

# Valley Forge

## TETRA TECH, INC.

By: RH    Date: 1/30/2017    Subject: Valley Forge 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 Valley Forge Road block valve site as part of the Sunoco Pipeline L.P. Pennsylvania Pipeline Project. The site is located within Juniata Township, Blair 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**

Blair 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); as necessary, provide additional peak rate control as required by the applicable and approved Act 167 plan.
- Blair County does not have a county-wide Act 167 plan adopted. Therefore, no additional stormwater runoff control is required under the Act 167 Plan.

This site will utilize three infiltration berms to manage the 2-year through 100-year peak rate increases. The infiltration berms will increase the post-construction time of concentration for the detained 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 the site is 4.9:1.

The drainage area loading ratio for the site is 20:1. However, runoff from the site and upslope drainage area will be dispersed to three infiltration berms. Berms have been placed to reduce the loading ratio to the maximum extent practicable, and other infiltration design parameters from the PA Stormwater BMP Manual have been met.

### **Disturbed Area**

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

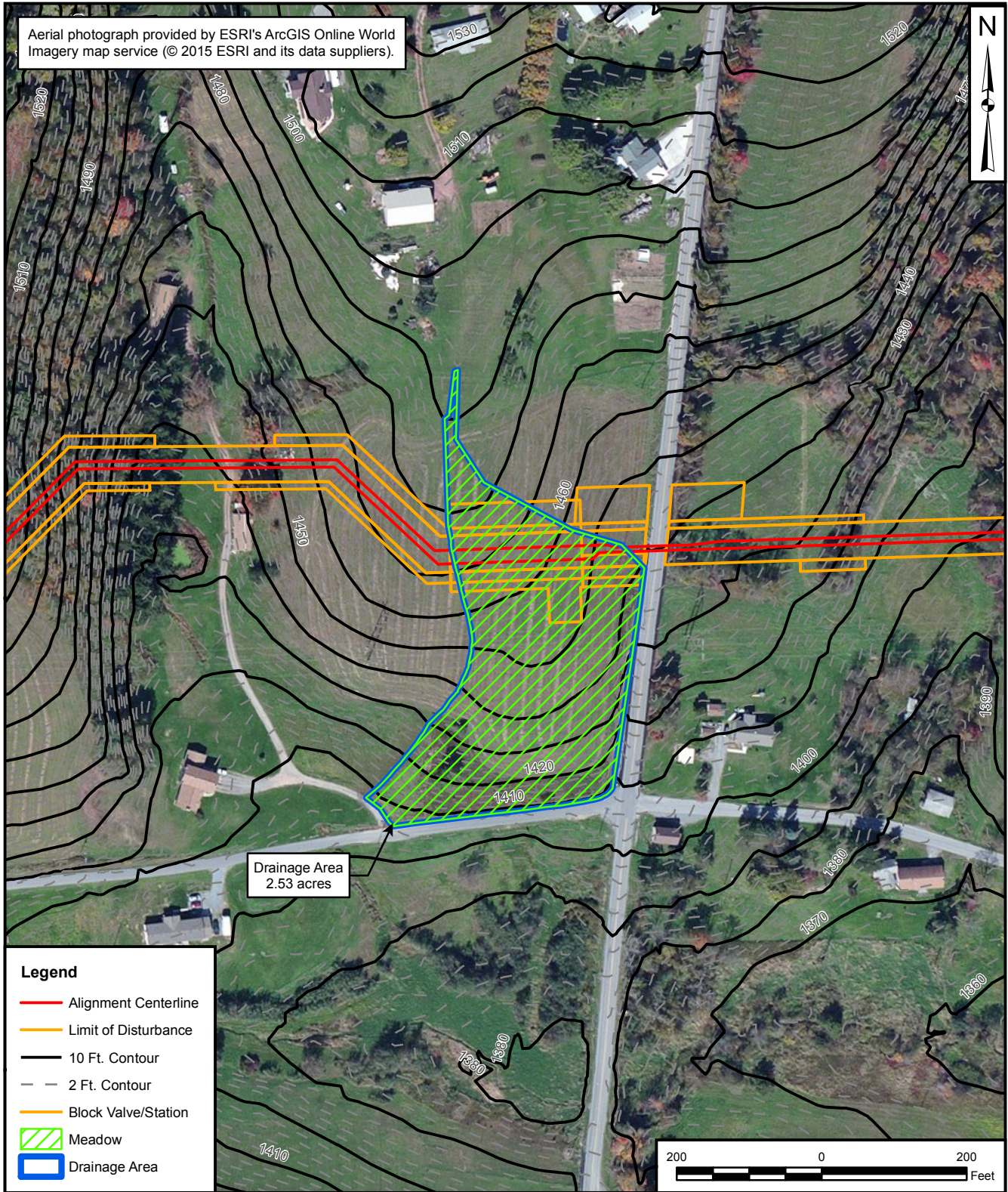
### **Karst Topography**

The Valley Forge Road block valve is not located in an area of karst terrain.

**Special Protection Watershed**

The Valley Forge Road block valve is not located within a special protection watershed, so antidegradation requirements do not apply.

Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2015 ESRI and its data suppliers).



**Legend**

- Alignment Centerline
- Limit of Disturbance
- 10 Ft. Contour
- 2 Ft. Contour
- Block Valve/Station
- Meadow
- Drainage Area



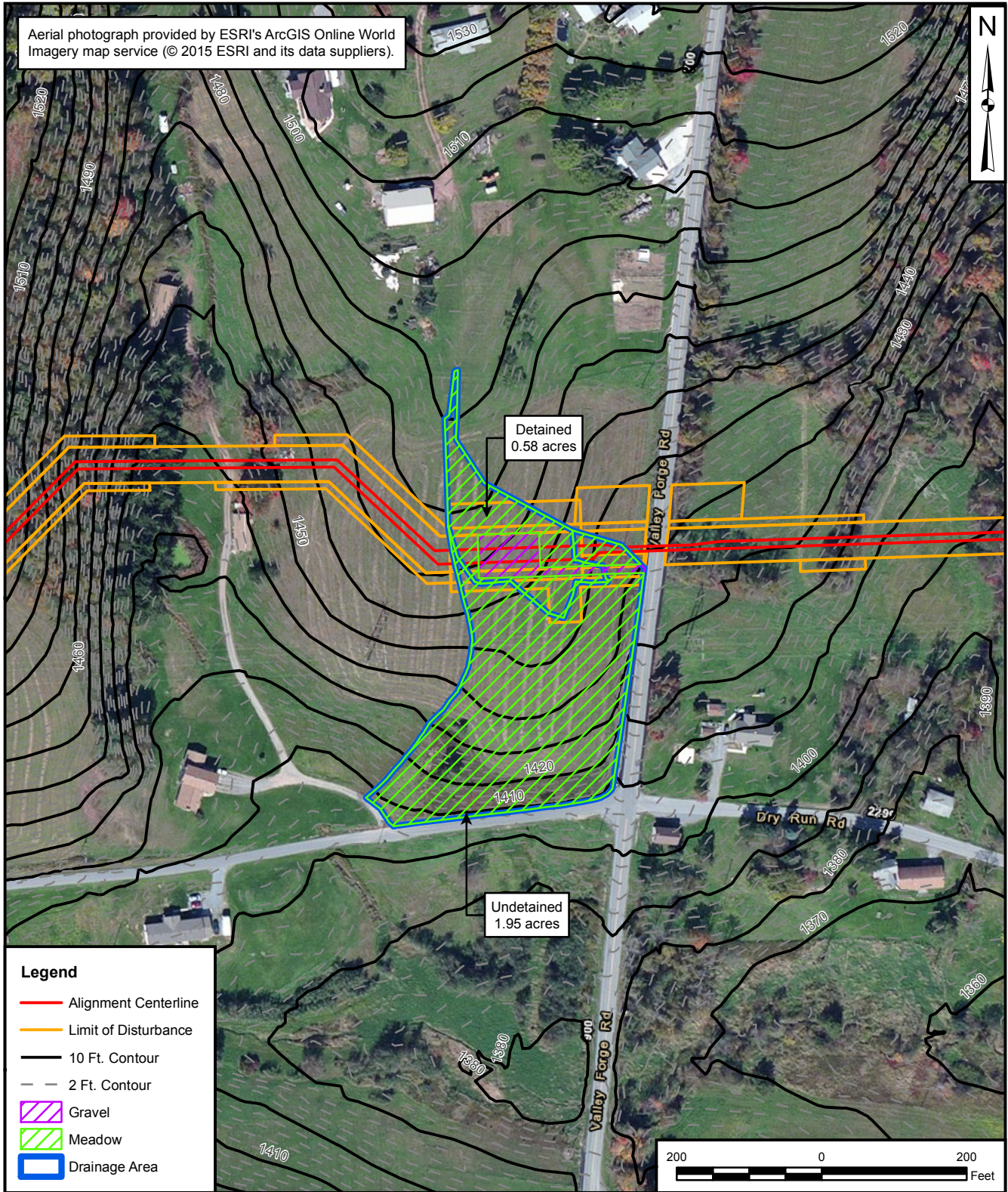
**PRE-DEVELOPMENT DRAINAGE AREA MAP**  
**VALLEY FORGE ROAD**  
**PENNSYLVANIA PIPELINE PROJECT**  
**SUNOCO LOGISTICS, L.P.**  
**BLAIR COUNTY, PENNSYLVANIA**

DRAWN BY: S. PAXTON 05/20/16  
 CHECKED BY: J. BRODY 11/09/16

APPROVED BY:  
 CONTRACT NUMBER: 112IC05958

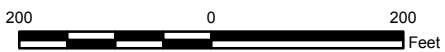
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Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2015 ESRI and its data suppliers).



**Legend**

- Alignment Centerline
- Limit of Disturbance
- 10 Ft. Contour
- 2 Ft. Contour
- Gravel
- Meadow
- Drainage Area



**POST-DEVELOPMENT DRAINAGE AREA MAP**  
**VALLEY FORGE ROAD**  
**PENNSYLVANIA PIPELINE PROJECT**  
**SUNOCO LOGISTICS, L.P.**  
**BLAIR COUNTY, PENNSYLVANIA**

DRAWN BY: S. PAXTON 05/20/16	
CHECKED BY: J. BRODY 11/09/16	
APPROVED BY:	
CONTRACT NUMBER: 112IC05958	
FIGURE NUMBER	REV
2	0



**NOAA Atlas 14, Volume 2, Version 3**  
**Location name: Juniata Twp, Pennsylvania, USA\***  
**Latitude: 40.4047°, Longitude: -78.4935°**  
**Elevation: 1439.28 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 & aerals](#)

