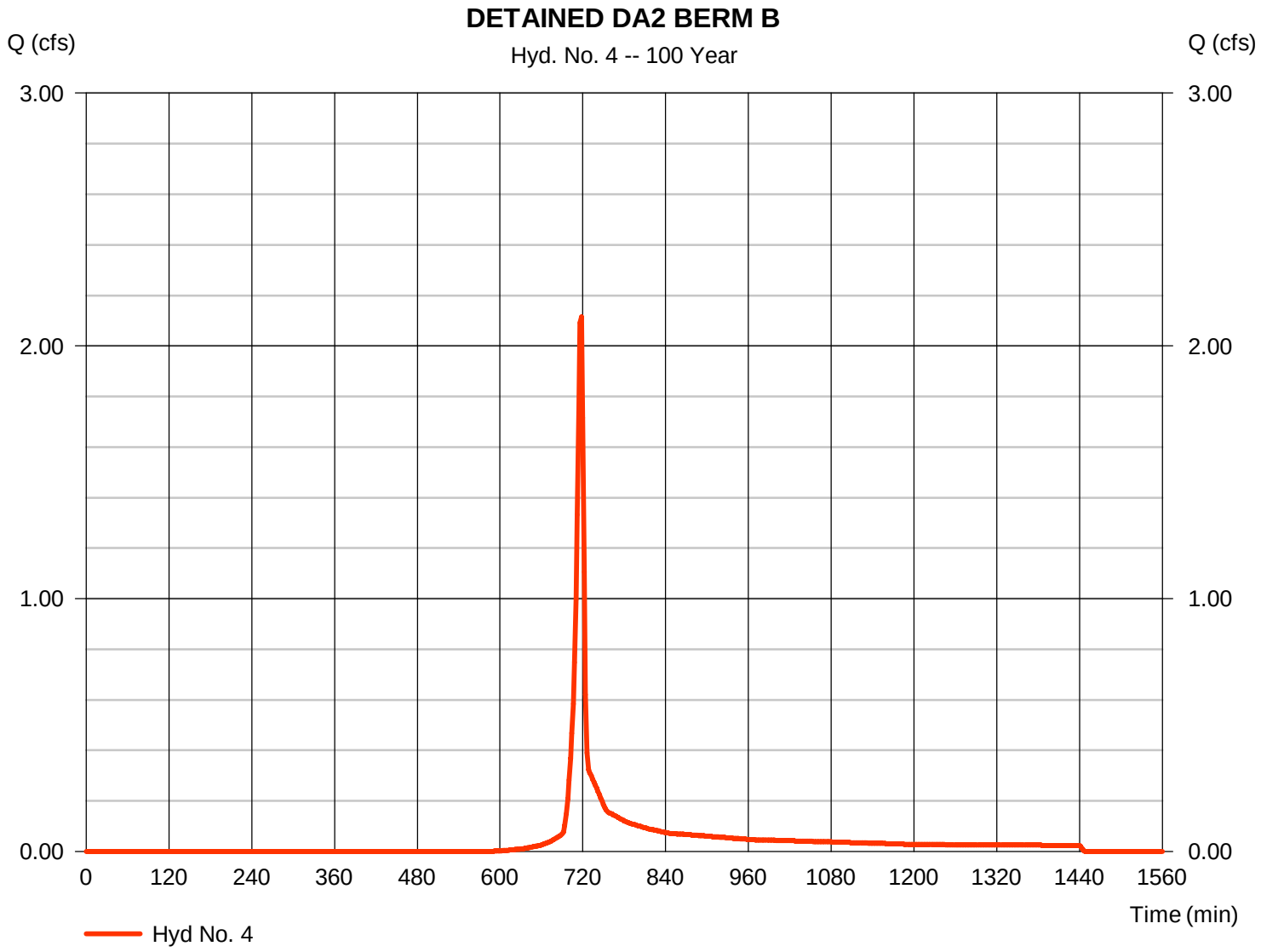
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.115 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	4,237 cuft
Drainage area	=	0.480 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	3.40 min
Total precip.	=	6.33 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480

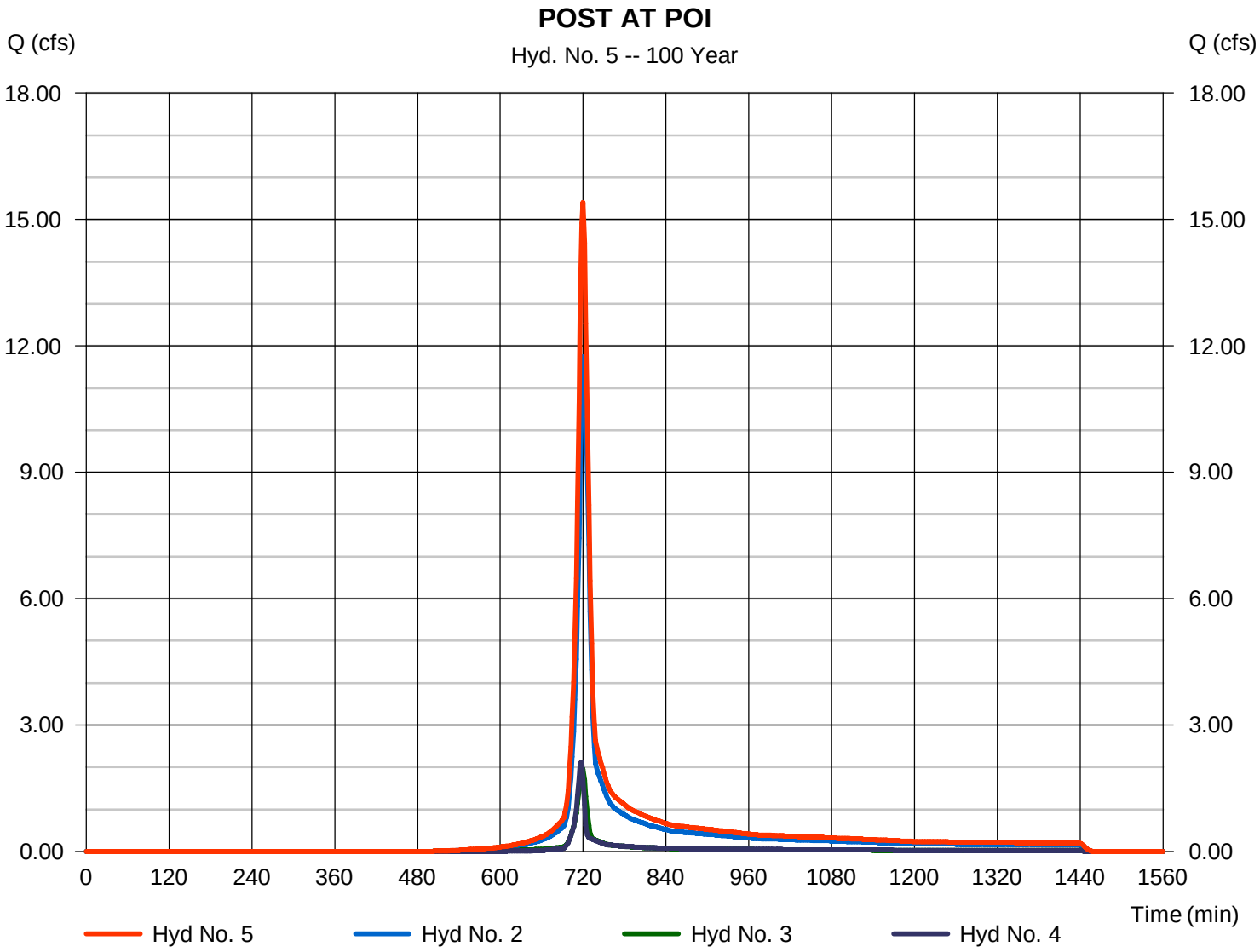


Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 15.41 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 39,234 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

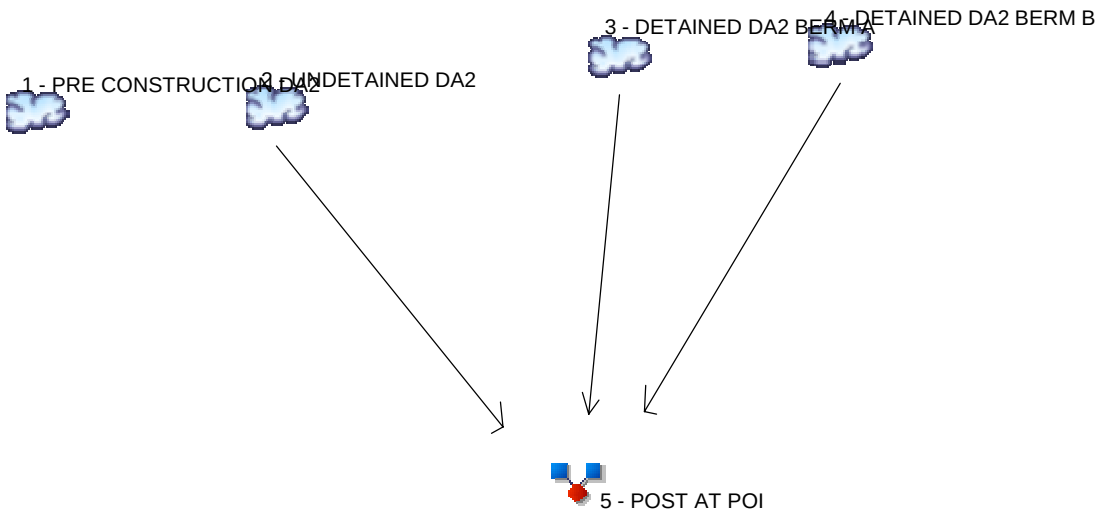
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA2
2	SCS Runoff	UNDETAINED DA2
3	SCS Runoff	DETAINED DA2 BERM A
4	SCS Runoff	DETAINED DA2 BERM B
5	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	2.266	-------	-------	-------	-------	-------	-------	PRE CONSTRUCTION DA2
2	SCS Runoff	------	-------	2.053	-------	-------	-------	-------	-------	-------	UNDETAINED DA2
3	SCS Runoff	------	-------	0.159	-------	-------	-------	-------	-------	-------	DETAINED DA2 BERM A
4	SCS Runoff	------	-------	0.086	-------	-------	-------	-------	-------	-------	DETAINED DA2 BERM B
5	Combine	2, 3, 4	-------	2.140	-------	-------	-------	-------	-------	-------	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	2.266	2	722	6,872	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	2.053	2	722	5,922	------	------	------	UNDETAINED DA2
3	SCS Runoff	0.159	2	744	1,010	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	0.086	2	744	690	------	------	------	DETAINED DA2 BERM B
5	Combine	2.140	2	722	7,623	2, 3, 4	------	------	POST AT POI

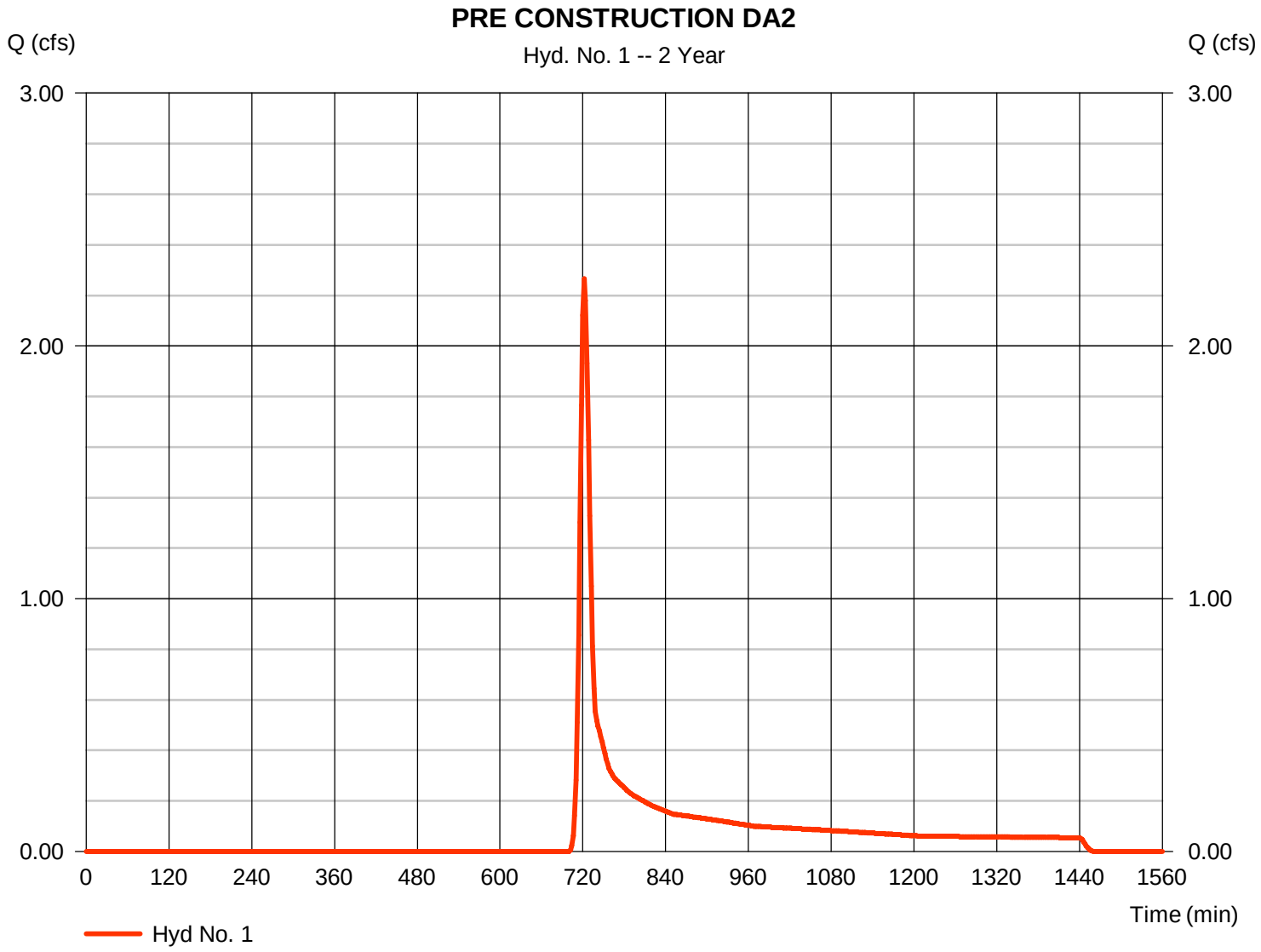
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.266 cfs
Storm frequency	=	2 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	6,872 cuft
Drainage area	=	3.430 ac	Curve number	=	69*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	2.74 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

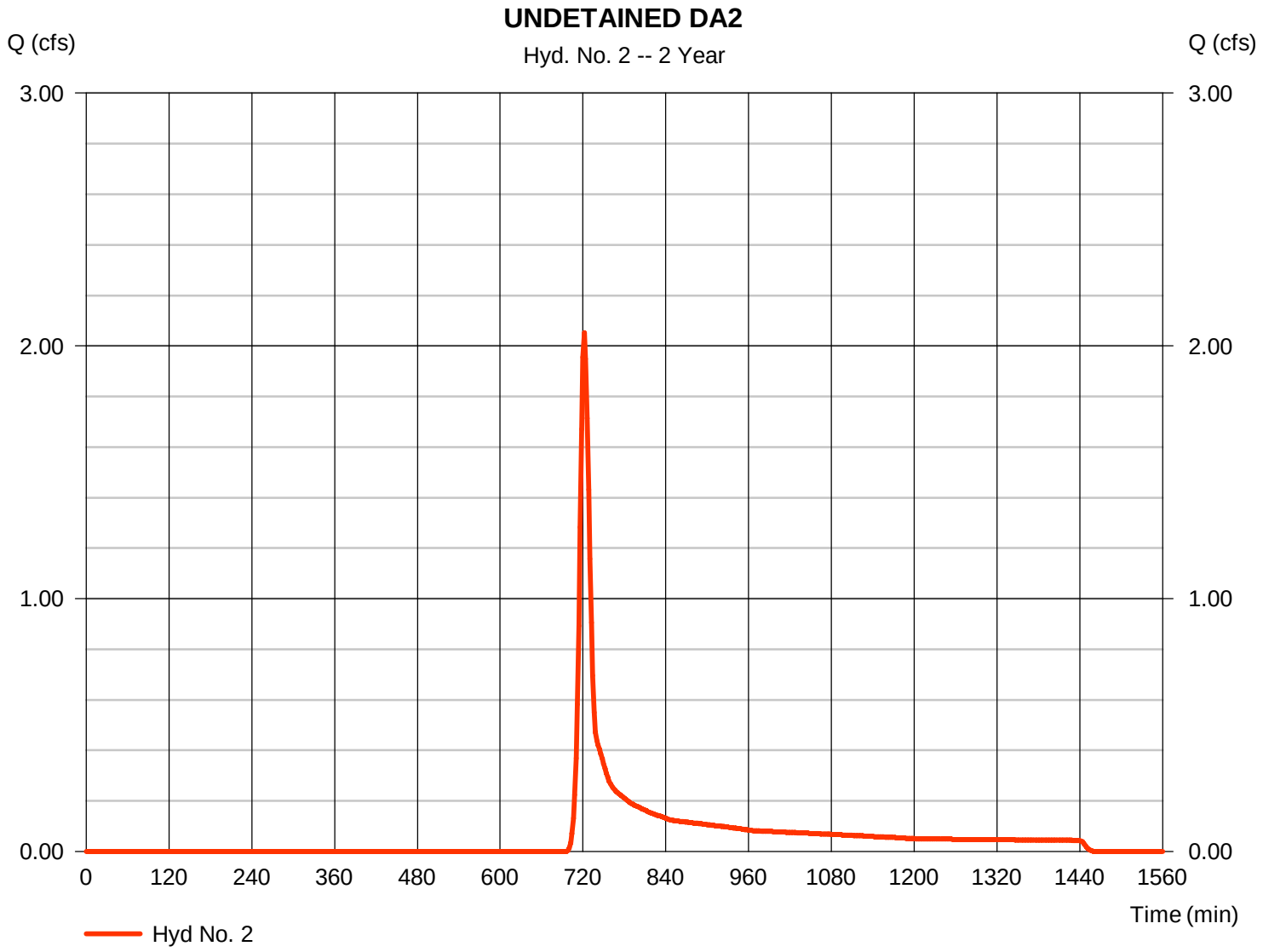
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.053 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 5,922 cuft
Drainage area	= 2.570 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



TR55 Tc Worksheet

Hyd. No. 2

UNDETAINED DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

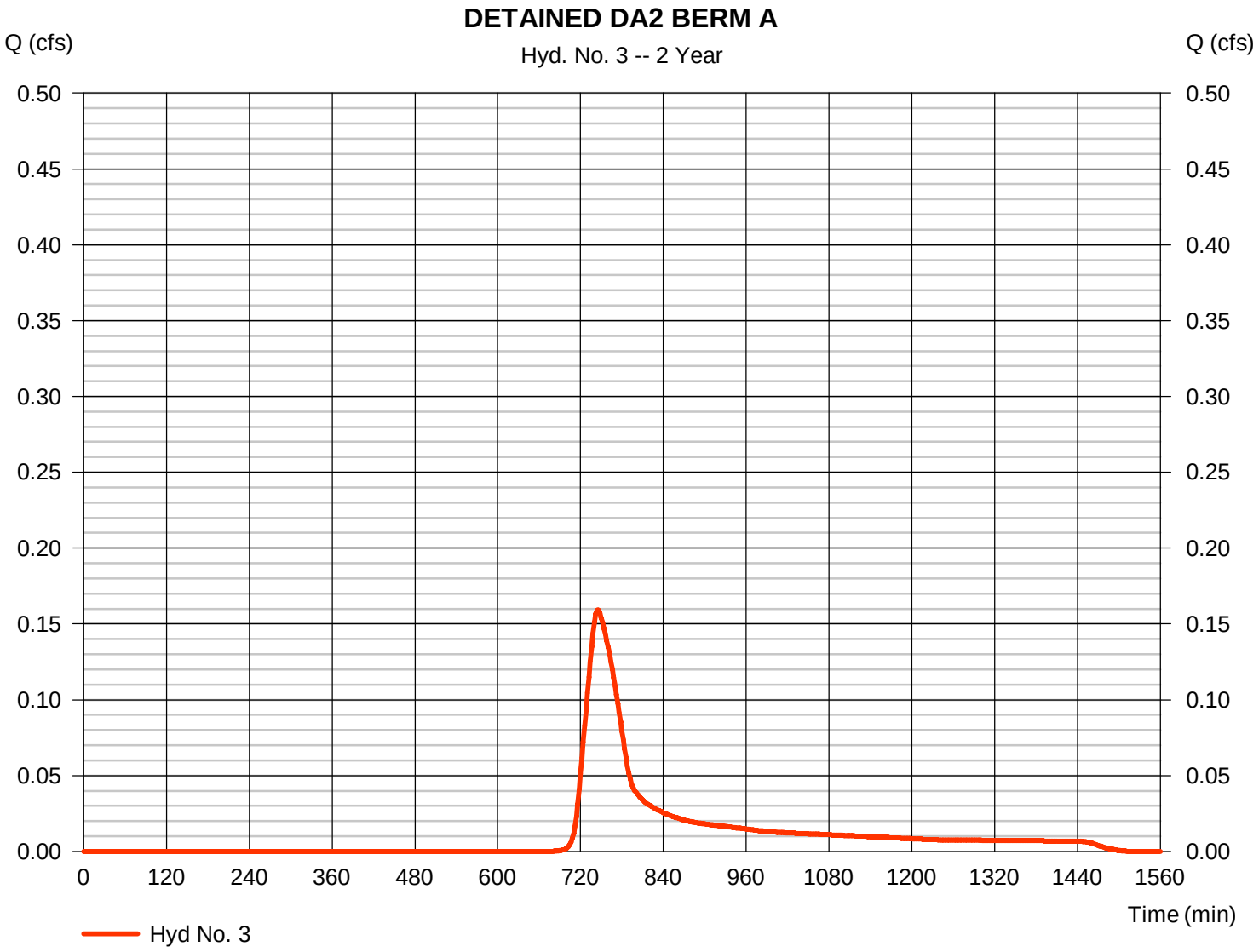
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.159 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 1,010 cuft
Drainage area	= 0.350 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 48.41 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



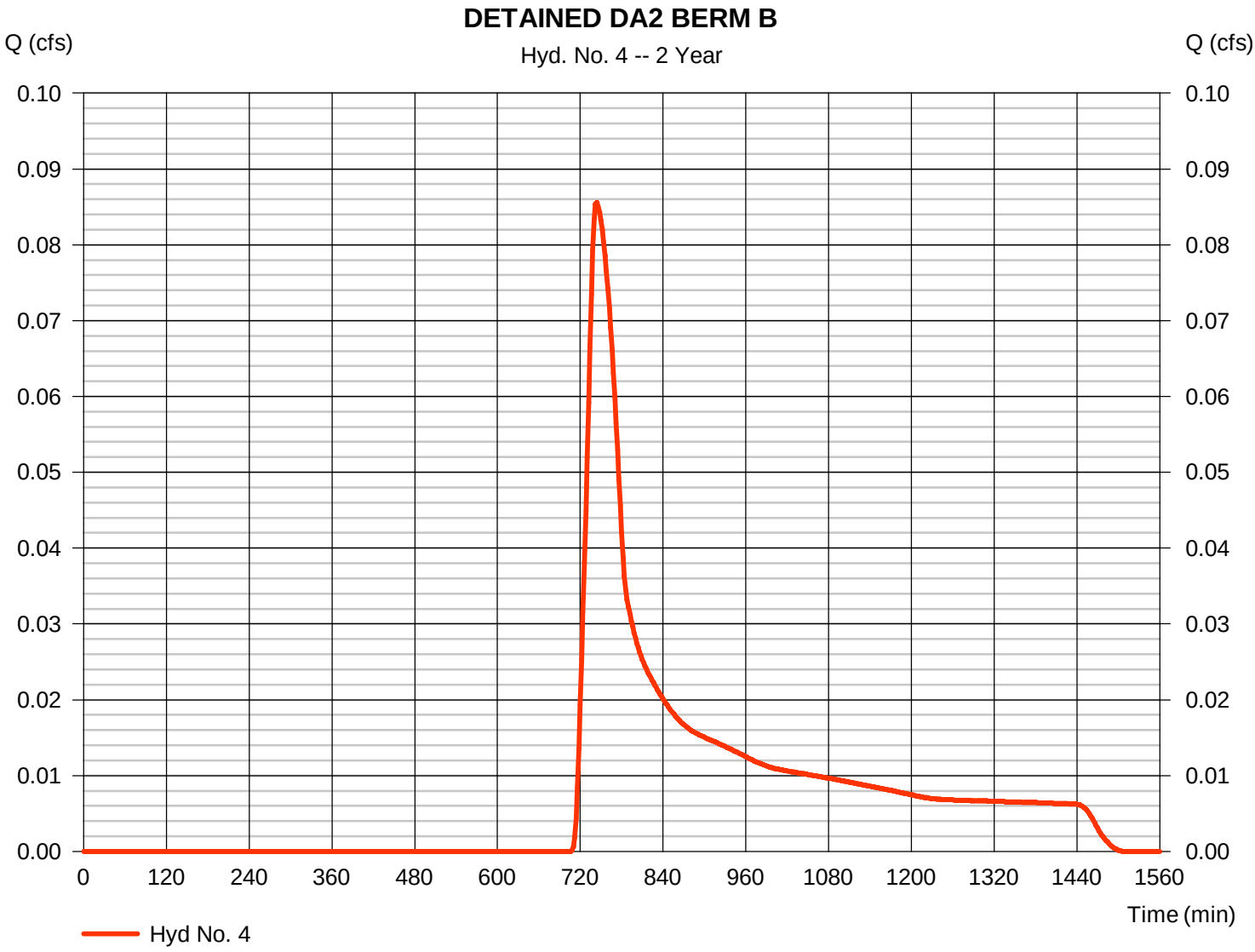
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.086 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 690 cuft
Drainage area	= 0.480 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 43.26 min
Total precip.	= 2.74 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480