**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
<b>5-min</b>	<b>0.309</b> (0.279-0.344)	<b>0.369</b> (0.334-0.411)	<b>0.450</b> (0.405-0.499)	<b>0.513</b> (0.460-0.569)	<b>0.596</b> (0.531-0.659)	<b>0.663</b> (0.587-0.731)	<b>0.729</b> (0.642-0.803)	<b>0.798</b> (0.698-0.878)	<b>0.894</b> (0.776-0.982)	<b>0.967</b> (0.831-1.06)
<b>10-min</b>	<b>0.480</b> (0.433-0.534)	<b>0.577</b> (0.521-0.641)	<b>0.699</b> (0.629-0.776)	<b>0.792</b> (0.710-0.878)	<b>0.912</b> (0.813-1.01)	<b>1.00</b> (0.890-1.11)	<b>1.10</b> (0.967-1.21)	<b>1.19</b> (1.04-1.31)	<b>1.31</b> (1.14-1.44)	<b>1.41</b> (1.21-1.54)
<b>15-min</b>	<b>0.588</b> (0.531-0.655)	<b>0.705</b> (0.637-0.784)	<b>0.858</b> (0.773-0.953)	<b>0.975</b> (0.874-1.08)	<b>1.13</b> (1.00-1.25)	<b>1.24</b> (1.10-1.37)	<b>1.36</b> (1.20-1.50)	<b>1.48</b> (1.30-1.63)	<b>1.64</b> (1.42-1.80)	<b>1.76</b> (1.51-1.93)
<b>30-min</b>	<b>0.778</b> (0.703-0.867)	<b>0.944</b> (0.852-1.05)	<b>1.18</b> (1.06-1.30)	<b>1.35</b> (1.21-1.50)	<b>1.59</b> (1.42-1.76)	<b>1.78</b> (1.57-1.96)	<b>1.97</b> (1.73-2.17)	<b>2.16</b> (1.89-2.38)	<b>2.43</b> (2.11-2.67)	<b>2.64</b> (2.27-2.89)
<b>60-min</b>	<b>0.950</b> (0.858-1.06)	<b>1.16</b> (1.05-1.29)	<b>1.48</b> (1.33-1.64)	<b>1.72</b> (1.54-1.91)	<b>2.06</b> (1.84-2.28)	<b>2.34</b> (2.08-2.58)	<b>2.63</b> (2.32-2.90)	<b>2.93</b> (2.57-3.23)	<b>3.36</b> (2.92-3.69)	<b>3.71</b> (3.18-4.06)
<b>2-hr</b>	<b>1.10</b> (0.989-1.23)	<b>1.33</b> (1.20-1.49)	<b>1.70</b> (1.52-1.90)	<b>2.00</b> (1.78-2.22)	<b>2.42</b> (2.14-2.68)	<b>2.76</b> (2.42-3.05)	<b>3.13</b> (2.73-3.45)	<b>3.52</b> (3.05-3.88)	<b>4.09</b> (3.50-4.50)	<b>4.55</b> (3.86-5.02)
<b>3-hr</b>	<b>1.19</b> (1.07-1.33)	<b>1.44</b> (1.30-1.60)	<b>1.82</b> (1.64-2.02)	<b>2.13</b> (1.91-2.36)	<b>2.57</b> (2.29-2.85)	<b>2.94</b> (2.60-3.24)	<b>3.34</b> (2.93-3.68)	<b>3.77</b> (3.28-4.14)	<b>4.39</b> (3.77-4.81)	<b>4.90</b> (4.17-5.36)
<b>6-hr</b>	<b>1.48</b> (1.34-1.65)	<b>1.78</b> (1.61-1.99)	<b>2.23</b> (2.01-2.48)	<b>2.59</b> (2.32-2.88)	<b>3.12</b> (2.78-3.46)	<b>3.56</b> (3.15-3.93)	<b>4.03</b> (3.53-4.44)	<b>4.54</b> (3.94-4.99)	<b>5.28</b> (4.53-5.79)	<b>5.89</b> (5.00-6.45)
<b>12-hr</b>	<b>1.84</b> (1.67-2.07)	<b>2.22</b> (2.01-2.48)	<b>2.75</b> (2.49-3.08)	<b>3.21</b> (2.88-3.57)	<b>3.87</b> (3.45-4.29)	<b>4.42</b> (3.92-4.90)	<b>5.04</b> (4.42-5.56)	<b>5.70</b> (4.95-6.29)	<b>6.67</b> (5.72-7.35)	<b>7.50</b> (6.35-8.24)
<b>24-hr</b>	<b>2.24</b> (2.06-2.45)	<b>2.69</b> (2.47-2.94)	<b>3.34</b> (3.06-3.65)	<b>3.88</b> (3.54-4.23)	<b>4.65</b> (4.23-5.06)	<b>5.30</b> (4.79-5.75)	<b>5.99</b> (5.38-6.49)	<b>6.73</b> (6.01-7.30)	<b>7.82</b> (6.90-8.46)	<b>8.71</b> (7.61-9.44)
<b>2-day</b>	<b>2.55</b> (2.35-2.78)	<b>3.05</b> (2.81-3.33)	<b>3.77</b> (3.47-4.11)	<b>4.37</b> (4.01-4.76)	<b>5.23</b> (4.78-5.69)	<b>5.95</b> (5.40-6.46)	<b>6.73</b> (6.06-7.30)	<b>7.55</b> (6.75-8.20)	<b>8.75</b> (7.73-9.49)	<b>9.73</b> (8.51-10.6)
<b>3-day</b>	<b>2.71</b> (2.51-2.95)	<b>3.25</b> (3.00-3.53)	<b>4.00</b> (3.69-4.35)	<b>4.62</b> (4.26-5.02)	<b>5.52</b> (5.06-5.98)	<b>6.26</b> (5.71-6.78)	<b>7.05</b> (6.38-7.63)	<b>7.90</b> (7.10-8.55)	<b>9.11</b> (8.09-9.88)	<b>10.1</b> (8.88-11.0)
<b>4-day</b>	<b>2.88</b> (2.67-3.13)	<b>3.44</b> (3.20-3.74)	<b>4.23</b> (3.92-4.58)	<b>4.88</b> (4.51-5.27)	<b>5.80</b> (5.34-6.27)	<b>6.57</b> (6.01-7.09)	<b>7.38</b> (6.71-7.97)	<b>8.24</b> (7.44-8.91)	<b>9.47</b> (8.45-10.3)	<b>10.5</b> (9.25-11.4)
<b>7-day</b>	<b>3.40</b> (3.18-3.66)	<b>4.06</b> (3.79-4.36)	<b>4.92</b> (4.59-5.29)	<b>5.61</b> (5.23-6.02)	<b>6.57</b> (6.10-7.05)	<b>7.33</b> (6.78-7.86)	<b>8.12</b> (7.48-8.71)	<b>8.94</b> (8.18-9.60)	<b>10.1</b> (9.12-10.8)	<b>10.9</b> (9.84-11.8)
<b>10-day</b>	<b>3.97</b> (3.72-4.25)	<b>4.70</b> (4.41-5.03)	<b>5.62</b> (5.27-6.02)	<b>6.36</b> (5.96-6.80)	<b>7.37</b> (6.88-7.88)	<b>8.17</b> (7.60-8.73)	<b>8.98</b> (8.32-9.60)	<b>9.81</b> (9.03-10.5)	<b>10.9</b> (9.99-11.7)	<b>11.8</b> (10.7-12.7)
<b>20-day</b>	<b>5.46</b> (5.18-5.77)	<b>6.43</b> (6.10-6.80)	<b>7.50</b> (7.11-7.93)	<b>8.32</b> (7.87-8.79)	<b>9.40</b> (8.87-9.93)	<b>10.2</b> (9.62-10.8)	<b>11.0</b> (10.3-11.6)	<b>11.8</b> (11.0-12.5)	<b>12.8</b> (11.9-13.5)	<b>13.5</b> (12.5-14.3)
<b>30-day</b>	<b>6.85</b> (6.50-7.20)	<b>8.02</b> (7.61-8.44)	<b>9.19</b> (8.73-9.67)	<b>10.1</b> (9.59-10.6)	<b>11.3</b> (10.7-11.8)	<b>12.1</b> (11.5-12.8)	<b>13.0</b> (12.2-13.6)	<b>13.7</b> (12.9-14.5)	<b>14.7</b> (13.8-15.5)	<b>15.4</b> (14.4-16.3)
<b>45-day</b>	<b>8.69</b> (8.28-9.12)	<b>10.2</b> (9.68-10.7)	<b>11.5</b> (11.0-12.1)	<b>12.5</b> (11.9-13.1)	<b>13.7</b> (13.1-14.4)	<b>14.6</b> (13.9-15.4)	<b>15.5</b> (14.7-16.2)	<b>16.2</b> (15.4-17.0)	<b>17.1</b> (16.2-18.0)	<b>17.7</b> (16.7-18.7)
<b>60-day</b>	<b>10.5</b> (10.0-10.9)	<b>12.2</b> (11.7-12.7)	<b>13.7</b> (13.1-14.3)	<b>14.8</b> (14.2-15.4)	<b>16.1</b> (15.4-16.8)	<b>17.0</b> (16.3-17.7)	<b>17.8</b> (17.0-18.6)	<b>18.5</b> (17.7-19.4)	<b>19.4</b> (18.5-20.3)	<b>20.0</b> (19.0-20.9)

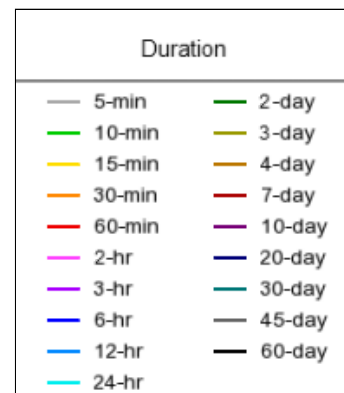
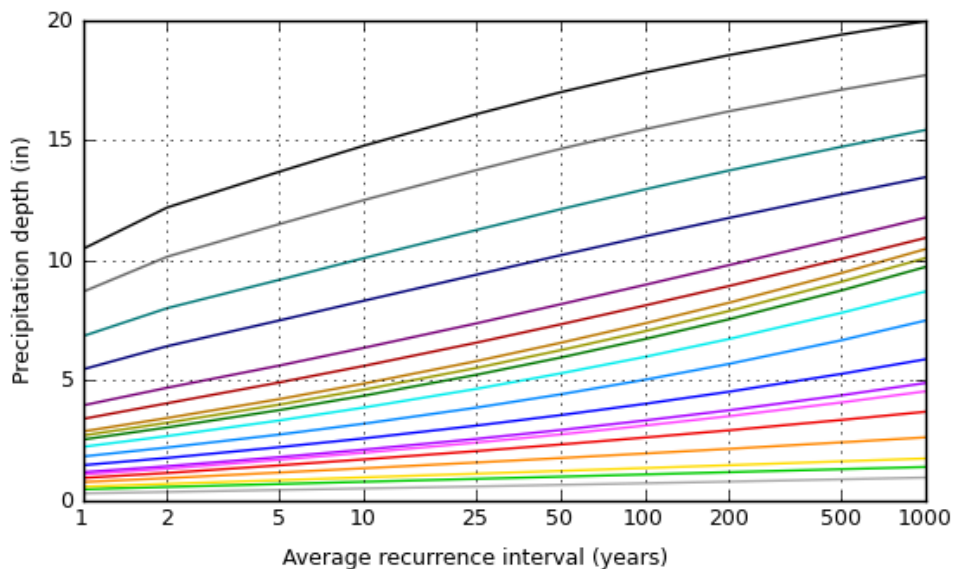
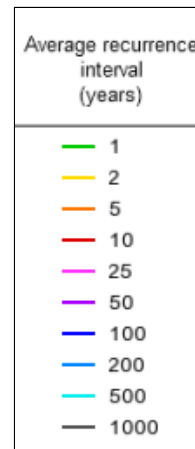
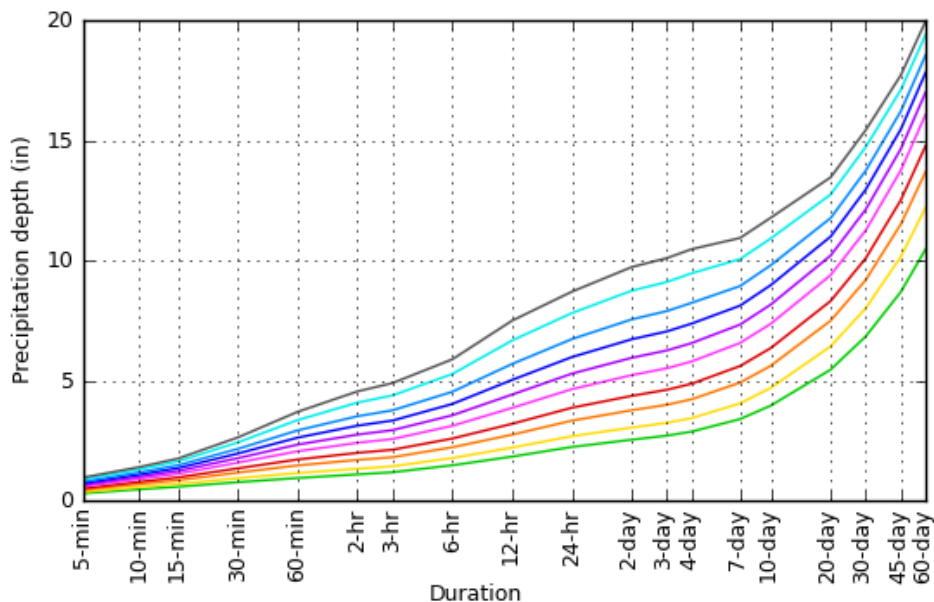
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration 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.

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# PF graphical

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

Latitude: 40.4047°, Longitude: -78.4935°



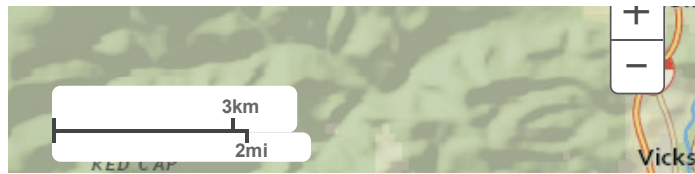
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## Maps & aerials

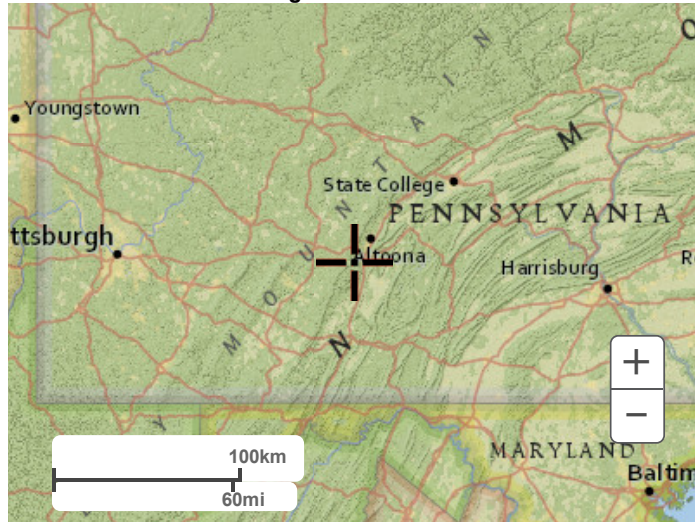
### Small scale terrain



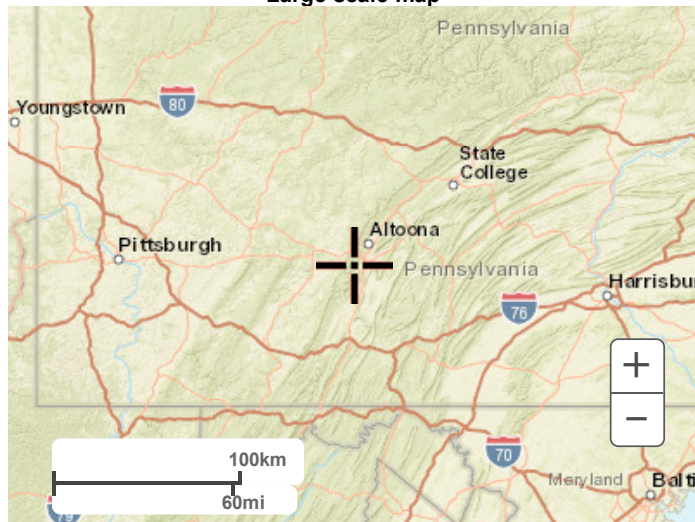




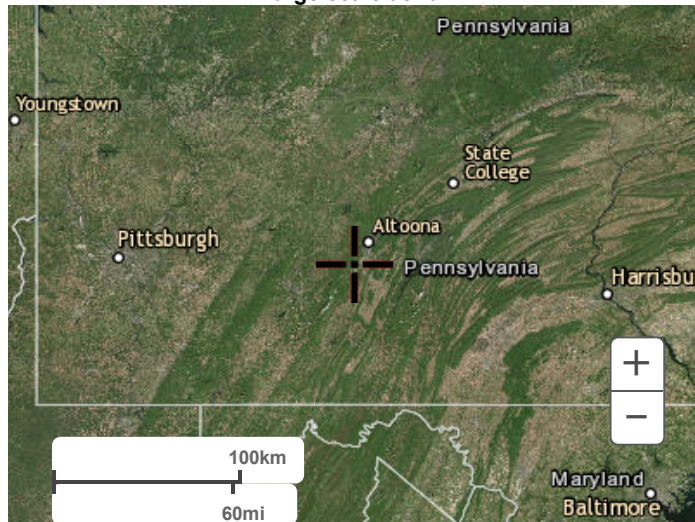
Large scale terrain



Large scale map



Large scale aerial



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**WORKSHEET 1. GENERAL SITE INFORMATION**

**Date:** November 11, 2016

**Project Name:** Valley Forge Road

**Municipality:** Juniata

**County:** Blair

**Total Area (acres):** 2.53

**Major River Basin:** Susquehanna River

**Watershed:** Frankstown Branch Juniata River

**Sub Basin:** Little Juniata River

**Nearest Surface Water to Receive Runoff:** Tributary #16353 to Dry Run

**Chapter 93 - Designated Water Use:** Warm Water Fishes (WWF)

**Impaired according to Chapter 303(d) list?** YES   
**List Causes of Impairment:** NO   
Metals; pH; Organic Enrichment/Low D.O.