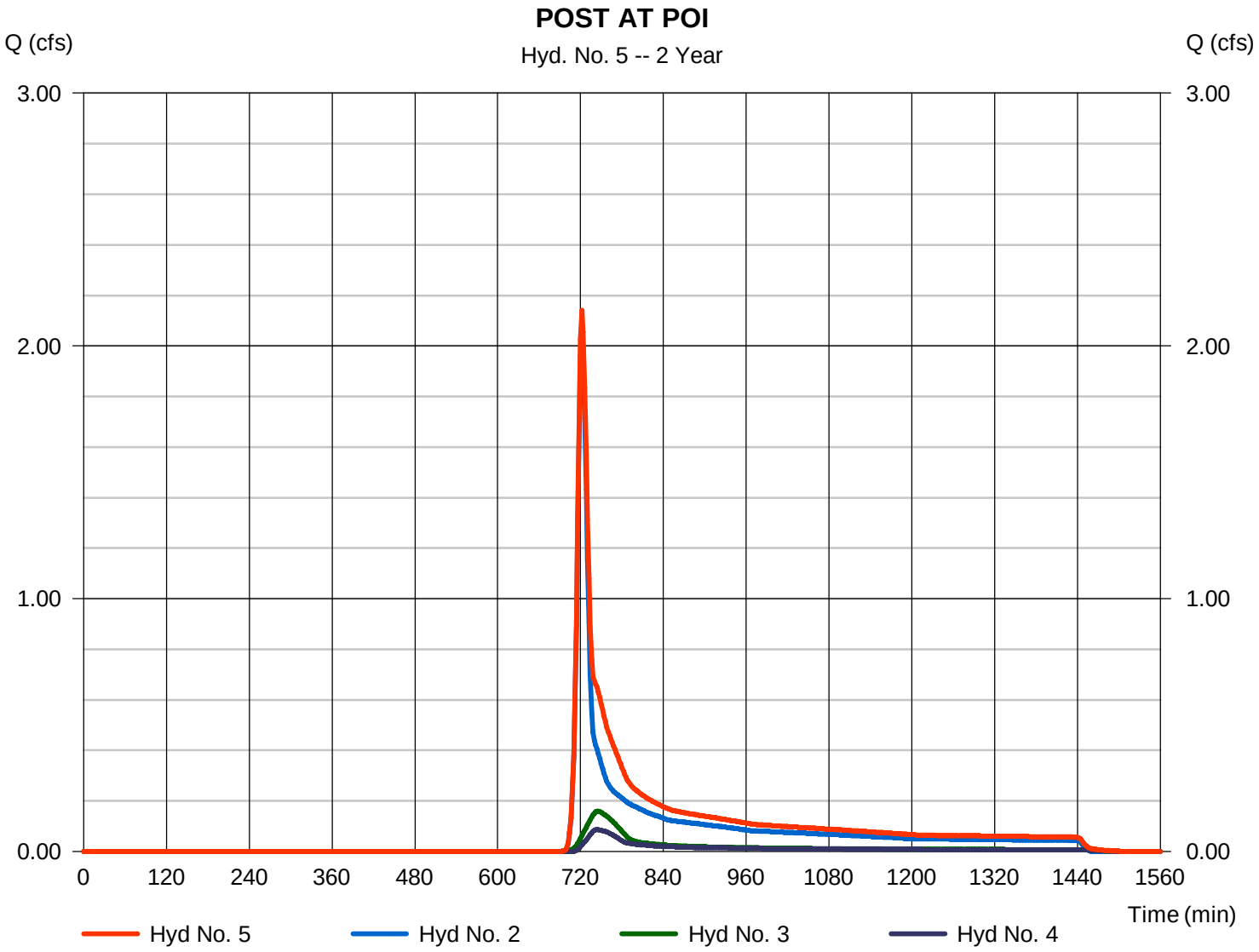


Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 2.140 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 7,623 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

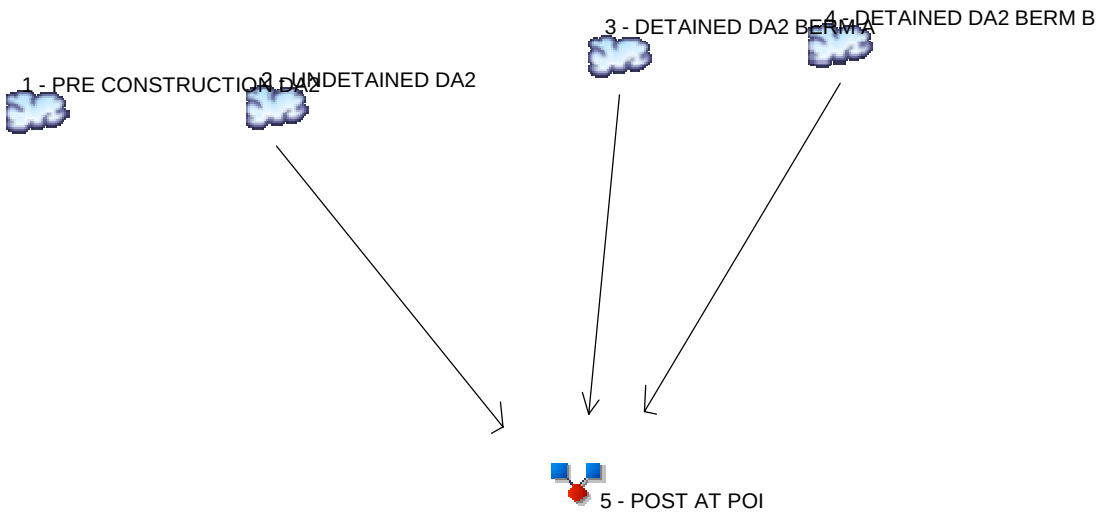
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA2
2	SCS Runoff	UNDETAINED DA2
3	SCS Runoff	DETAINED DA2 BERM A
4	SCS Runoff	DETAINED DA2 BERM B
5	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	-------	-------	-------	5.933	-------	-------	-------	PRE CONSTRUCTION DA2
2	SCS Runoff	------	-------	-------	-------	-------	4.955	-------	-------	-------	UNDETAINED DA2
3	SCS Runoff	------	-------	-------	-------	-------	0.356	-------	-------	-------	DETAINED DA2 BERM A
4	SCS Runoff	------	-------	-------	-------	-------	0.310	-------	-------	-------	DETAINED DA2 BERM B
5	Combine	2, 3, 4	-------	-------	-------	-------	5.264	-------	-------	-------	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	5.933	2	722	15,930	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	4.955	2	722	13,150	------	------	------	UNDETAINED DA2
3	SCS Runoff	0.356	2	744	2,079	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	0.310	2	738	1,752	------	------	------	DETAINED DA2 BERM B
5	Combine	5.264	2	722	16,981	2, 3, 4	------	------	POST AT POI

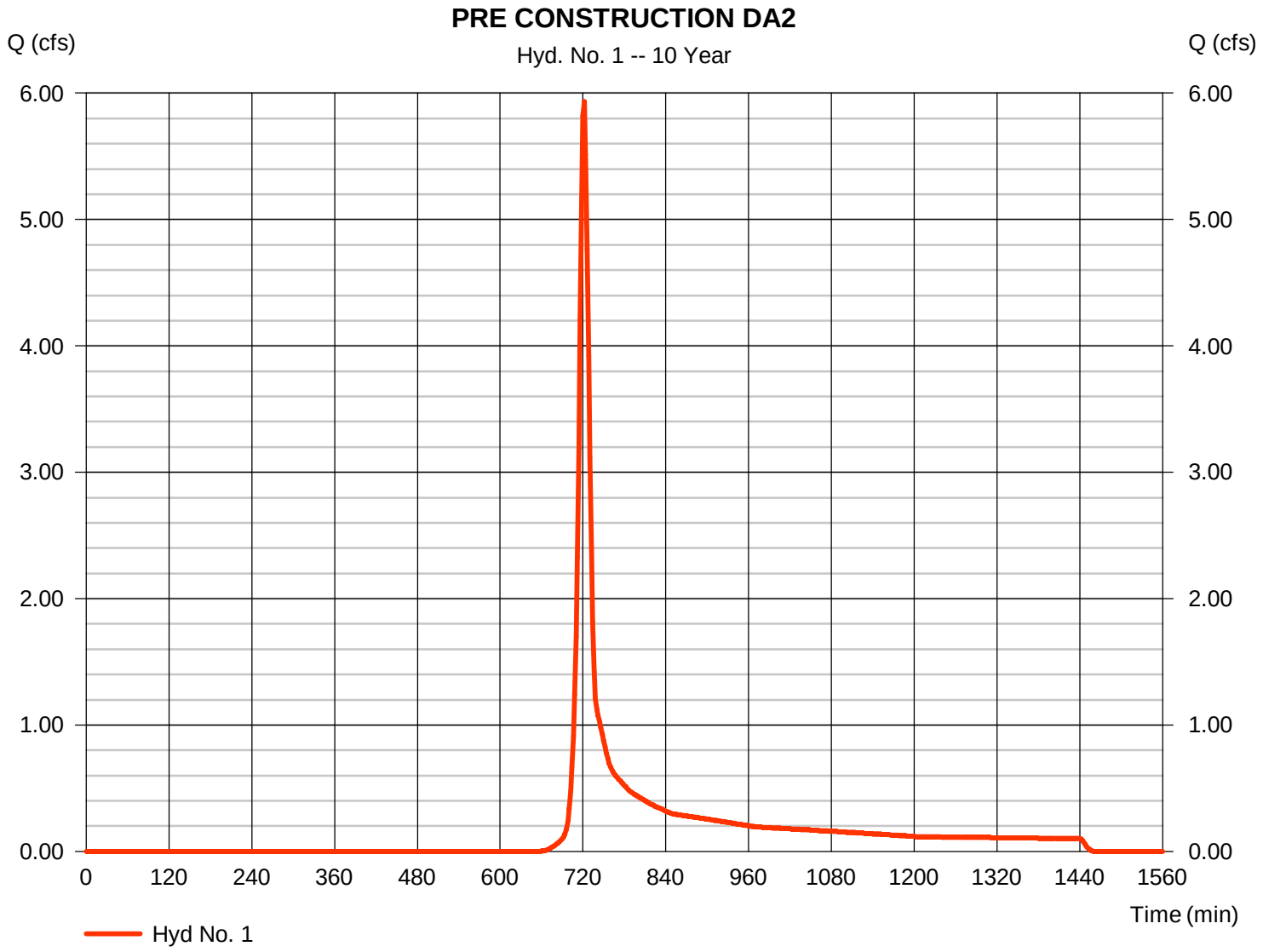
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.933 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	15,930 cuft
Drainage area	=	3.430 ac	Curve number	=	69*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	3.96 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