***Is Project Subject to, or Part of:***

**Municipal Separate Storm Sewer System (MS4) Requirements** YES   
NO

**Existing or Planned drinking water supply?** YES   
NO

**If yes, distance from proposed discharge (miles):** \_\_\_\_\_

**Approved Act 167 Plan?** YES   
NO

**Existing River Conservation Plan?** YES   
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.

0.00 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	N/A		
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
<b>TOTAL EXISTING:</b>		<b>0.00</b>	<b>0.00</b>

## 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
<b>TOTAL</b>	<b>0.00 Ac</b>

Site Area	Minus	Protected Area	=	Stormwater Management Area
0.60	-	0	=	0.60
				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<sup>2</sup> x 1/4" x 1/12 = \_\_\_\_\_ ft<sup>3</sup>

Meadow \_\_\_\_\_ ft<sup>2</sup> x 1/3" x 1/12 = \_\_\_\_\_ ft<sup>3</sup>

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

*For Trees within 100 feet of impervious area:*

Tree Canopy \_\_\_\_\_ ft<sup>2</sup> x 1/2" x 1/12 = \_\_\_\_\_ ft<sup>3</sup>

#### 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<sup>2</sup> x 1/3" x 1/12 = \_\_\_\_\_ ft<sup>3</sup>

*For all other disconnected roof areas*

Roof Area \_\_\_\_\_ ft<sup>2</sup> x 1/4" x 1/12 = \_\_\_\_\_ ft<sup>3</sup>

#### 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<sup>2</sup> x 1/3" x 1/12 = \_\_\_\_\_ ft<sup>3</sup>

*For all other disconnected roof areas*

Impervious Area \_\_\_\_\_ ft<sup>2</sup> x 1/4" x 1/12 = \_\_\_\_\_ ft<sup>3</sup>

**TOTAL NON-STRUCTURAL VOLUME CREDIT\*** \_\_\_\_\_ ft<sup>3</sup>

\*For use on Worksheet 5

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

PROJECT: Valley Forge Road  
 Drainage Area: 2.53 acres  
 2-Year Rainfall: 2.69 in

Total Site Area: 0.60 acres  
 Protected Site Area: N/A acres  
 Managed Site Area: 0.60 acres

### Existing Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>3</sup> (ft <sup>3</sup> )
Meadow	B	26,136	0.60	58	7.24	1.45	0.18	396
<b>TOTAL:</b>		<b>26,136</b>	<b>0.60</b>					<b>396</b>

### Developed Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>3</sup> (ft <sup>3</sup> )
Impervious-Gravel	B	6,098	0.14	85	1.76	0.35	1.33	677
Meadow	B	20,038	0.46	58	7.24	1.45	0.18	304
<b>TOTAL:</b>		<b>26,136</b>	<b>0.60</b>					<b>980</b>

2-Year Volume Increase (ft <sup>3</sup> ):	<b>584</b>
--	------------

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

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

2. Runoff Volume (CF) =  $Q \times \text{Area} \times 1/12$   
 $Q = \text{Runoff (in)}$   
 $\text{Area} = \text{Land use area (sq. ft.)}$

**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: Valley Forge Road  
 SUB-BASIN: \_\_\_\_\_

<b>Required Control Volume (ft<sup>3</sup>) - from Worksheet 4:</b>	584
<b>Non-structural Volume Credit (ft<sup>3</sup>) - from Worksheet 3:</b> (maximum is 25% of required volume)	N/A
<b>Structural Volume Reqmt (ft<sup>3</sup>):</b> <i>(Required Control Volume minus Non-structural Credit)</i>	584

Proposed BMPs from PA Stormwater Best Management Practices Manual Chapter 6	Area (ft <sup>2</sup> )	Volume Reduction Permanently Removed (ft <sup>3</sup> )
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/Bioretenion		
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	707	734
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		
<i>Other:</i>		
<b>Total Structural Volume (ft<sup>3</sup>):</b>		<b>734</b>
<b>Structural Volume Requirement (ft<sup>3</sup>):</b>		<b>584</b>
<b>VOLUME CREDIT DETERMINATION</b>		
	<b>DIFFERENCE:</b>	<b>-150</b>

1	Detained area runoff volume from Hydraflow	=	<u>734</u>	cf
2a	Storage volume of the BMPs	=	<u>970</u>	cf
2b	Infiltrated volume within 2 hours after the 2-yr/24-hr event (Infiltration Rate/12) x Infiltration Area x 2 hrs	=	<u>24</u>	cf
2 (total)	2a + 2b	=	<u>994</u>	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	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.5.4 - Cluster Uses at Each Site	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.1 - Minimize Total Disturbed Area	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native Species)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.9.1 - Street Sweeping / Vacuuming	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input type="checkbox"/>

**SECONDARY BMPs FOR NITRATE:**

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

INFILTRATION BERM DEWATERING CALCULATION

SITE NAME: Valley Forge

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STORAGE VOLUME 734 CF  
DESIGN INFILTRATION RATE 0.20 IN/HR BASED ON IT-01 AND IT-02  
INFILTRATION AREA 707 SF

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

**DEWATERING TIME = 62.3 HOURS**



**TIME OF CONCENTRATION ADJUSTMENT**

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 6.1 MIN

STRUCTURAL VOLUME PROVIDED BY BMP

734 CF - 2 YEAR/24-HR STORM ONLY  
970 CF - FOR ALL OTHER REMAINING STORM EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.301
10 YR/24 HR	0.924
50 YR/24 HR	1.832
100 YR/24 HR	2.312

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

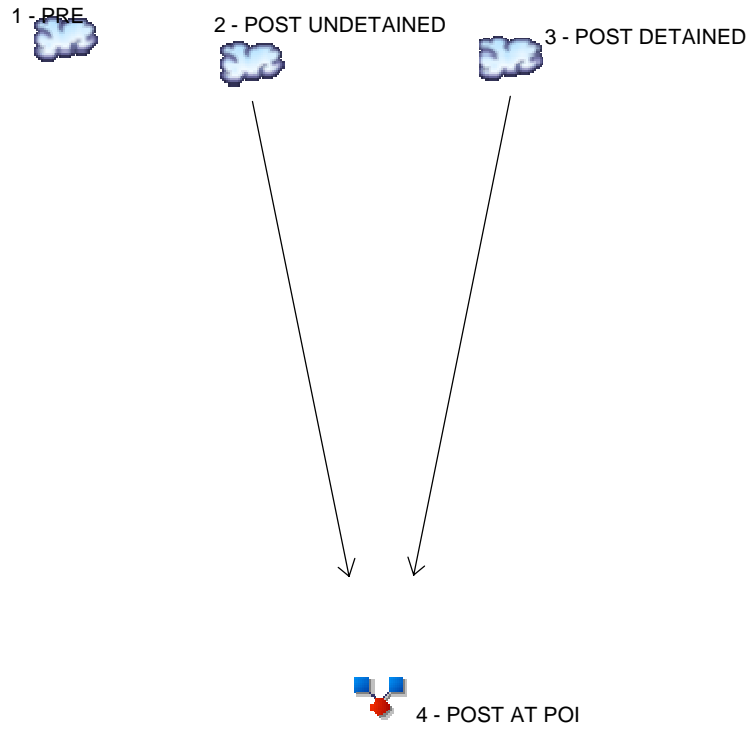
Storm Event	Q (CFS)	Additional Residence Time (min.)
2 YR/24 HR	0.301	40.642
10 YR/24 HR	0.924	17.496
50 YR/24 HR	1.832	8.825
100 YR/24 HR	2.312	6.993

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	0.301	40.642	46.742
10 YR/24 HR	0.924	17.496	23.596
50 YR/24 HR	1.832	8.825	14.925
100 YR/24 HR	2.312	6.993	13.093

# Watershed Model Schematic

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



## Legend

<u>Hyd. Origin</u>	<u>Description</u>
1	SCS Runoff PRE
2	SCS Runoff POST UNDETAINED
3	SCS Runoff POST DETAINED
4	Combine POST AT POI

# Hydrograph Return Period Recap

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

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	-----	-----	0.276	-----	-----	2.141	-----	5.441	7.280	PRE
2	SCS Runoff	-----	-----	0.185	-----	-----	1.546	-----	3.956	5.297	POST UNDETAINED
3	SCS Runoff	-----	-----	0.301	-----	-----	0.924	-----	1.832	2.312	POST DETAINED
4	Combine	2, 3	-----	0.423	-----	-----	2.324	-----	5.602	7.433	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	0.276	1	722	1,627	-----	-----	-----	PRE	
2	SCS Runoff	0.185	2	722	1,283	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	0.301	2	718	734	-----	-----	-----	POST DETAINED	
4	Combine	0.423	2	720	2,017	2, 3	-----	-----	POST AT POI	
Valley Forge.gpw					Return Period: 2 Year			Monday, 01 / 23 / 2017		

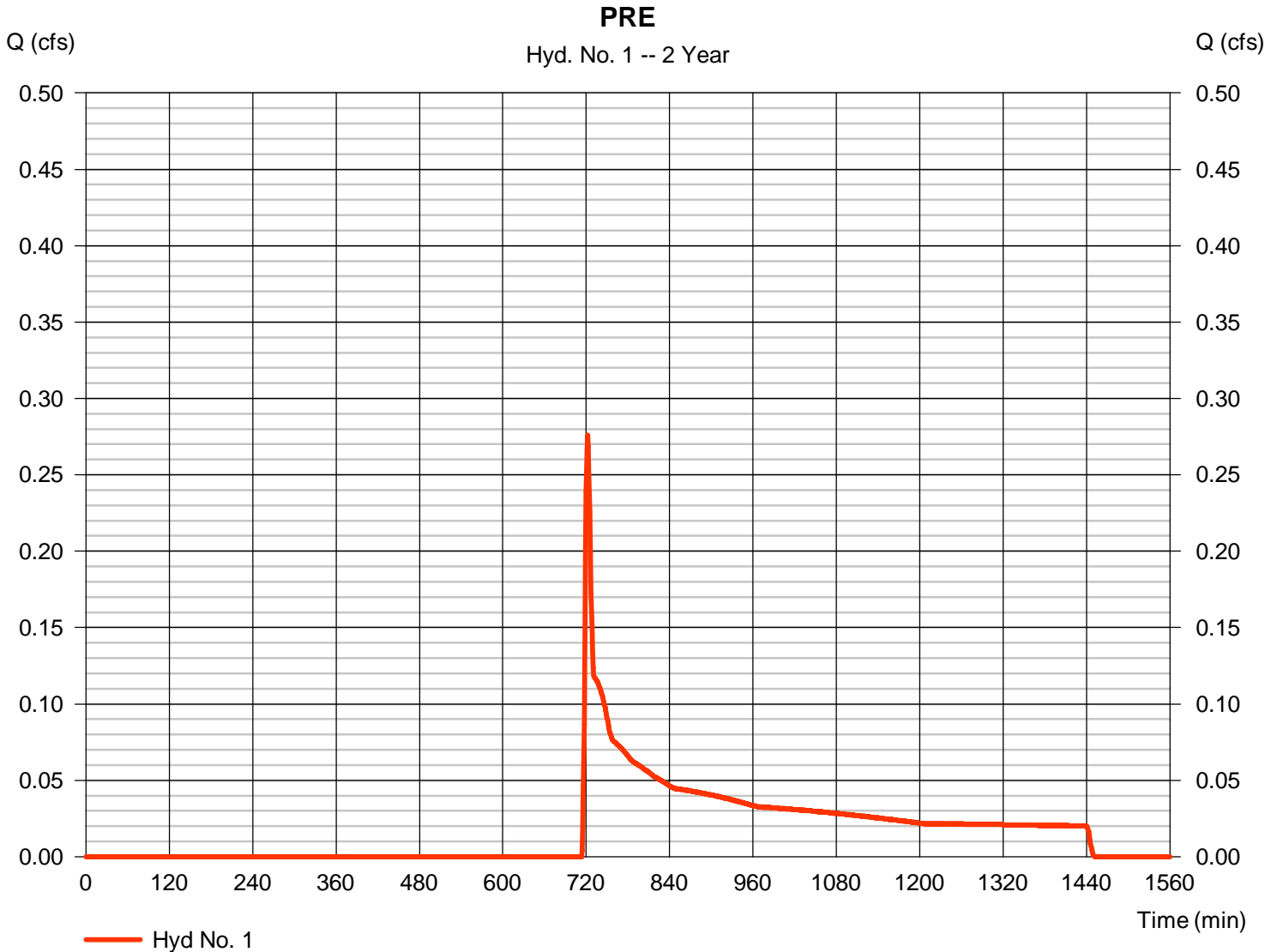
# Hydrograph Report

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.276 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 1,627 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 5.79	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.84</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 5.84</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 671.00	0.00	0.00	
Watercourse slope (%)	= 15.66	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.38	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.75</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 1.75</b>
<b>Channel Flow</b>				
X sectional flow area (sqft)	= 16.00	0.00	0.00	
Wetted perimeter (ft)	= 28.00	0.00	0.00	
Channel slope (%)	= 0.56	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=5.11	0.00	0.00	
Flow length (ft)	140.0	0.0	0.0	
<b>Travel Time (min)</b>	<b>= 0.46</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 0.46</b>
<b>Total Travel Time, Tc .....</b>				<b>8.10 min</b>