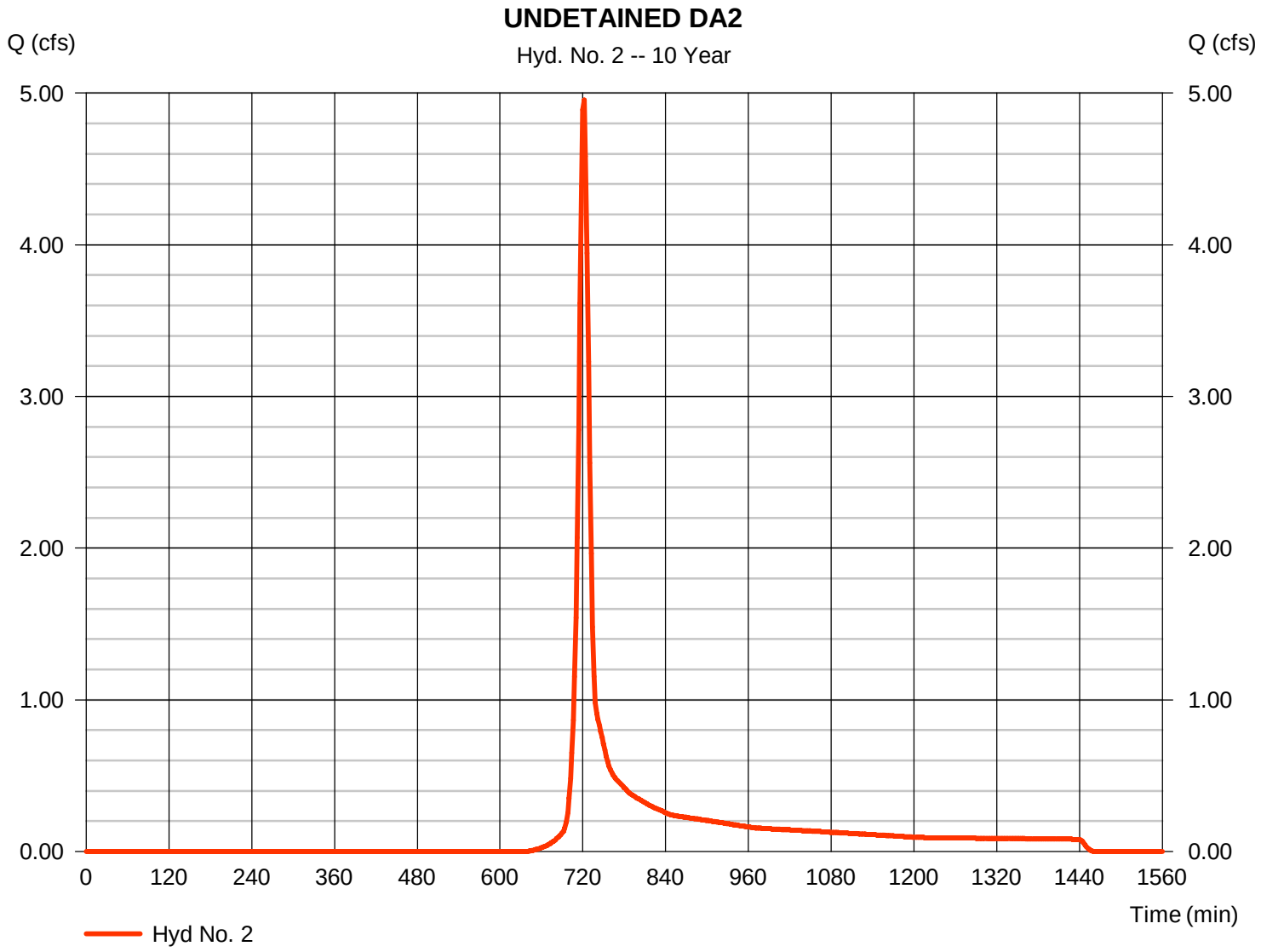
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.955 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	13,150 cuft
Drainage area	=	2.570 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	3.96 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



TR55 Tc Worksheet

Hyd. No. 2

UNDETAINED DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

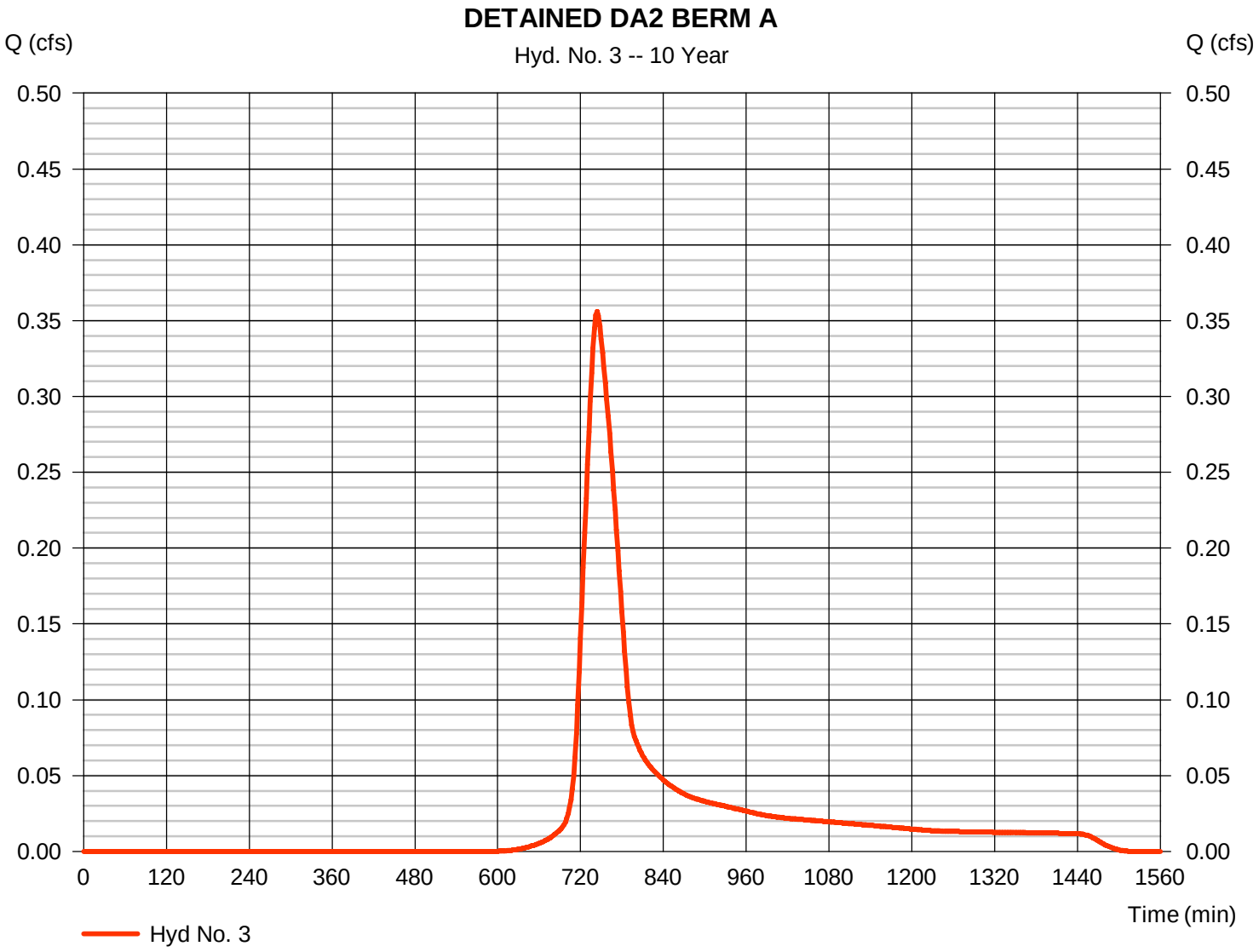
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.356 cfs
Storm frequency	= 10 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 2,079 cuft
Drainage area	= 0.350 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 47.82 min
Total precip.	= 3.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



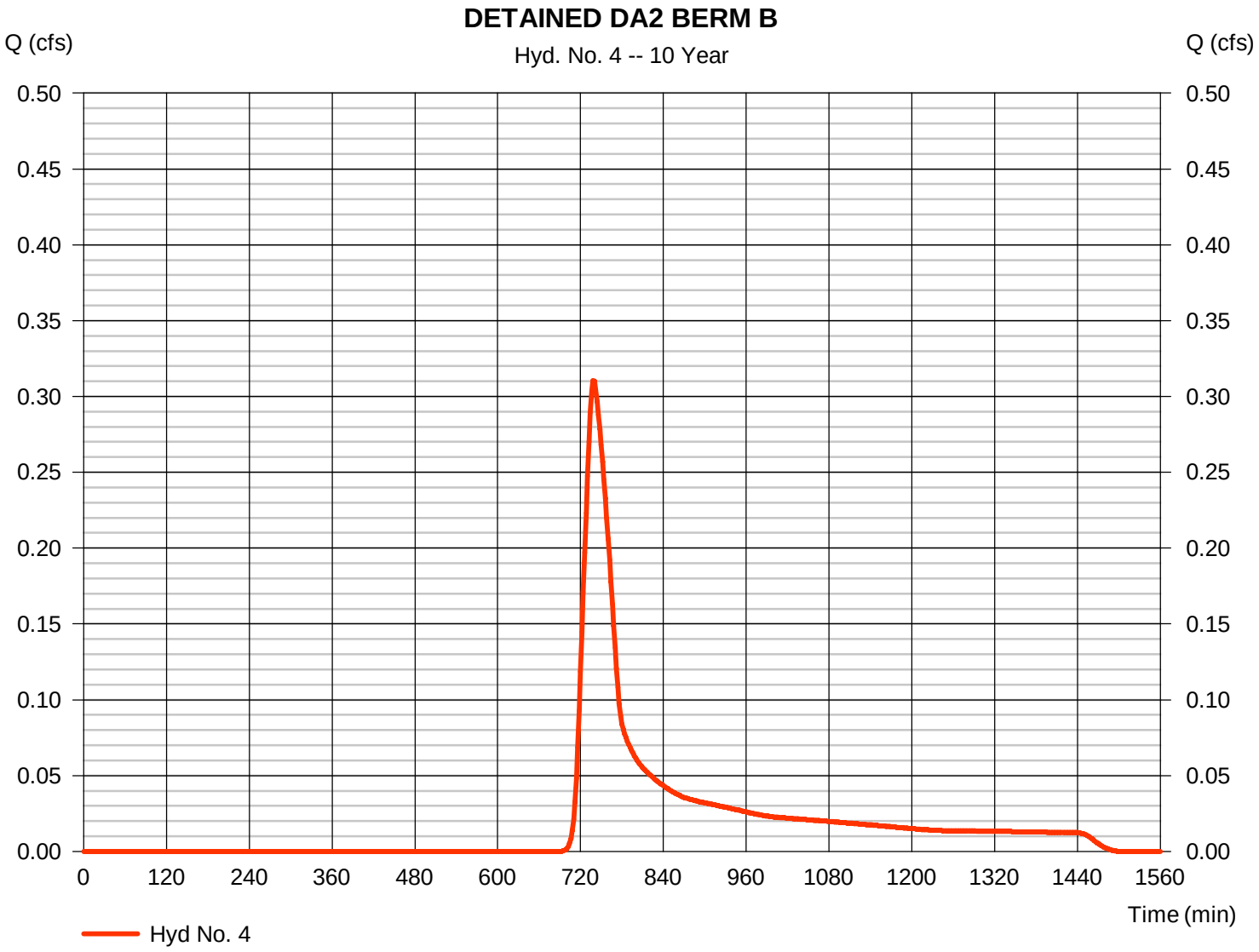
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.310 cfs
Storm frequency	= 10 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 1,752 cuft
Drainage area	= 0.480 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.44 min
Total precip.	= 3.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480