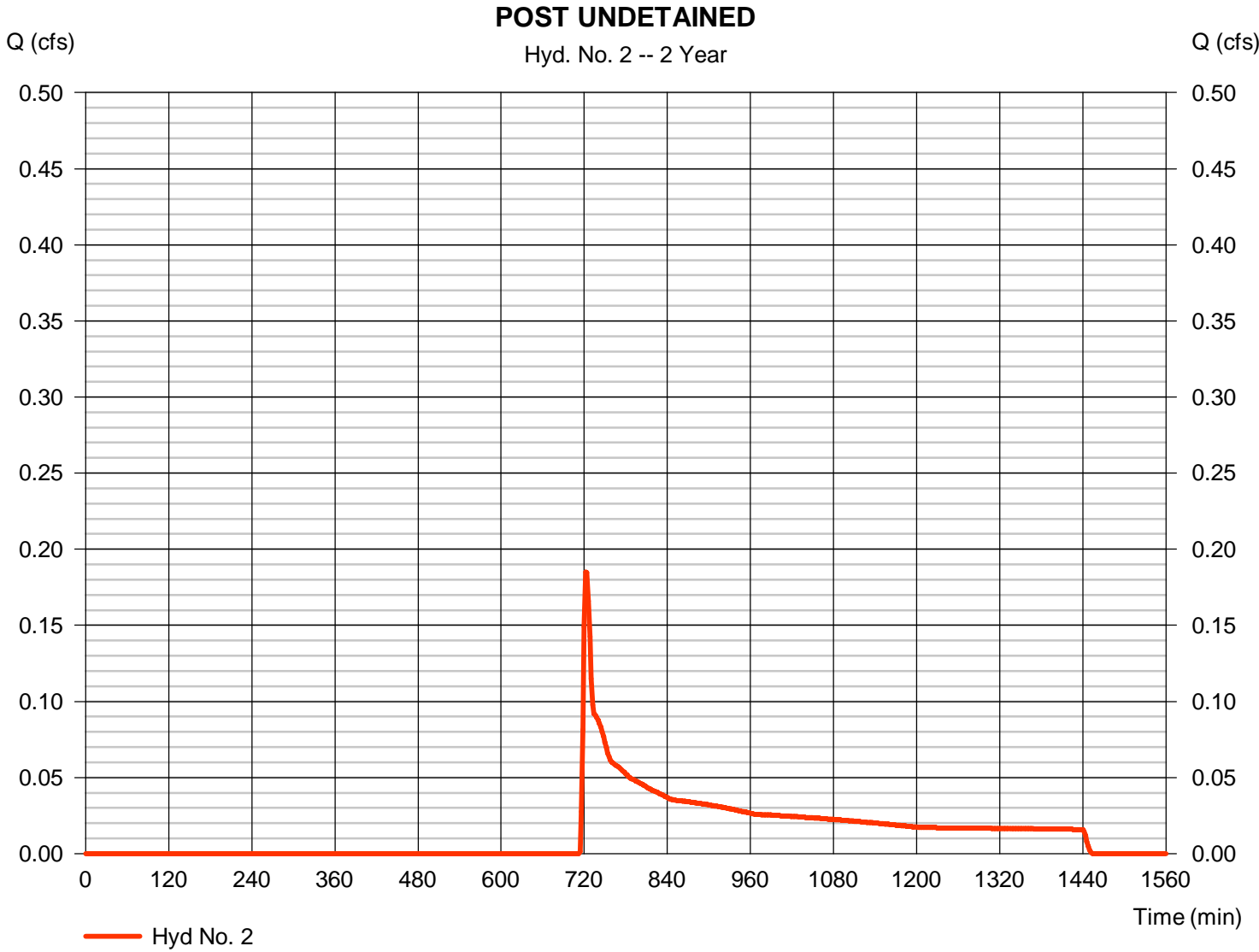
# Hydrograph Report

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.185 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 1,283 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) =  $[(0.010 \times 85) + (1.570 \times 58) + (0.370 \times 58)] / 1.950$



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 7.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.42</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 5.42</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 422.00	43.00	0.00	
Watercourse slope (%)	= 16.00	9.30	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.45	6.20	0.00	
<b>Travel Time (min)</b>	<b>= 1.09</b>	<b>+ 0.12</b>	<b>+ 0.00</b>	<b>= 1.21</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>6.60 min</b>



# Hydrograph Report

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

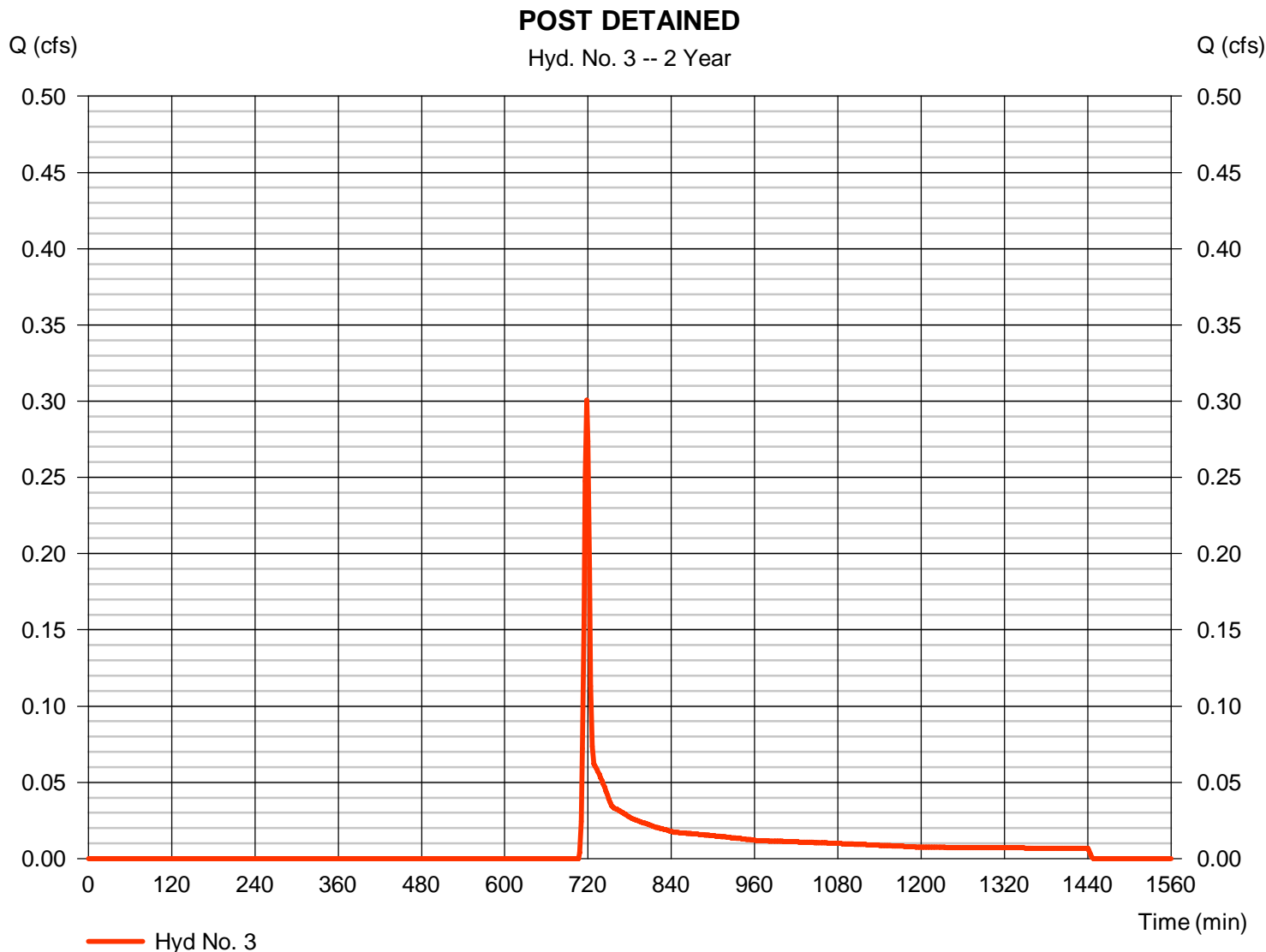
Monday, 01 / 23 / 2017

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.301 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 734 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.10 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# TR55 Tc Worksheet

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

## Hyd. No. 3

POST DETAINED

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
<b>Sheet Flow</b>							
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)	= 2.69		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
<b>Travel Time (min)</b>	<b>= 5.42</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>5.42</b>
<b>Shallow Concentrated Flow</b>							
Flow length (ft)	= 43.00		105.00		52.00		
Watercourse slope (%)	= 39.50		4.30		9.60		
Surface description	= Unpaved		Paved		Unpaved		
Average velocity (ft/s)	=10.14		4.22		5.00		
<b>Travel Time (min)</b>	<b>= 0.07</b>	<b>+</b>	<b>0.42</b>	<b>+</b>	<b>0.17</b>	<b>=</b>	<b>0.66</b>
<b>Channel Flow</b>							
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		
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>0.00</b>
<b>Total Travel Time, Tc .....</b>							<b>6.10 min</b>

# Hydrograph Report

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

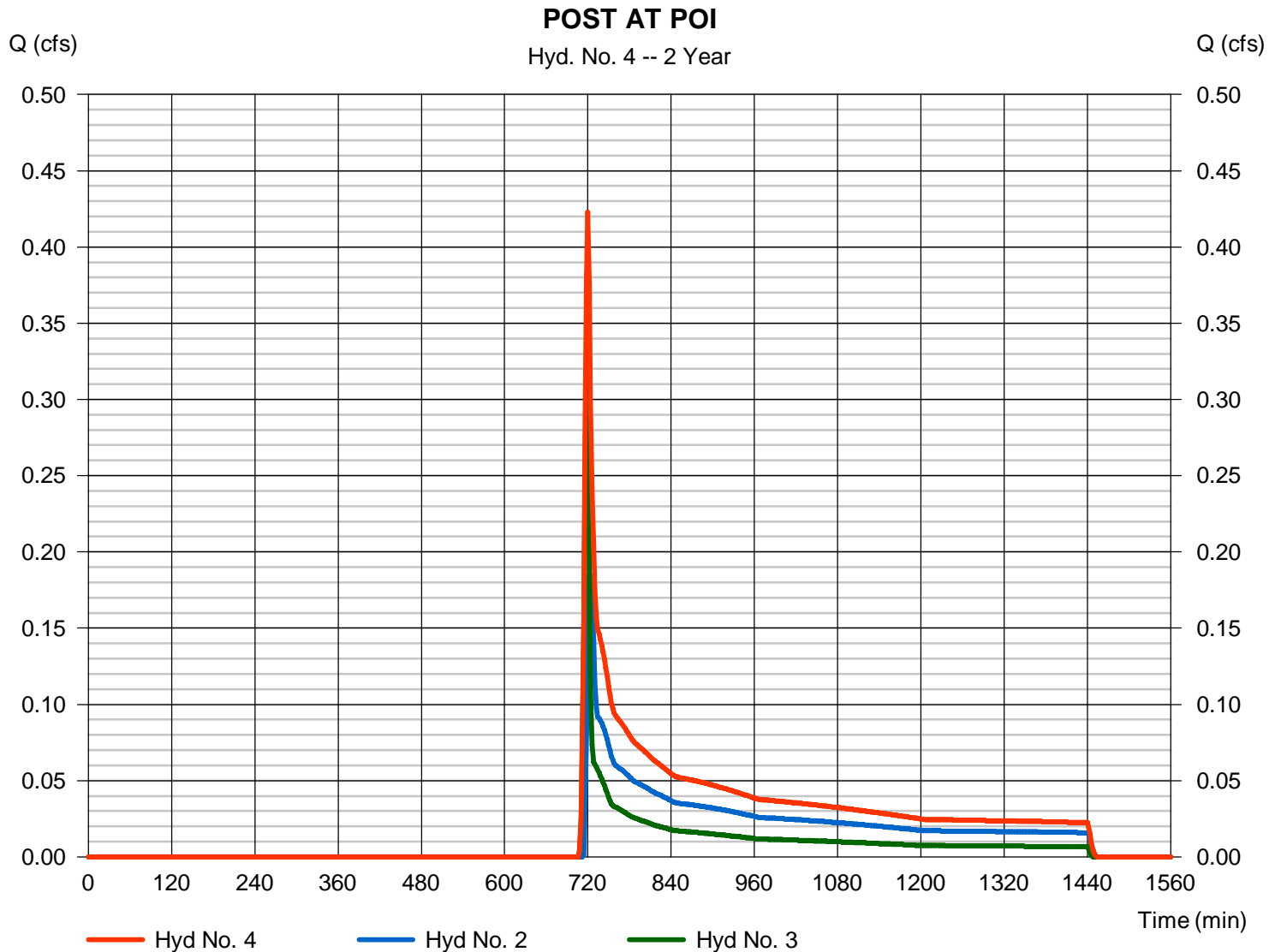
Monday, 01 / 23 / 2017

## Hyd. No. 4

POST AT POI

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

Peak discharge = 0.423 cfs  
Time to peak = 720 min  
Hyd. volume = 2,017 cuft  
Contrib. drain. area = 2.530 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	2.141	1	720	5,474	-----	-----	-----	PRE	
2	SCS Runoff	1.546	2	720	4,327	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	0.924	2	718	1,894	-----	-----	-----	POST DETAINED	
4	Combine	2.324	2	720	6,221	2, 3	-----	-----	POST AT POI	
Valley Forge.gpw					Return Period: 10 Year			Monday, 01 / 23 / 2017		

# Hydrograph Report

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

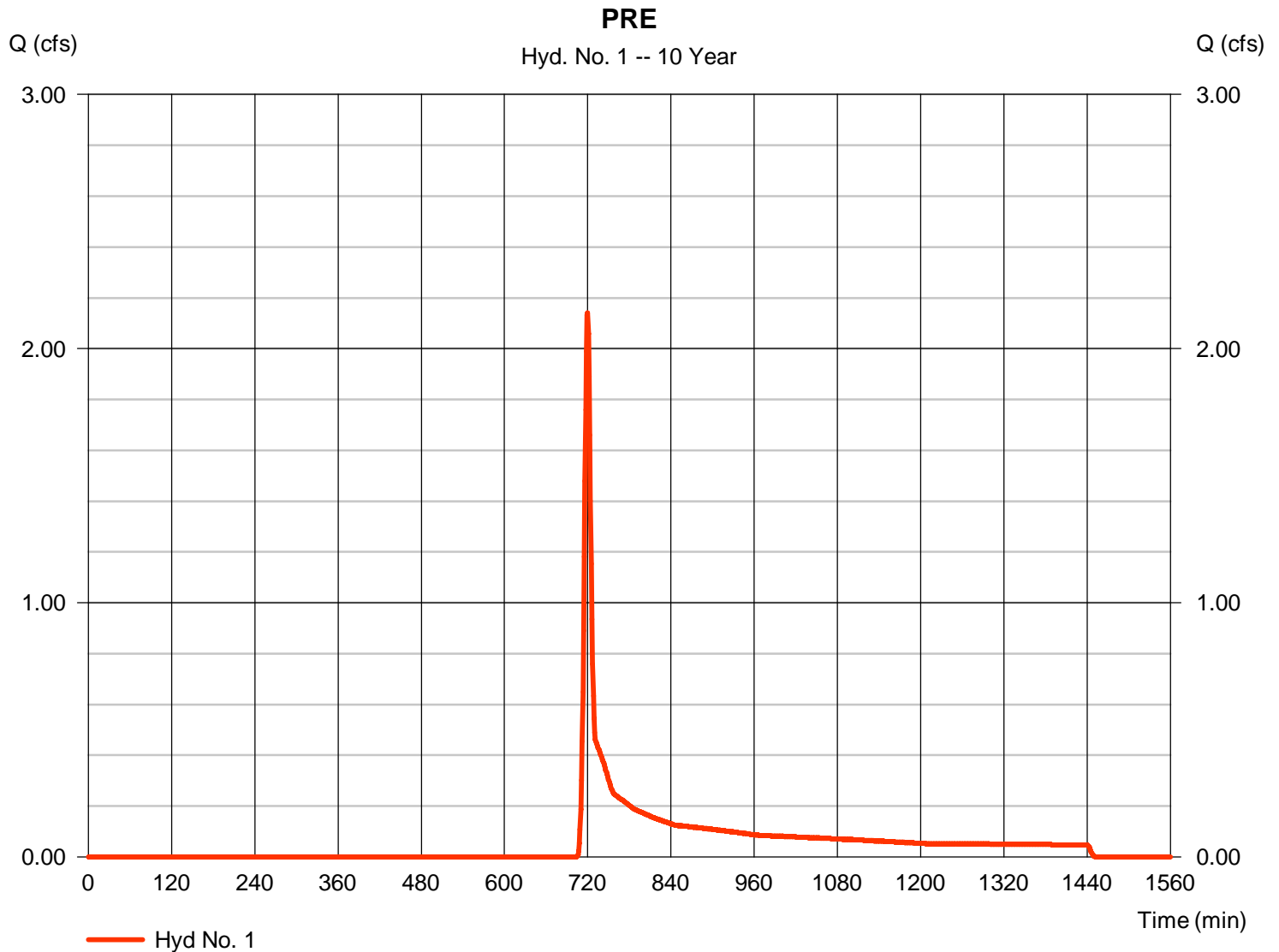
Monday, 01 / 23 / 2017

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 2.141 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 5,474 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 3.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# Hydrograph Report

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

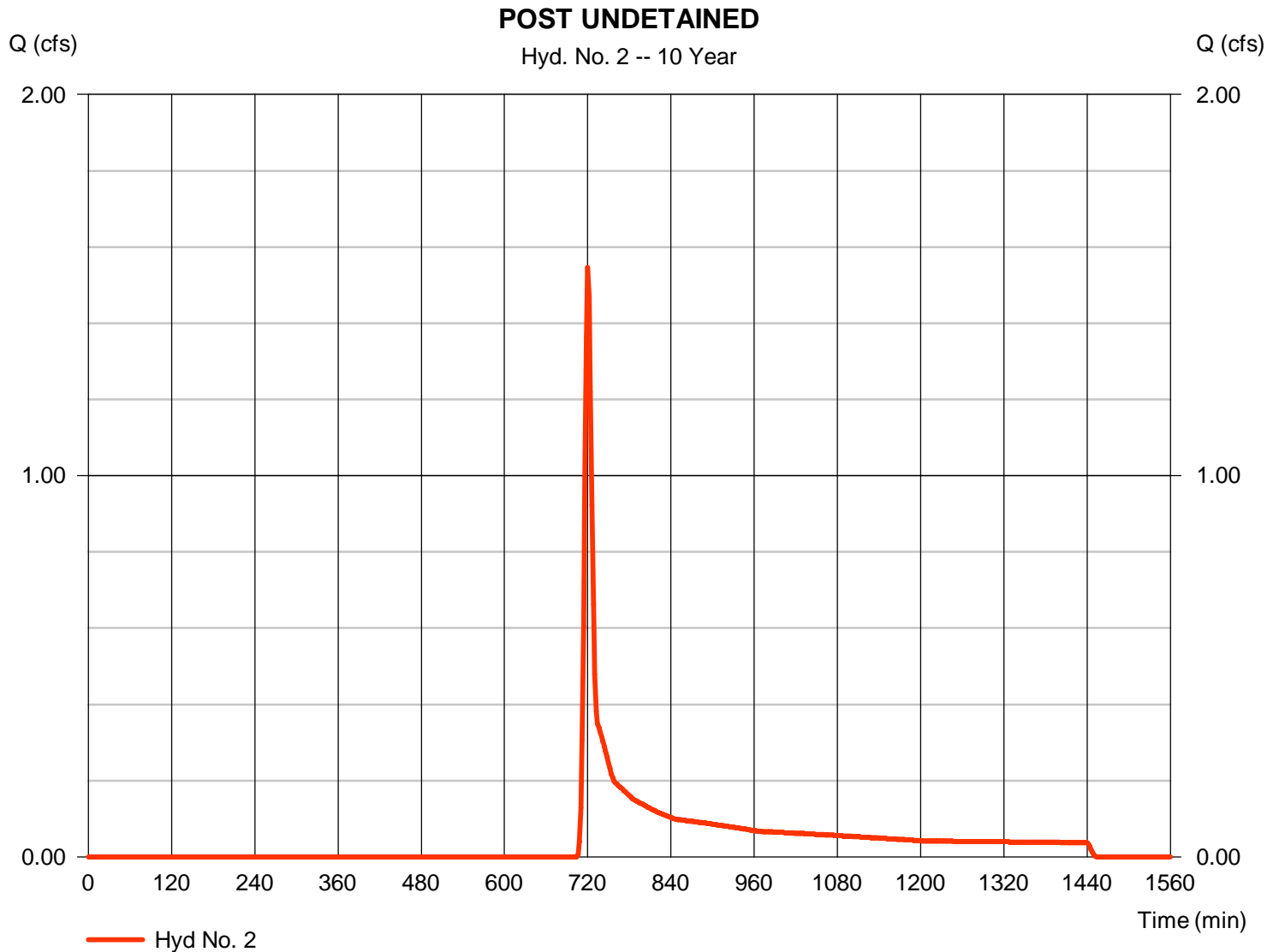
Monday, 01 / 23 / 2017

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.546 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 4,327 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 3.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



# Hydrograph Report

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

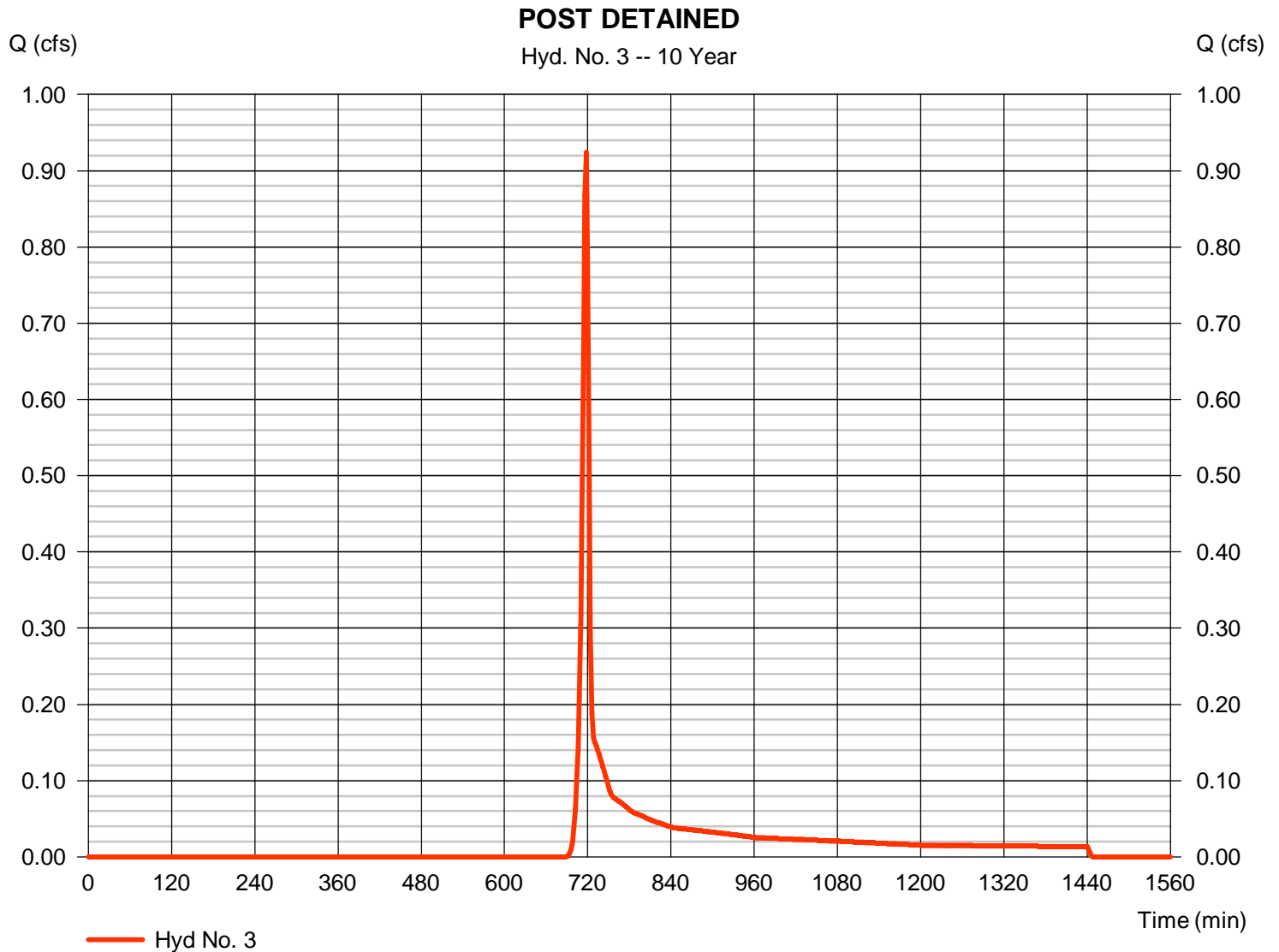
Monday, 01 / 23 / 2017

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.924 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,894 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.10 min
Total precip.	= 3.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# Hydrograph Report

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

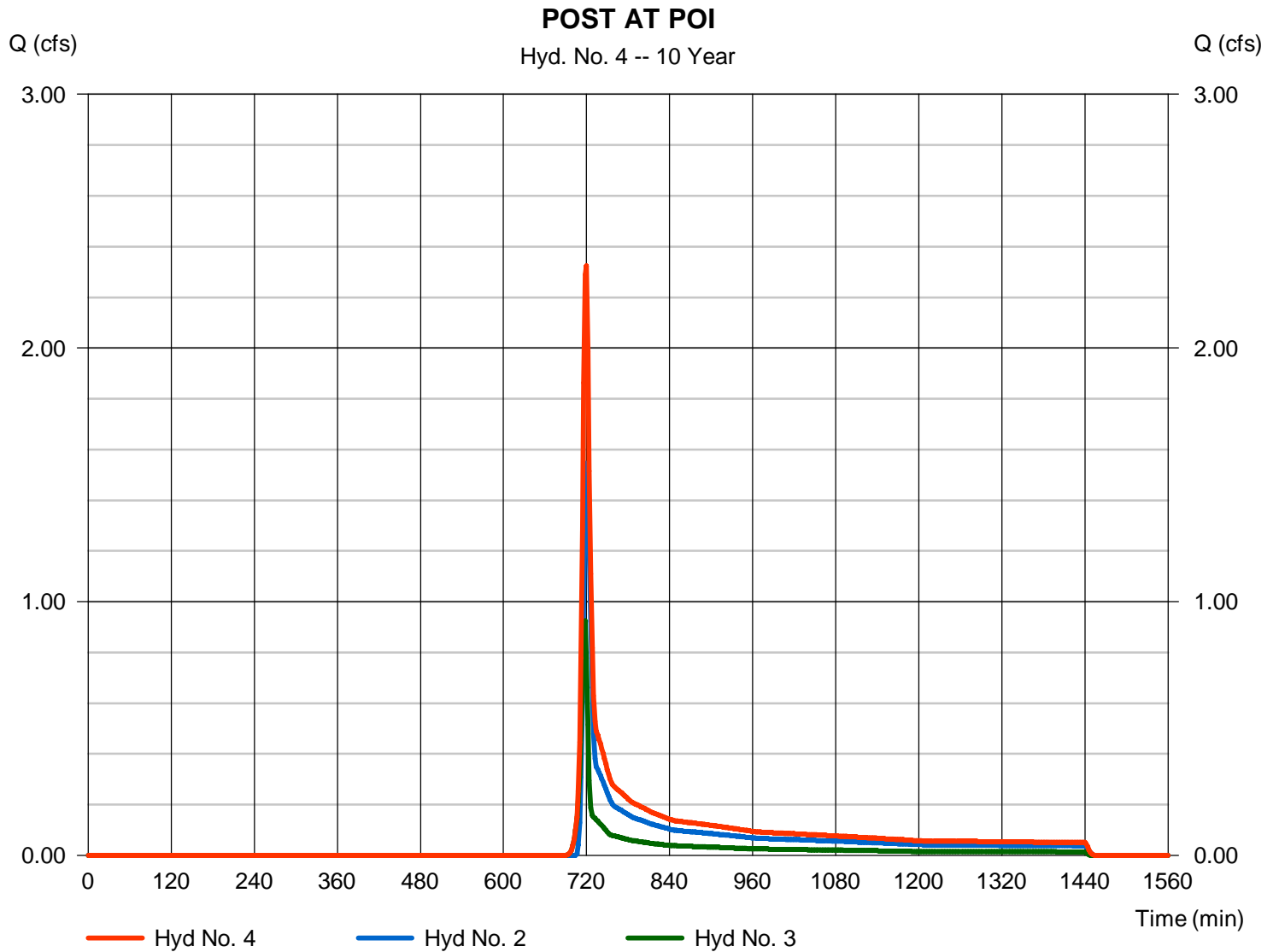
Monday, 01 / 23 / 2017

## Hyd. No. 4

POST AT POI

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

Peak discharge = 2.324 cfs  
 Time to peak = 720 min  
 Hyd. volume = 6,221 cuft  
 Contrib. drain. area = 2.530 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	5.441	1	719	11,975	-----	-----	-----	PRE	
2	SCS Runoff	3.956	2	720	9,467	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	1.832	2	718	3,664	-----	-----	-----	POST DETAINED	
4	Combine	5.602	2	718	13,131	2, 3	-----	-----	POST AT POI	
Valley Forge.gpw					Return Period: 50 Year			Monday, 01 / 23 / 2017		