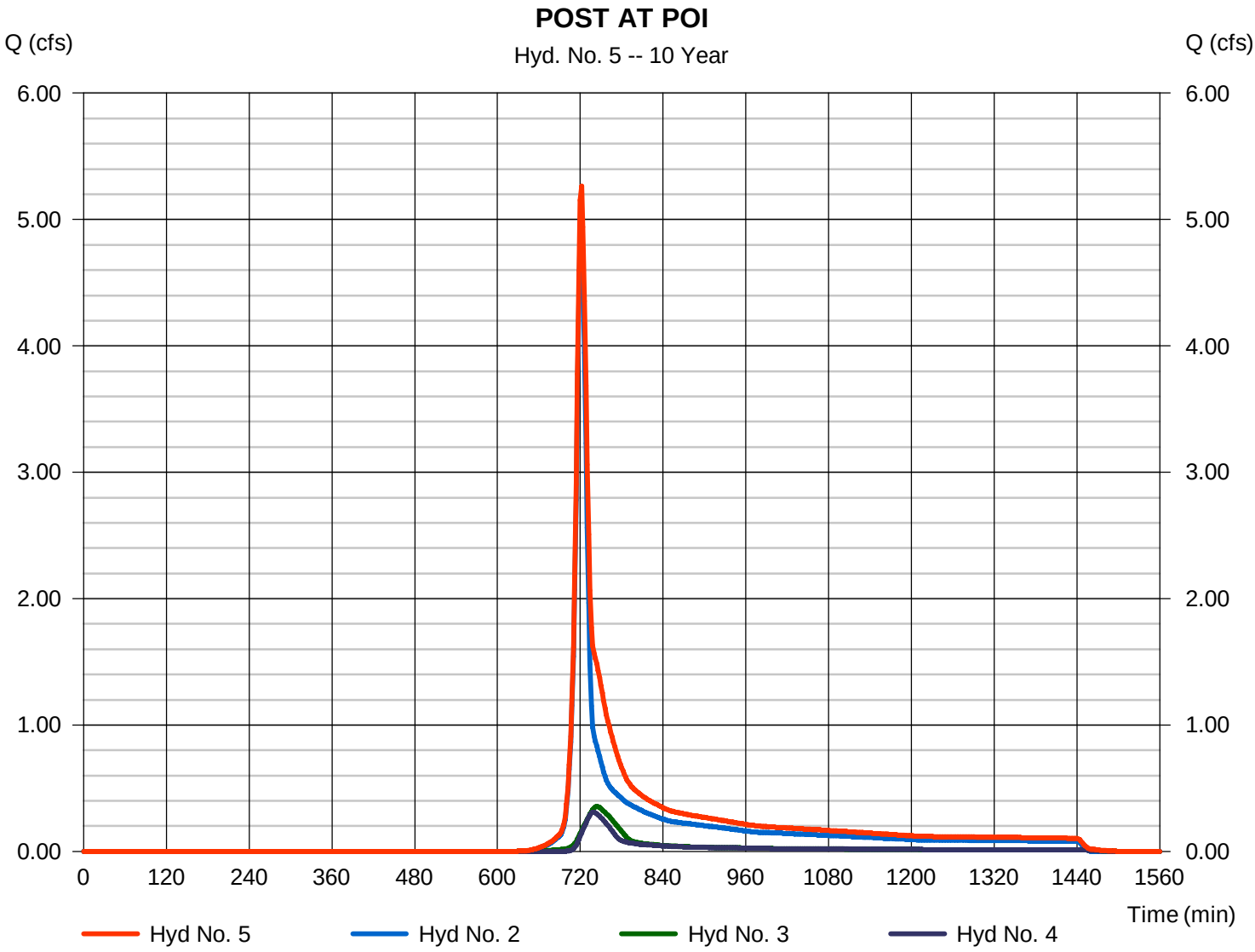


Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 5.264 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 16,981 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

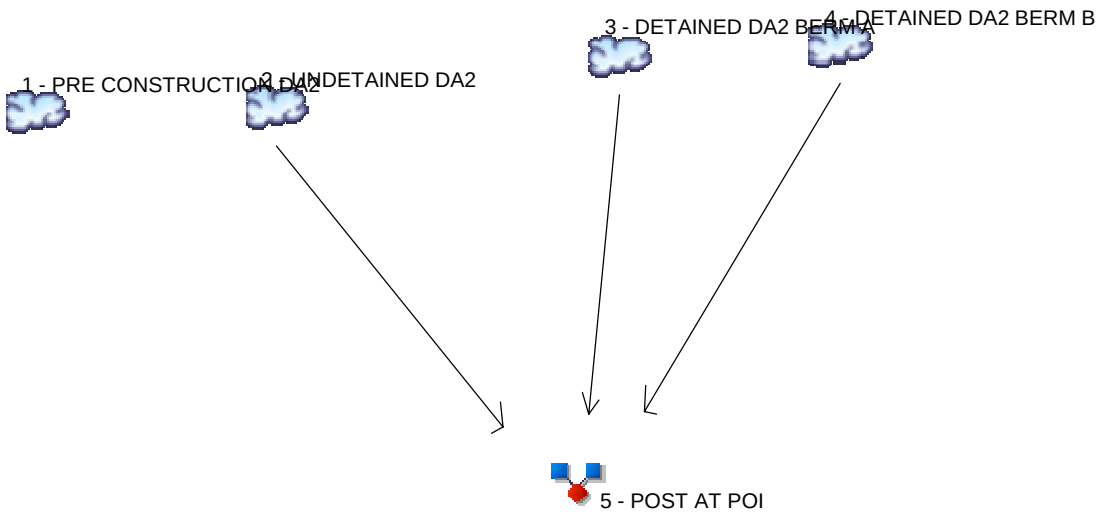
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA2
2	SCS Runoff	UNDETAINED DA2
3	SCS Runoff	DETAINED DA2 BERM A
4	SCS Runoff	DETAINED DA2 BERM B
5	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	-------	-------	-------	-------	-------	11.50	-------	PRE CONSTRUCTION DA2
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	9.295	-------	UNDETAINED DA2
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	0.751	-------	DETAINED DA2 BERM A
4	SCS Runoff	------	-------	-------	-------	-------	-------	-------	0.839	-------	DETAINED DA2 BERM B
5	Combine	2, 3, 4	-------	-------	-------	-------	-------	-------	10.32	-------	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	11.50	2	722	30,089	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	9.295	2	720	24,216	------	------	------	UNDETAINED DA2
3	SCS Runoff	0.751	2	738	3,656	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	0.839	2	732	3,500	------	------	------	DETAINED DA2 BERM B
5	Combine	10.32	2	722	31,371	2, 3, 4	------	------	POST AT POI

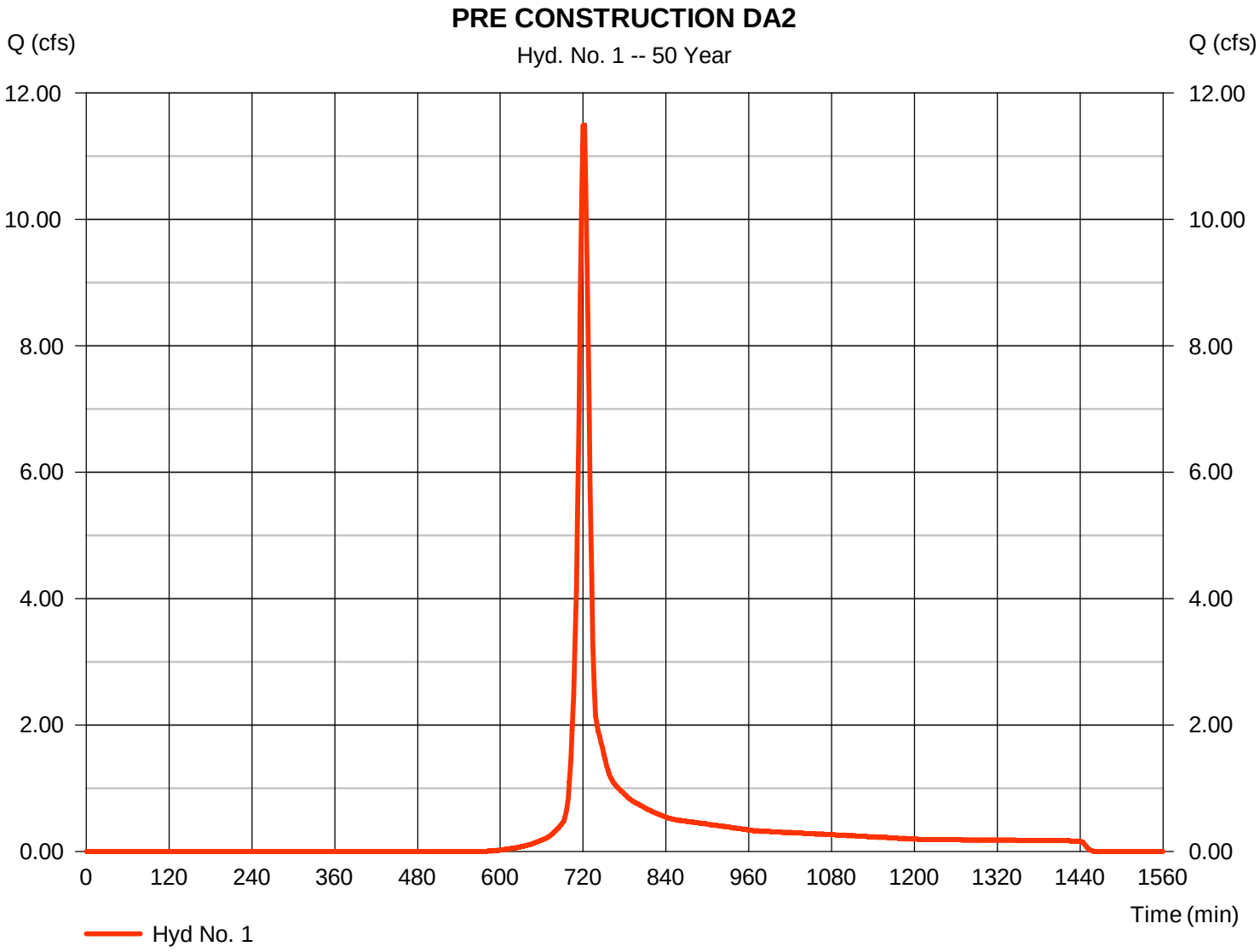
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 11.50 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 30,089 cuft
Drainage area	= 3.430 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 5.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

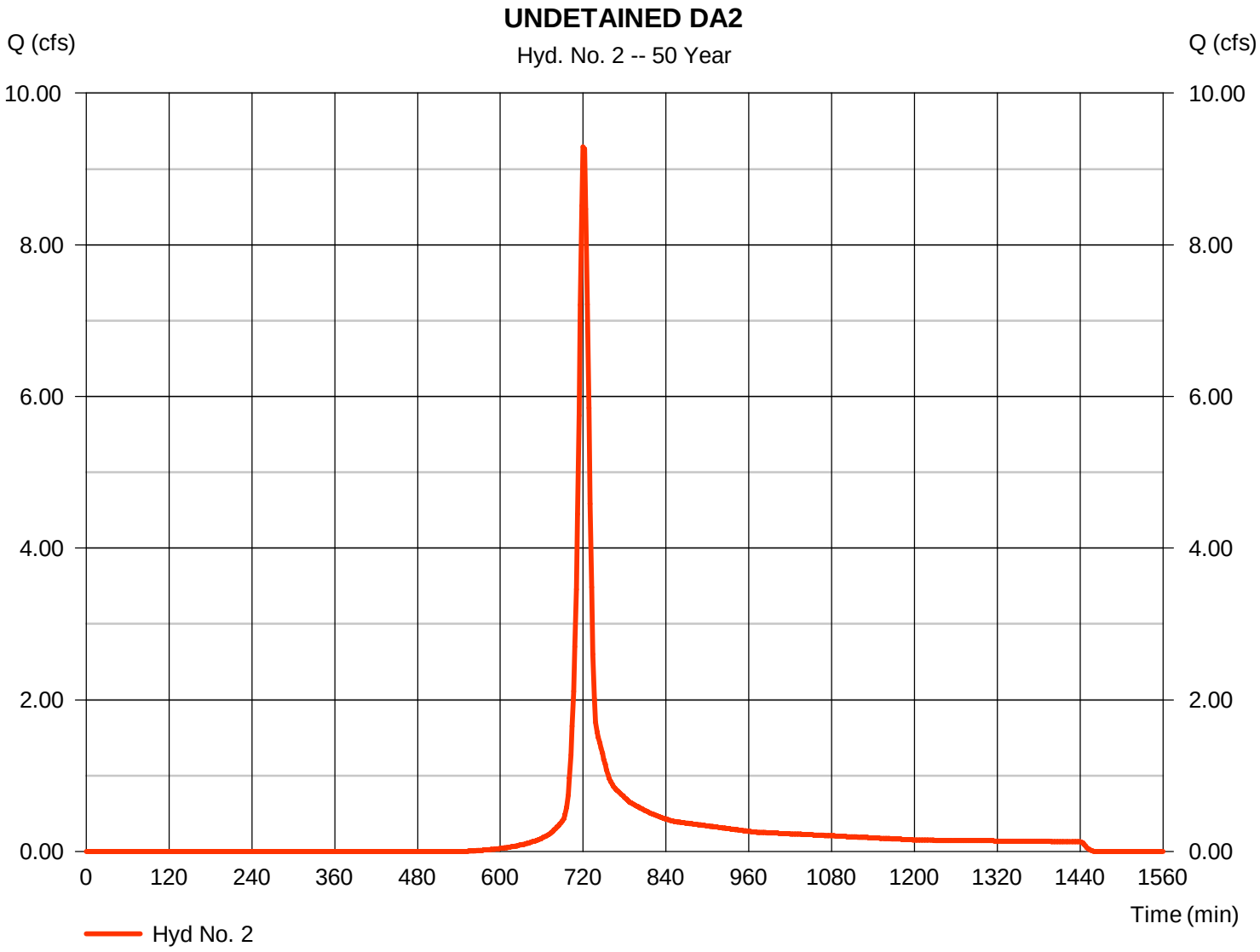
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 9.295 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 24,216 cuft
Drainage area	= 2.570 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 5.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