# Hydrograph Report

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

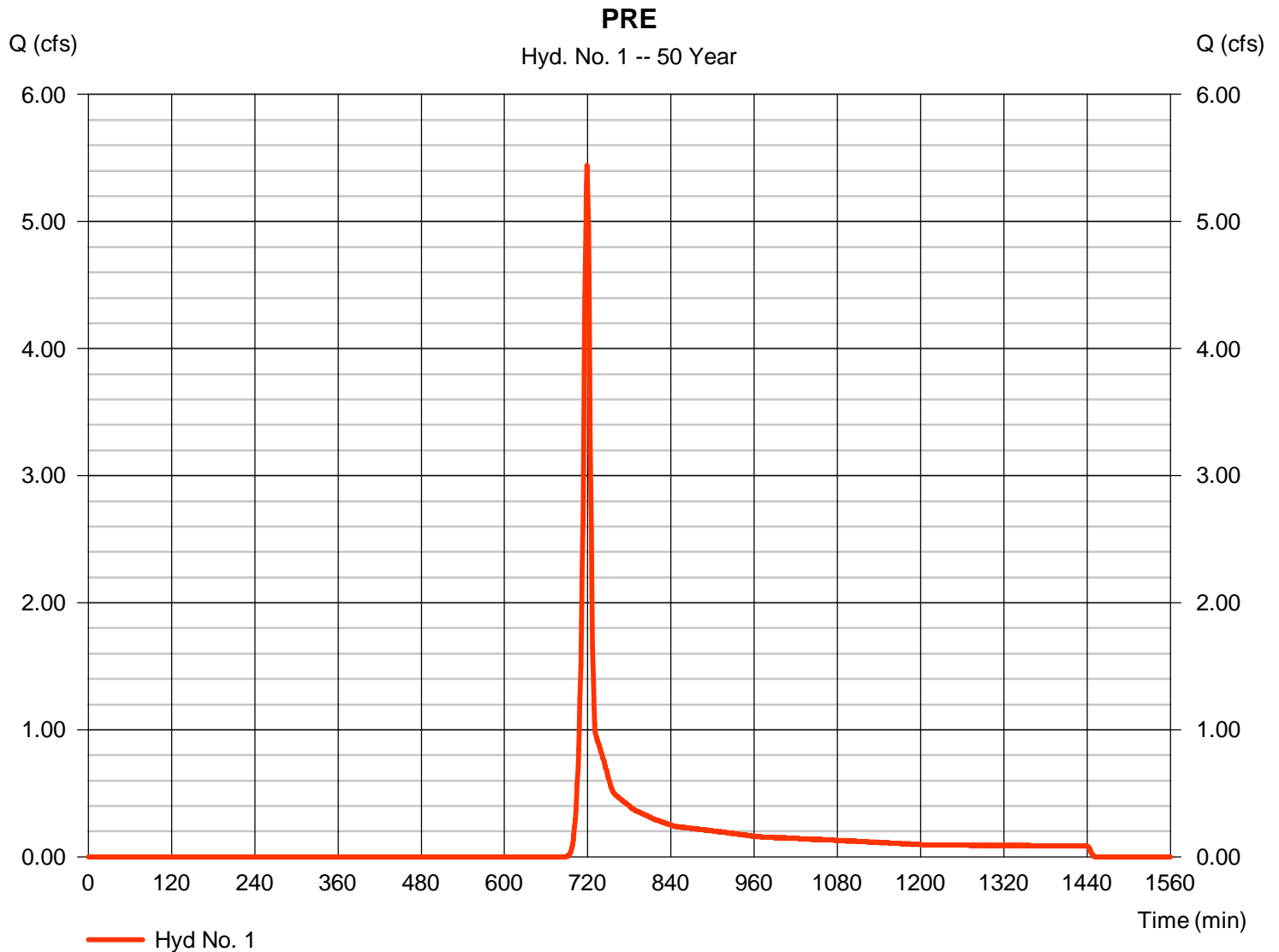
Monday, 01 / 23 / 2017

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 5.441 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 11,975 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# Hydrograph Report

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

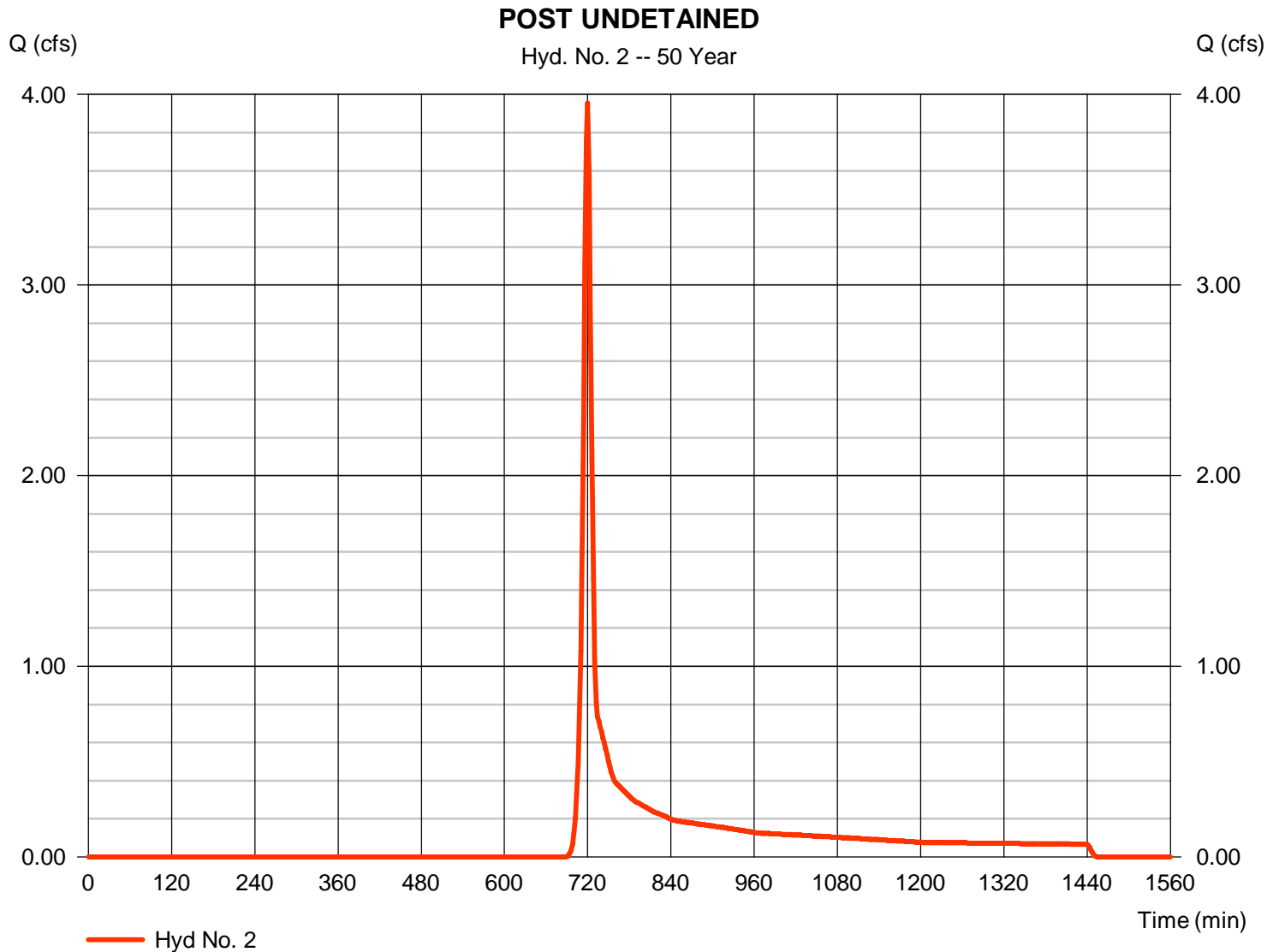
Monday, 01 / 23 / 2017

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 3.956 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 9,467 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



# Hydrograph Report

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

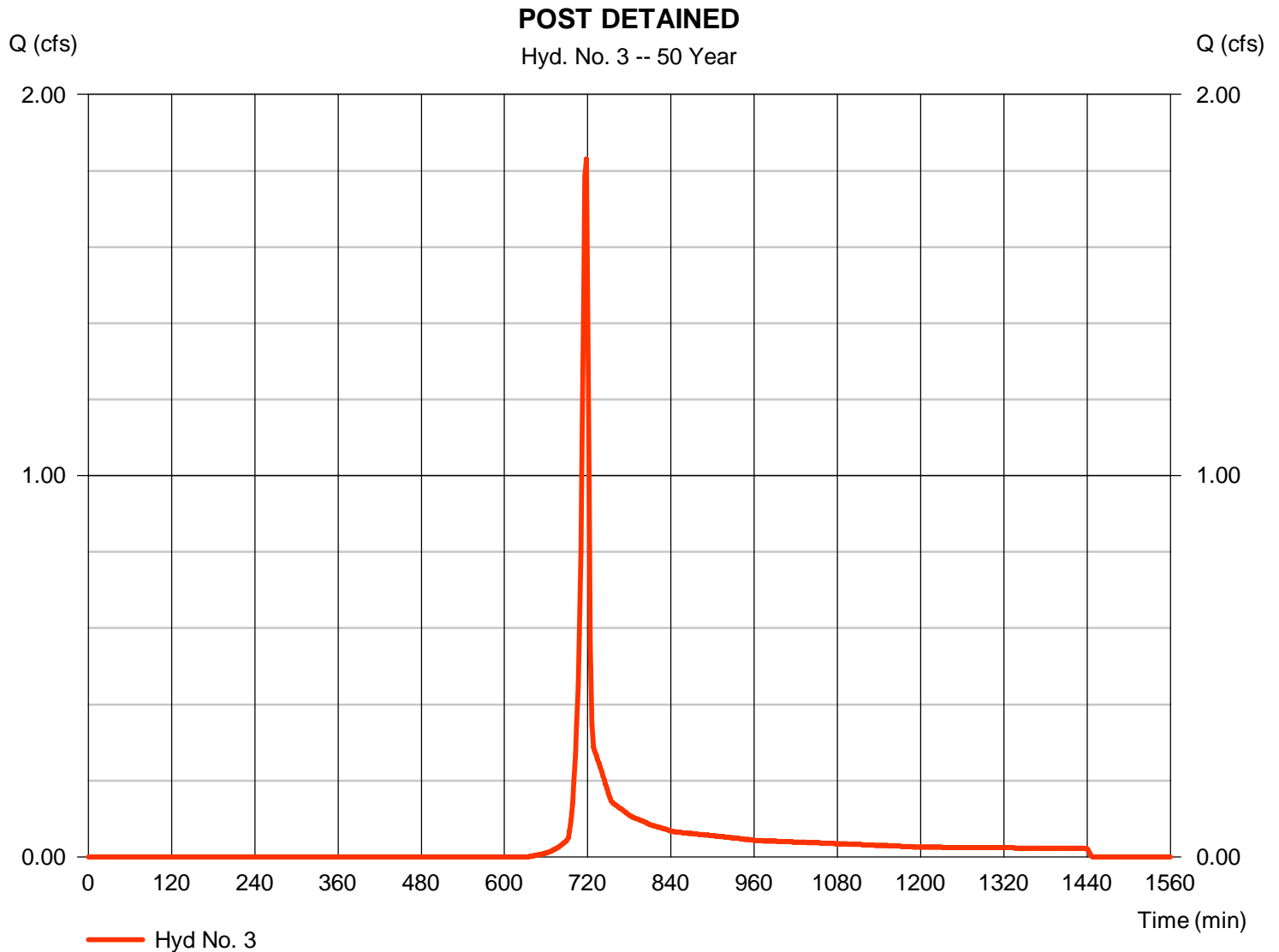
Monday, 01 / 23 / 2017

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.832 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 3,664 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.10 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# Hydrograph Report

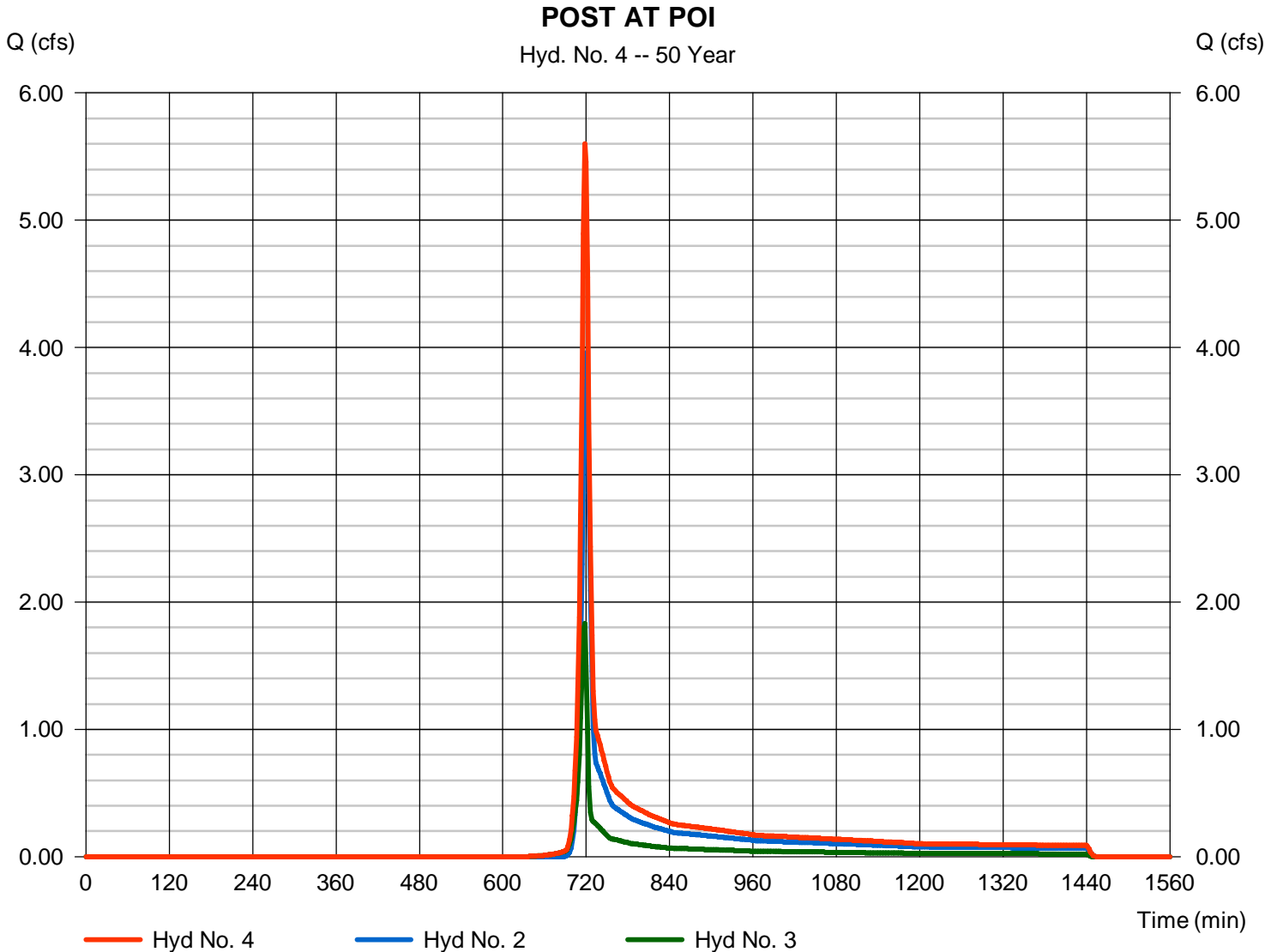
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 5.602 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 13,131 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 2.530 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	7.280	1	719	15,675	-----	-----	-----	PRE	
2	SCS Runoff	5.297	2	720	12,391	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	2.312	2	718	4,627	-----	-----	-----	POST DETAINED	
4	Combine	7.433	2	718	17,018	2, 3	-----	-----	POST AT POI	
Valley Forge.gpw					Return Period: 100 Year			Monday, 01 / 23 / 2017		