TR55 Tc Worksheet

Hyd. No. 2

UNDETAINED DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

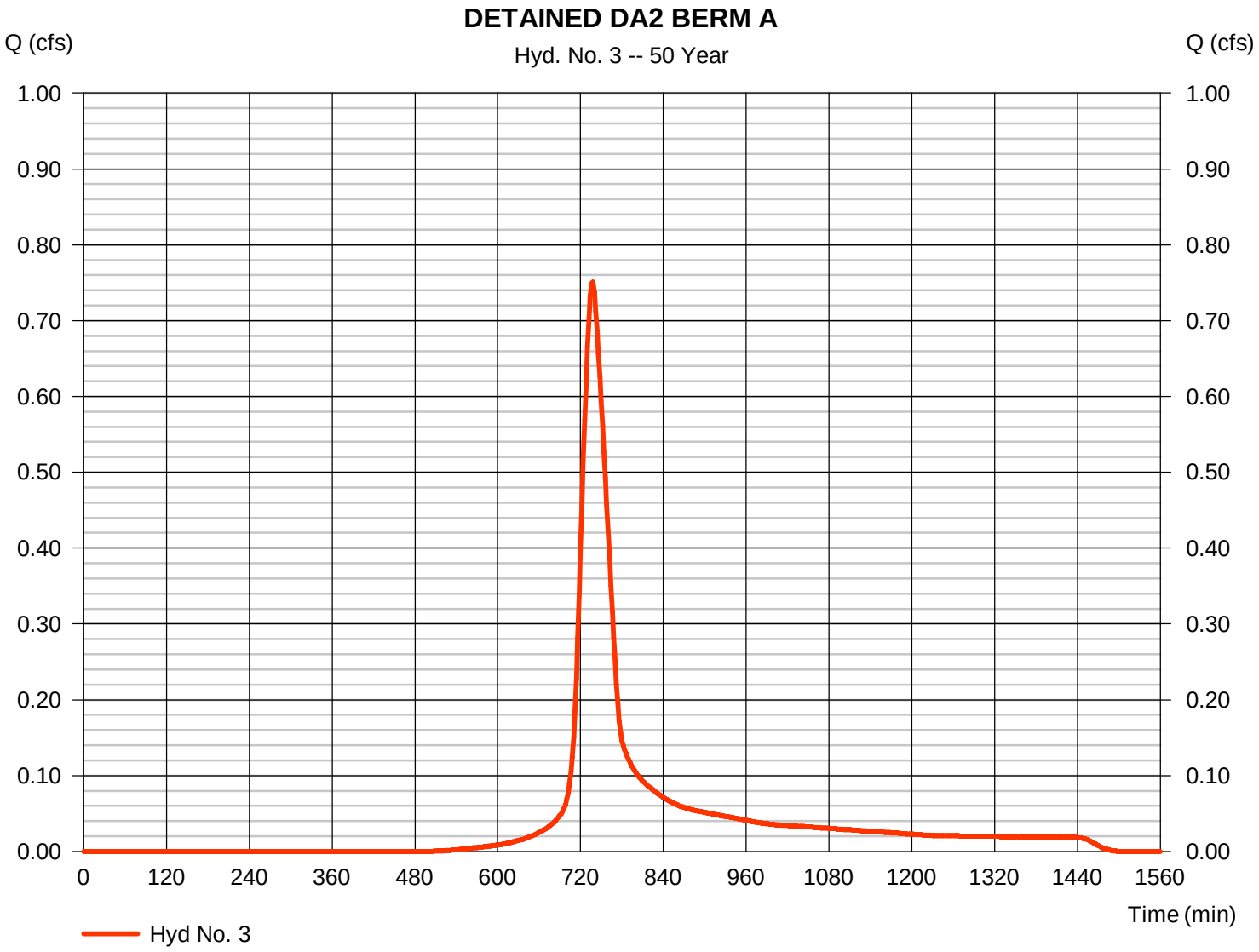
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.751 cfs
Storm frequency	= 50 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 3,656 cuft
Drainage area	= 0.350 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.90 min
Total precip.	= 5.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



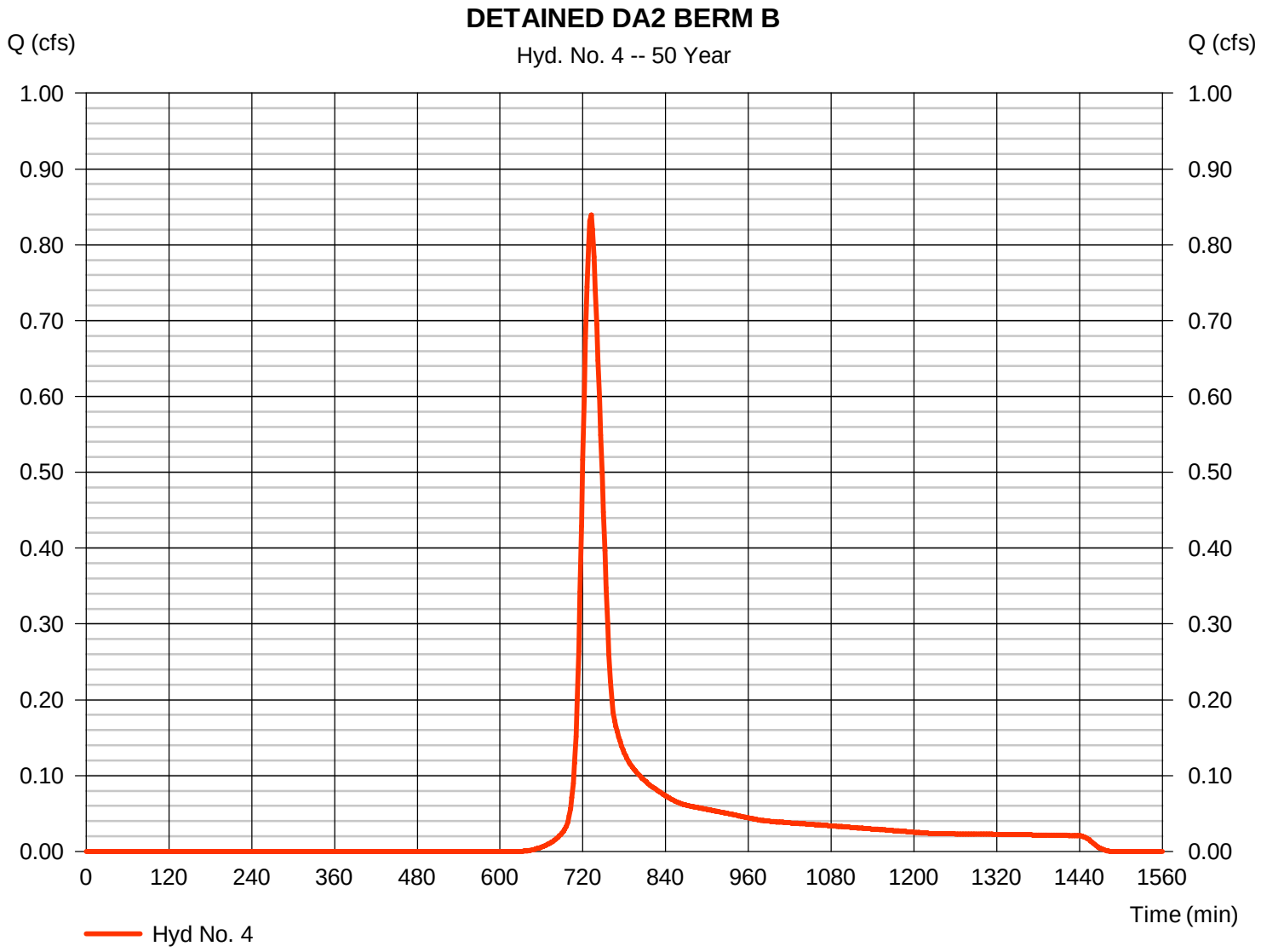
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.839 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 3,500 cuft
Drainage area	= 0.480 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 5.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480

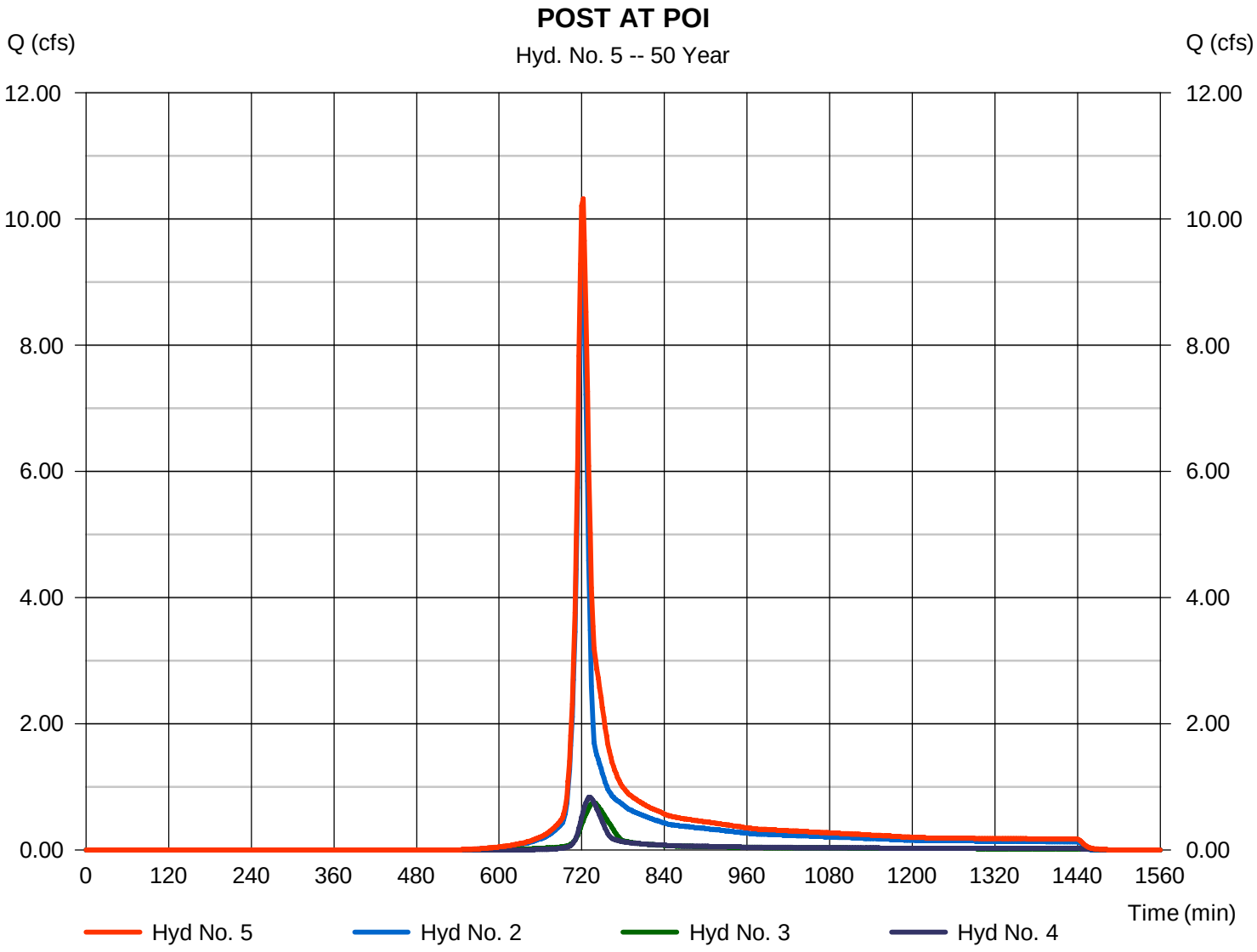


Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 10.32 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 31,371 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