# Hydrograph Report

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

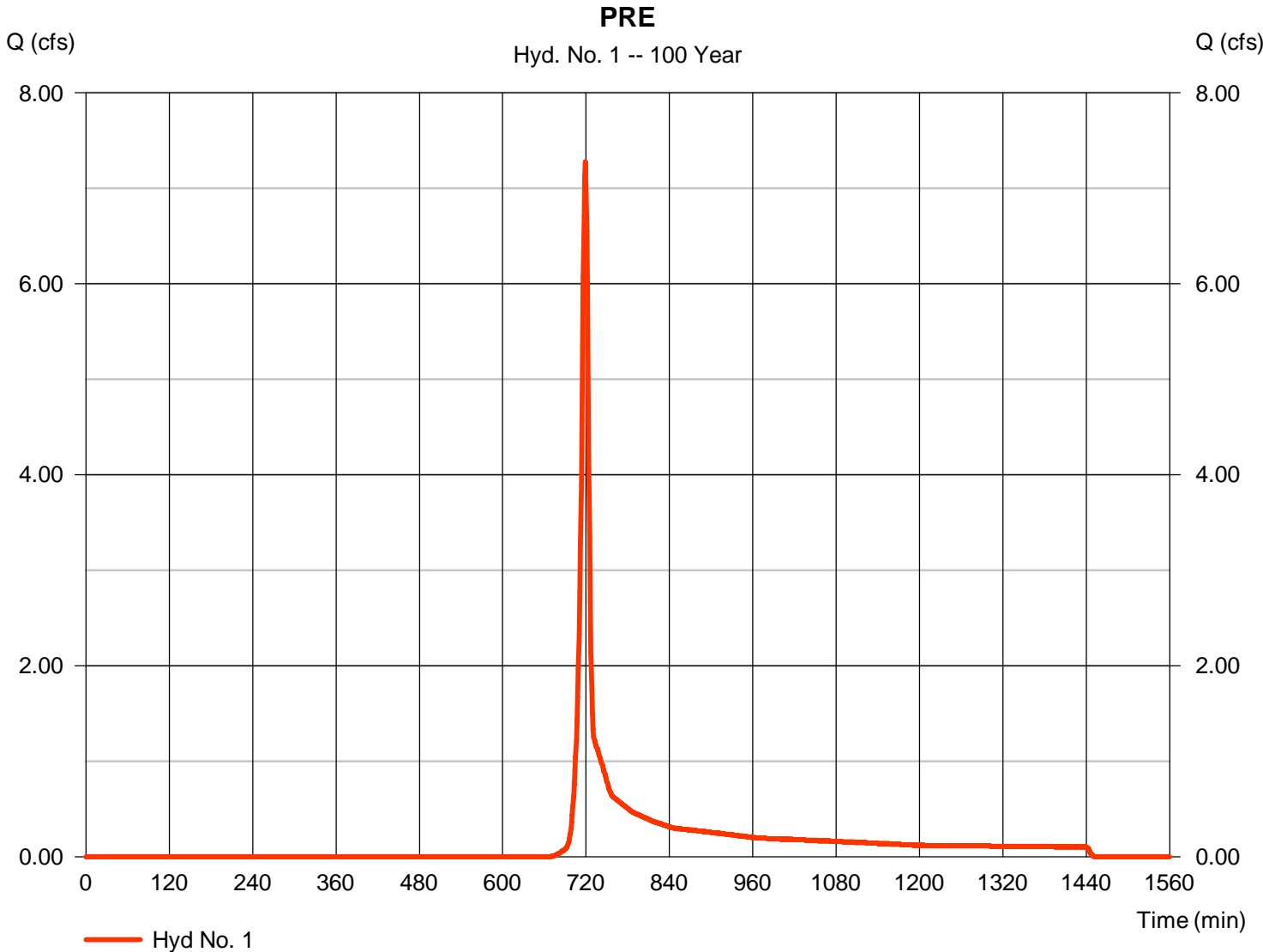
Monday, 01 / 23 / 2017

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 7.280 cfs
Storm frequency	= 100 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 15,675 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# Hydrograph Report

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

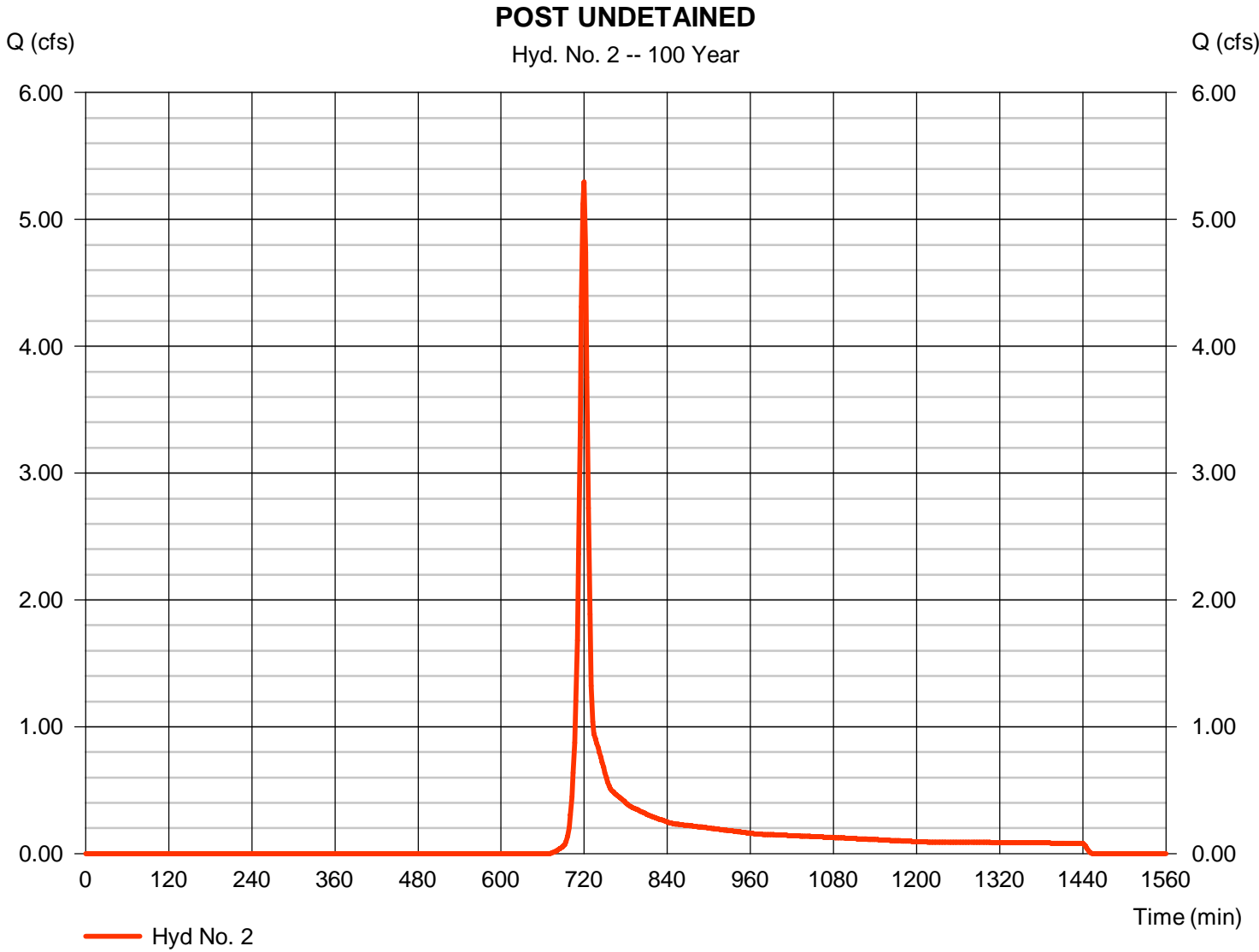
Monday, 01 / 23 / 2017

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 5.297 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 12,391 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950





# Hydrograph Report

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

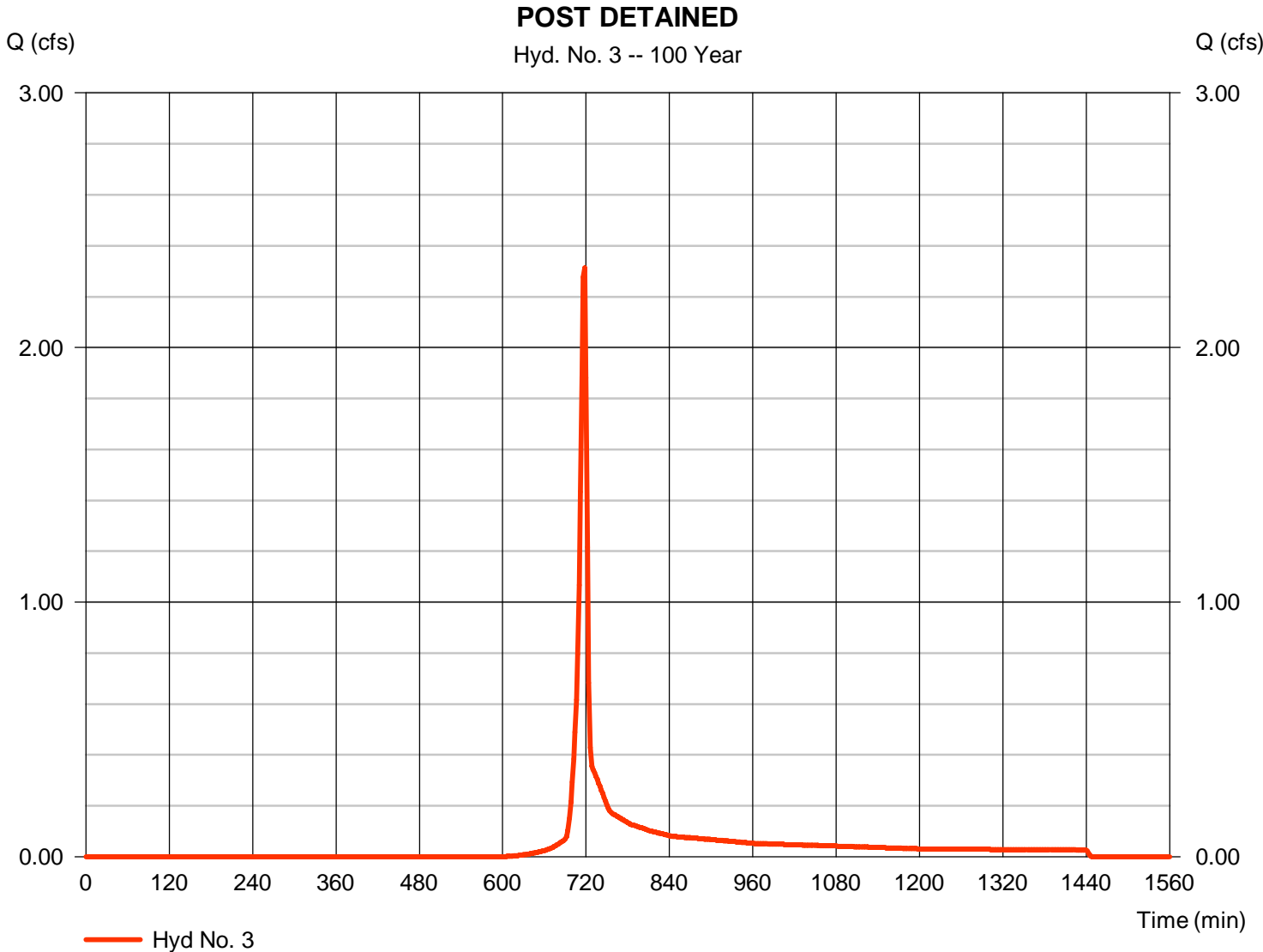
Monday, 01 / 23 / 2017

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.312 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 4,627 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.10 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# Hydrograph Report