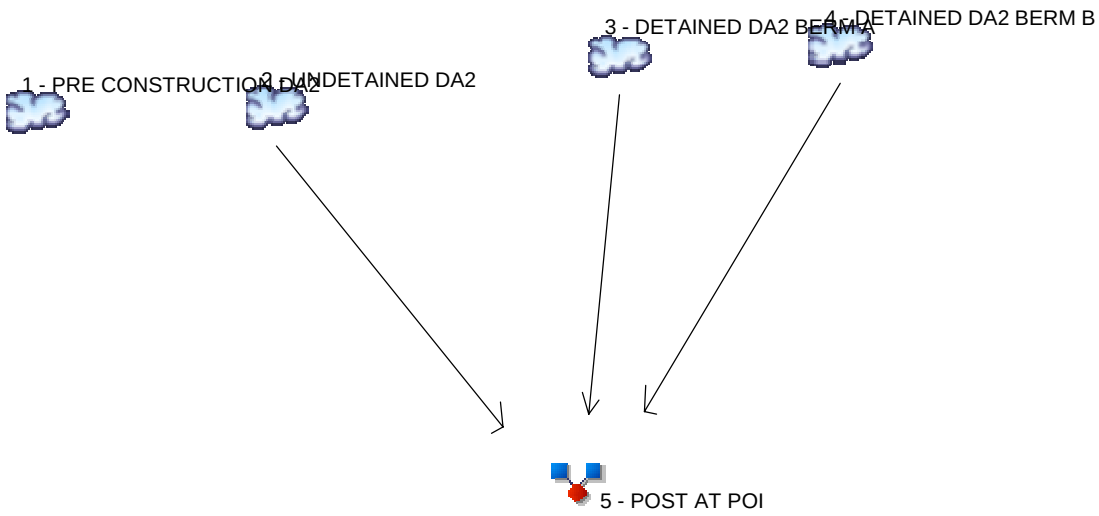
Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE CONSTRUCTION DA2
2	SCS Runoff	UNDETAINED DA2
3	SCS Runoff	DETAINED DA2 BERM A
4	SCS Runoff	DETAINED DA2 BERM B
5	Combine	POST AT POI

Hydrograph Return Period Recap

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	------	-------	-------	-------	-------	-------	-------	-------	14.68	PRE CONSTRUCTION DA2
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	11.74	UNDETAINED DA2
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	1.060	DETAINED DA2 BERM A
4	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	1.303	DETAINED DA2 BERM B
5	Combine	2, 3, 4	-------	-------	-------	-------	-------	-------	-------	13.55	POST AT POI

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	14.68	2	720	38,168	------	------	------	PRE CONSTRUCTION DA2
2	SCS Runoff	11.74	2	720	30,467	------	------	------	UNDETAINED DA2
3	SCS Runoff	1.060	2	732	4,586	------	------	------	DETAINED DA2 BERM A
4	SCS Runoff	1.303	2	728	4,601	------	------	------	DETAINED DA2 BERM B
5	Combine	13.55	2	722	39,654	2, 3, 4	------	------	POST AT POI

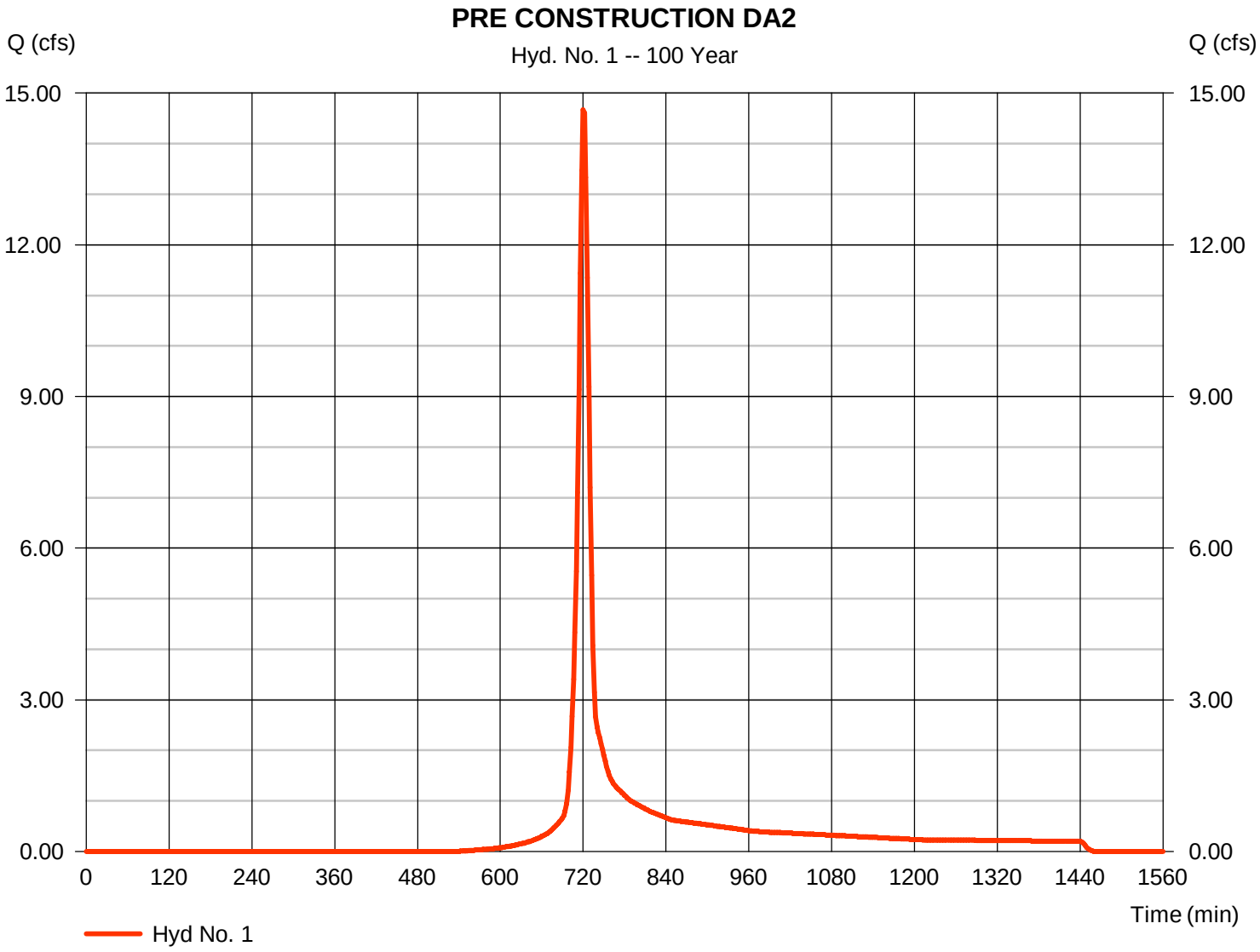
Hydrograph Report

Hyd. No. 1

PRE CONSTRUCTION DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 14.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 38,168 cuft
Drainage area	= 3.430 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.800 x 58) + (0.780 x 78) + (0.050 x 55) + (0.490 x 77) + (0.310 x 98)] / 3.430



TR55 Tc Worksheet

Hyd. No. 1

PRE CONSTRUCTION DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

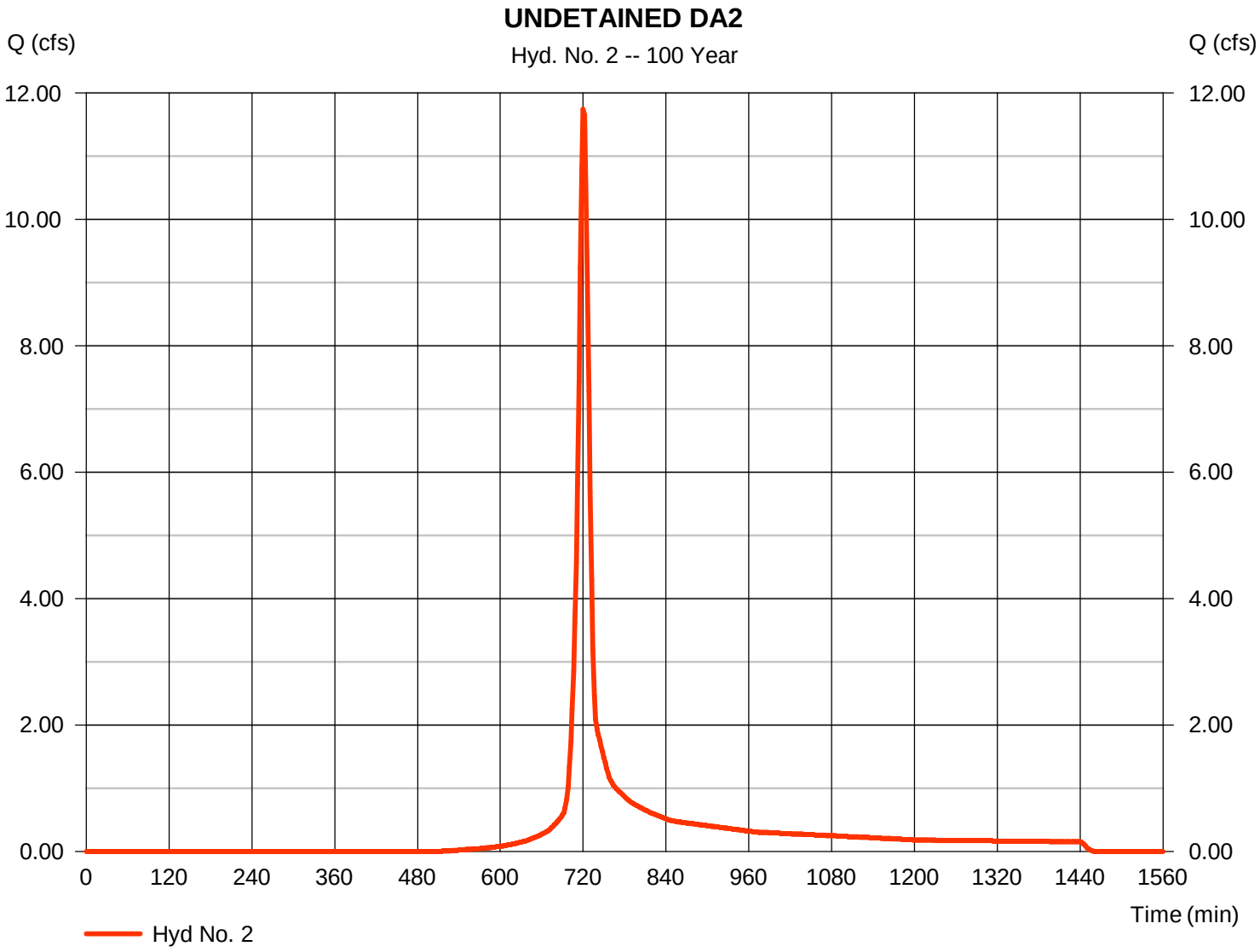
Hydrograph Report

Hyd. No. 2

UNDETAINED DA2

Hydrograph type	= SCS Runoff	Peak discharge	= 11.74 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 30,467 cuft
Drainage area	= 2.570 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.50 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.080 x 58) + (0.830 x 78) + (0.210 x 98) + (0.050 x 55) + (0.400 x 77)] / 2.570



TR55 Tc Worksheet

Hyd. No. 2

UNDETAINED DA2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.74		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 8.10**	**+**	**0.00**	**+**	**0.00**	**=**	**8.10**
Shallow Concentrated Flow							
Flow length (ft)	= 85.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**
Channel Flow							
X sectional flow area (sqft)	= 2.00		0.00		0.00		
Wetted perimeter (ft)	= 4.47		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=4.20						
			0.00				
					0.00		
Flow length (ft)	({0})747.0		0.0		0.0		
Travel Time (min)	**= 2.96**	**+**	**0.00**	**+**	**0.00**	**=**	**2.96**

Total Travel Time, Tc ..... 11.50 min

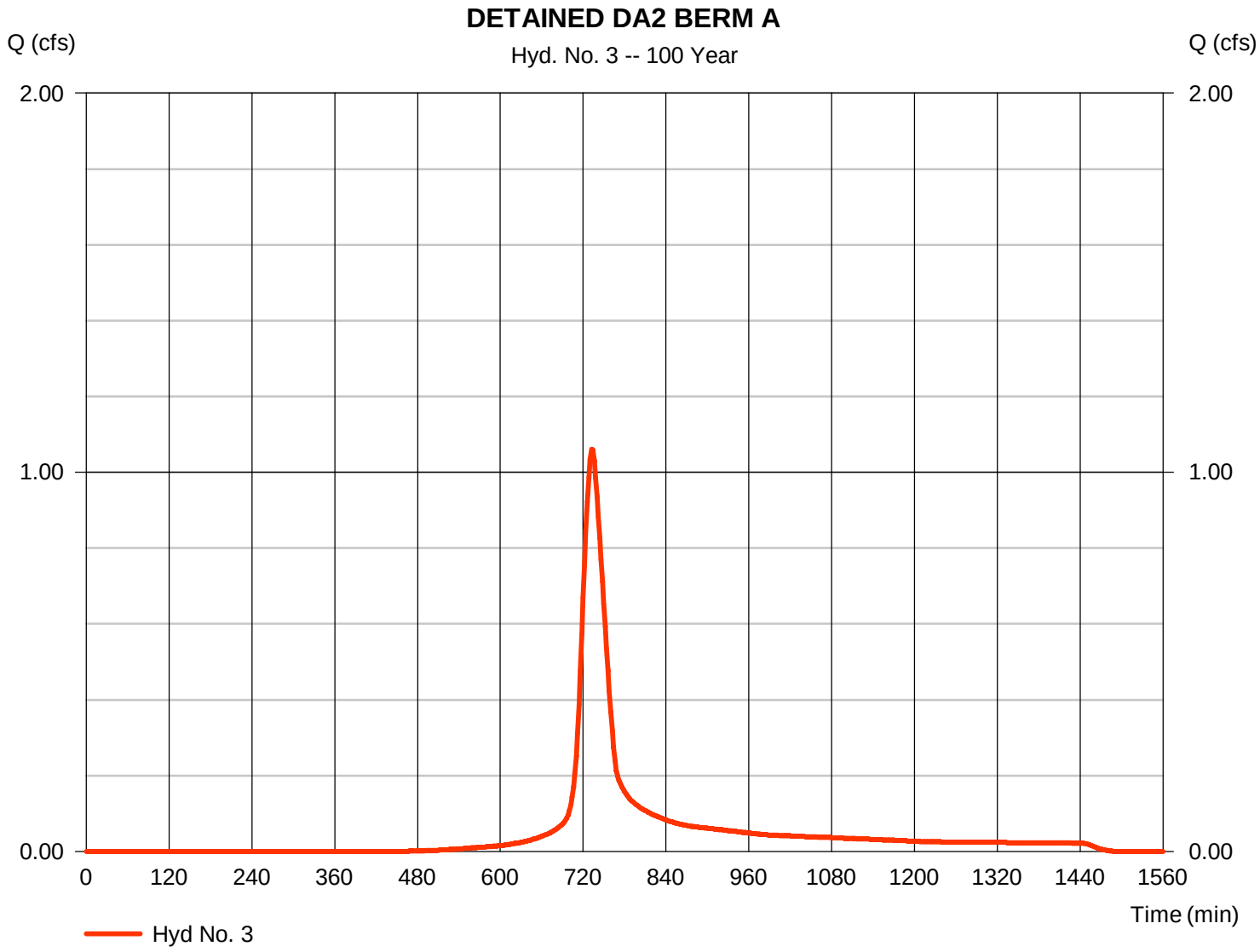
Hydrograph Report

Hyd. No. 3

DETAINED DA2 BERM A

Hydrograph type	= SCS Runoff	Peak discharge	= 1.060 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 4,586 cuft
Drainage area	= 0.350 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 32.52 min
Total precip.	= 6.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.120 x 85) + (0.140 x 58) + (0.040 x 78) + (0.050 x 98)] / 0.350



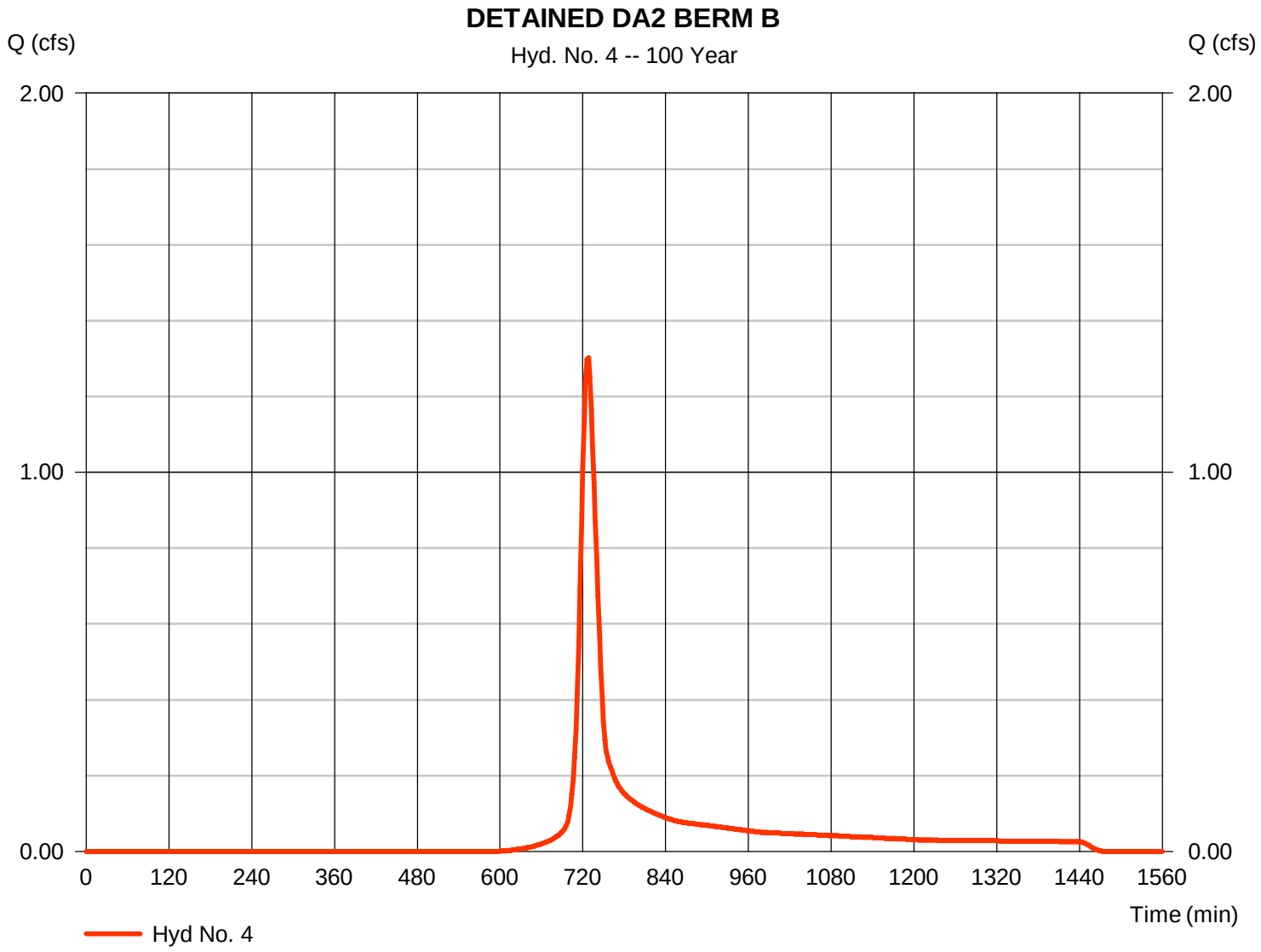
Hydrograph Report

Hyd. No. 4

DETAINED DA2 BERM B

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.303 cfs
Storm frequency	=	100 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	4,601 cuft
Drainage area	=	0.480 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	23.34 min
Total precip.	=	6.33 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.050 x 98) + (0.380 x 58) + (0.050 x 85)] / 0.480

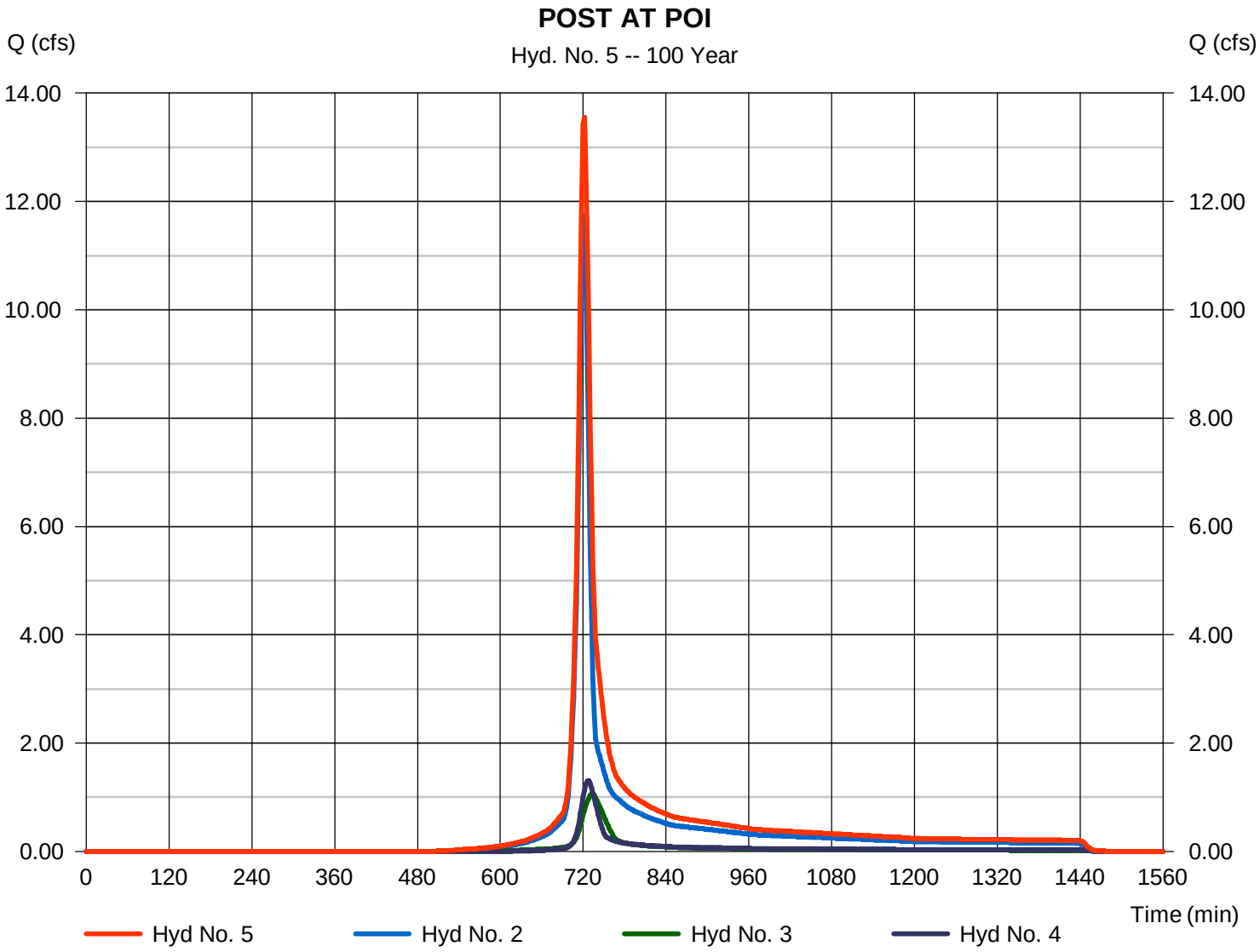


Hydrograph Report

Hyd. No. 5

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 13.55 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 39,654 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 3.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	41.1552	9.9000	0.8796	--------
2	50.2632	10.3000	0.8802	--------
3	0.0000	0.0000	0.0000	--------
5	48.7073	9.2000	0.8183	--------
10	48.1971	8.4000	0.7820	--------
25	47.6820	7.5000	0.7369	--------
50	44.9224	6.5000	0.6940	--------
100	44.3522	5.8000	0.6642	--------

File name: Shade Valley IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.82	2.96	2.43	2.07	1.81	1.61	1.45	1.32	1.21	1.12	1.05	0.98
2	4.55	3.55	2.93	2.50	2.18	1.94	1.75	1.60	1.47	1.36	1.27	1.19
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	5.55	4.34	3.59	3.08	2.71	2.42	2.19	2.01	1.86	1.73	1.62	1.52
10	6.33	4.94	4.10	3.52	3.10	2.78	2.53	2.32	2.15	2.00	1.88	1.77
25	7.41	5.79	4.81	4.15	3.67	3.30	3.01	2.77	2.58	2.41	2.26	2.14
50	8.25	6.42	5.34	4.62	4.10	3.70	3.38	3.13	2.91	2.73	2.58	2.44
100	9.13	7.09	5.91	5.12	4.55	4.12	3.78	3.50	3.27	3.07	2.90	2.75

Tc = time in minutes. Values may exceed 60.

SCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Shade Valley\Hydraflow Rev 1\Shade Valley Precip.pc

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.28	2.74	0.00	3.40	3.96	4.79	5.52	6.33
SCS 6-Hr	1.51	1.82	0.00	2.26	2.65	3.21	3.69	4.22
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00