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

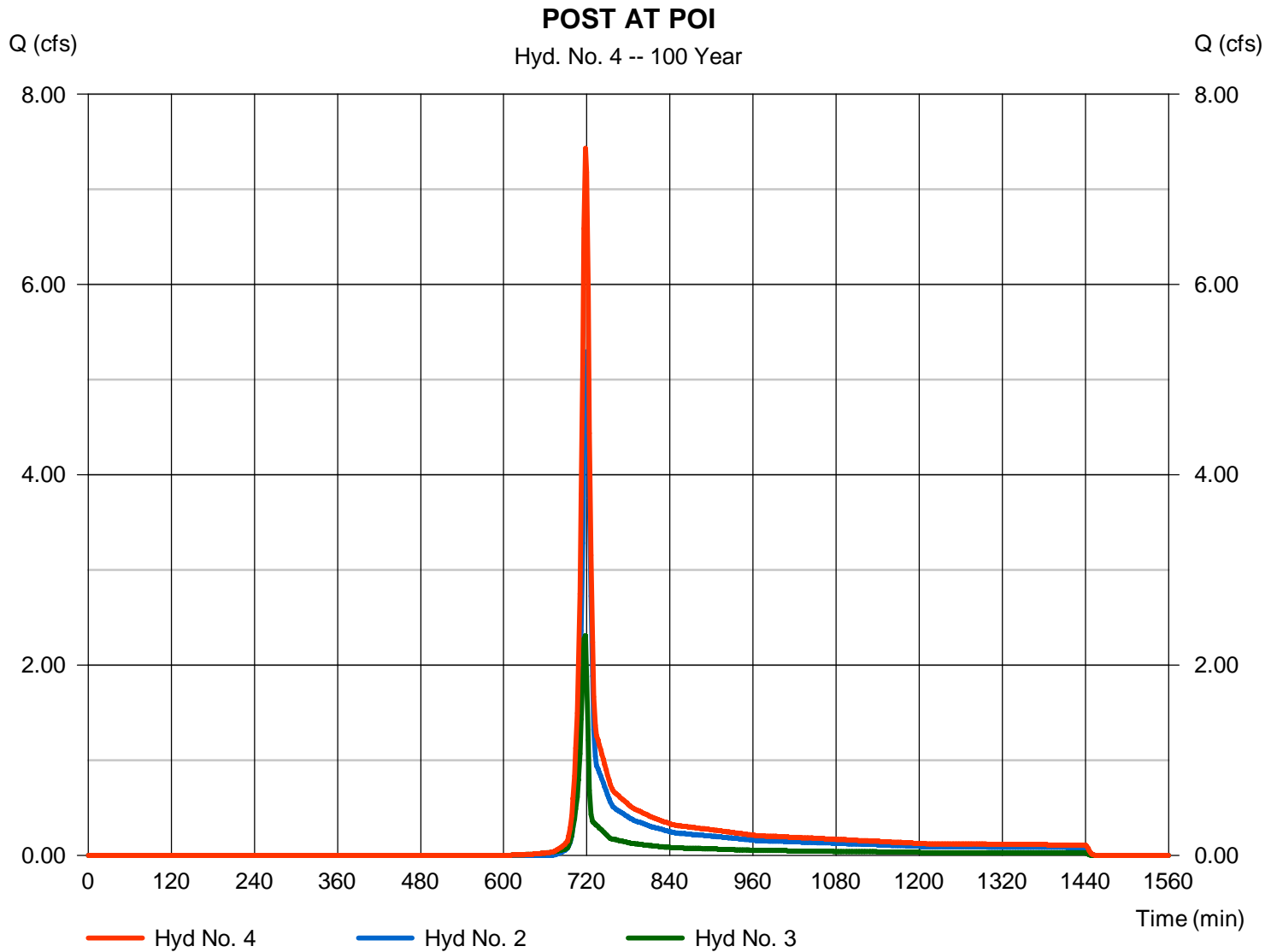
Monday, 01 / 23 / 2017

## Hyd. No. 4

POST AT POI

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Time interval = 2 min  
Inflow hyds. = 2, 3

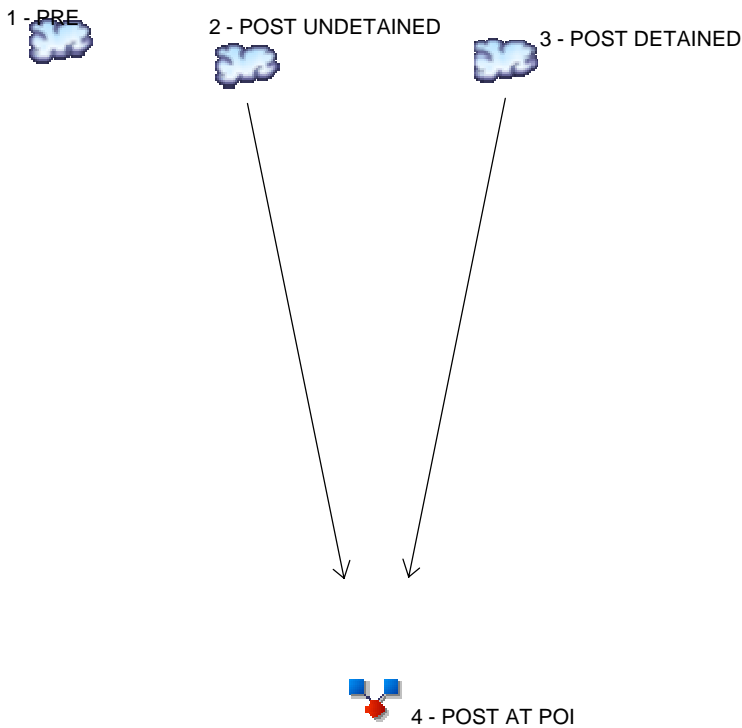
Peak discharge = 7.433 cfs  
Time to peak = 718 min  
Hyd. volume = 17,018 cuft  
Contrib. drain. area = 2.530 ac





# Watershed Model Schematic

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



**Legend**

<u>Hyd. Origin</u>	<u>Description</u>
1 SCS Runoff	PRE
2 SCS Runoff	POST UNDETAINED
3 SCS Runoff	POST DETAINED
4 Combine	POST AT POI

# Hydrograph Return Period Recap

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

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	-----	-----	0.276	-----	-----	-----	-----	-----	-----	PRE
2	SCS Runoff	-----	-----	0.185	-----	-----	-----	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	0.091	-----	-----	-----	-----	-----	-----	POST DETAINED
4	Combine	2, 3	-----	0.214	-----	-----	-----	-----	-----	-----	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	0.276	1	722	1,627	-----	-----	-----	PRE
2	SCS Runoff	0.185	2	722	1,283	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	0.091	2	746	776	-----	-----	-----	POST DETAINED
4	Combine	0.214	2	724	2,058	2, 3	-----	-----	POST AT POI
2-year.gpw					Return Period: 2 Year			Monday, 01 / 23 / 2017	

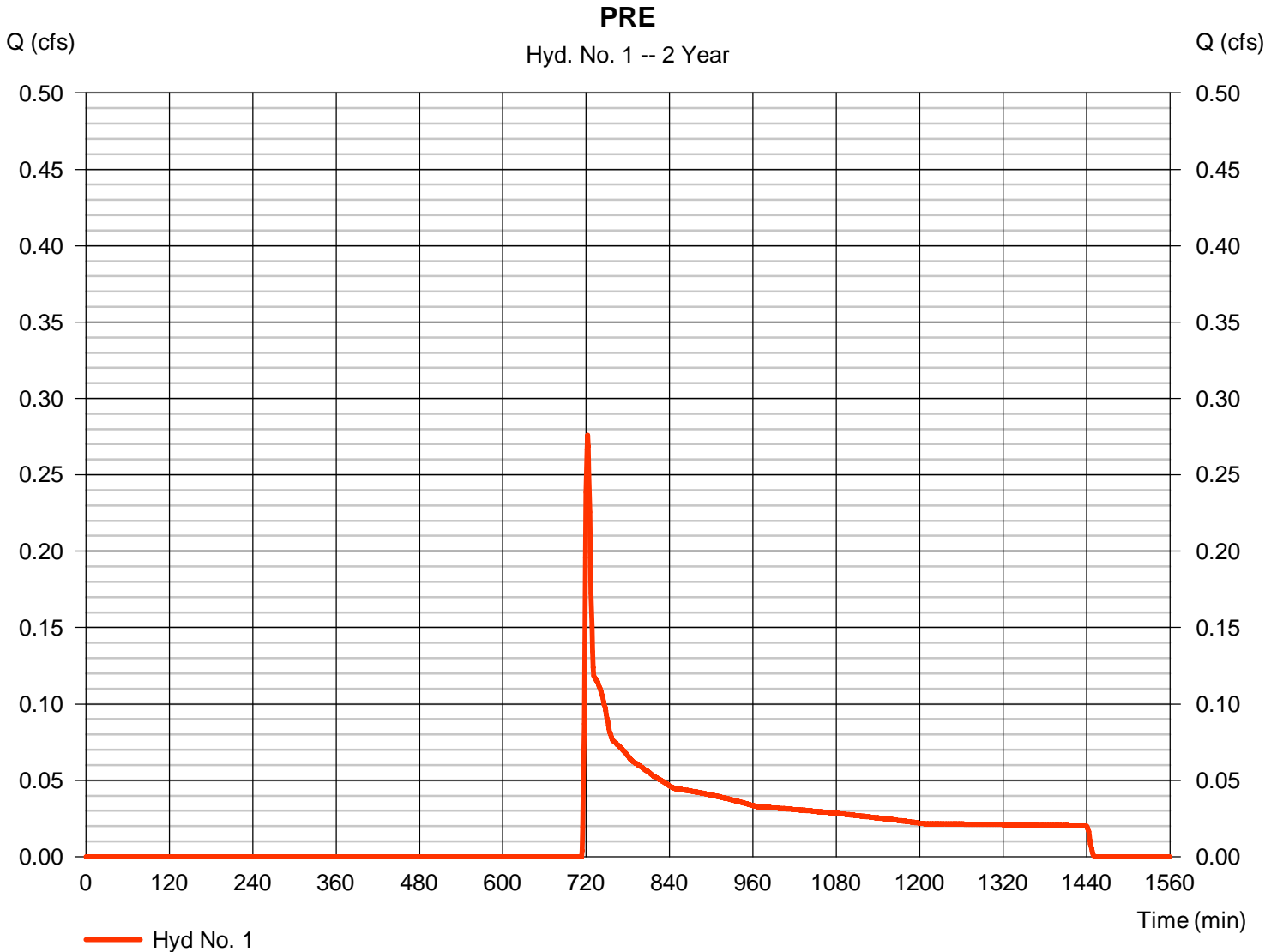
# Hydrograph Report

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.276 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 1,627 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 5.79	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.84</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 5.84</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 671.00	0.00	0.00	
Watercourse slope (%)	= 15.66	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.38	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.75</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 1.75</b>
<b>Channel Flow</b>				
X sectional flow area (sqft)	= 16.00	0.00	0.00	
Wetted perimeter (ft)	= 28.00	0.00	0.00	
Channel slope (%)	= 0.56	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=5.11	0.00	0.00	
Flow length (ft)	140.0	0.0	0.0	
<b>Travel Time (min)</b>	<b>= 0.46</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 0.46</b>
<b>Total Travel Time, Tc .....</b>				<b>8.10 min</b>



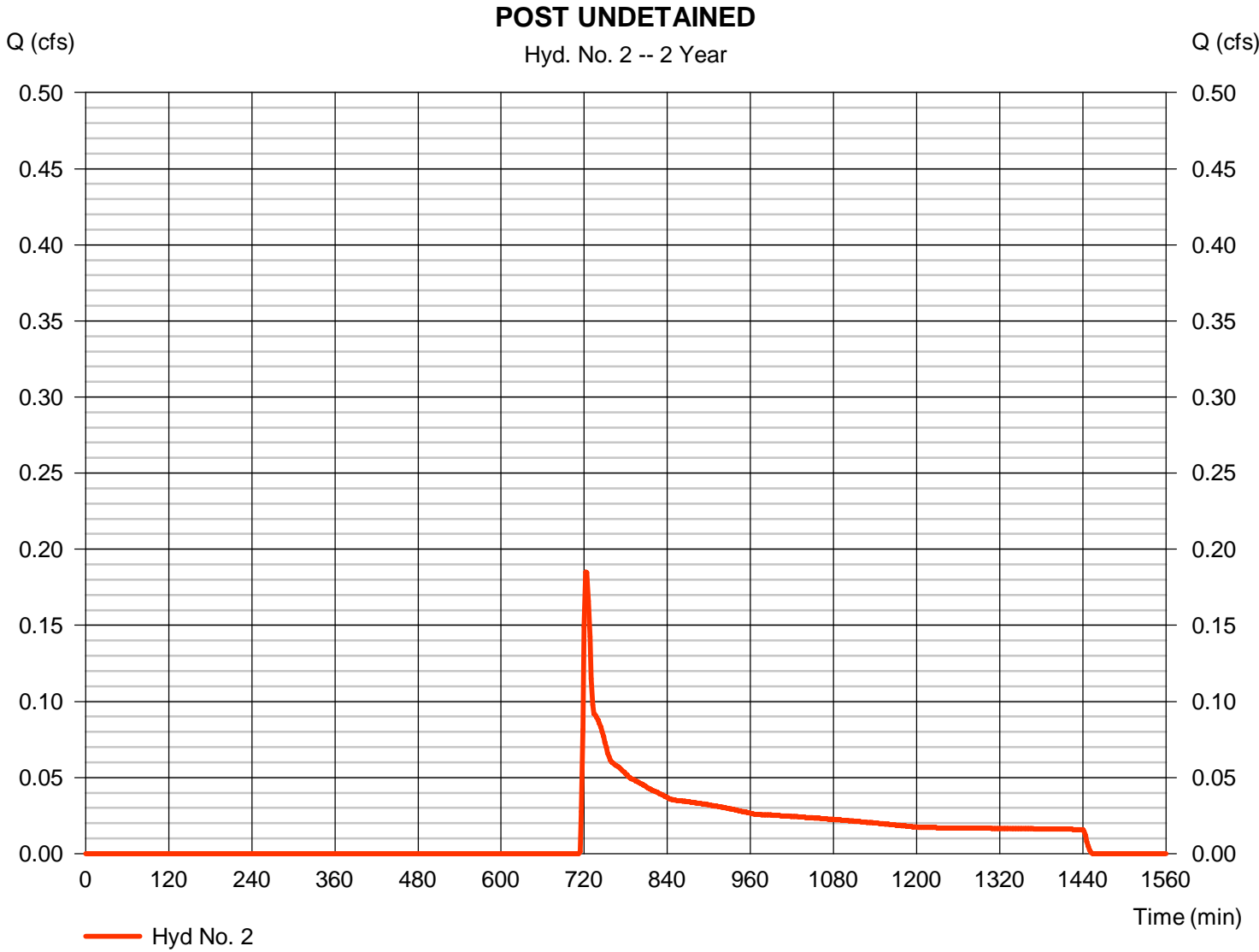
# Hydrograph Report

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.185 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 1,283 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 7.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.42</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 5.42</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 422.00	43.00	0.00	
Watercourse slope (%)	= 16.00	9.30	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.45	6.20	0.00	
<b>Travel Time (min)</b>	<b>= 1.09</b>	<b>+ 0.12</b>	<b>+ 0.00</b>	<b>= 1.21</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>6.60 min</b>

# Hydrograph Report

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

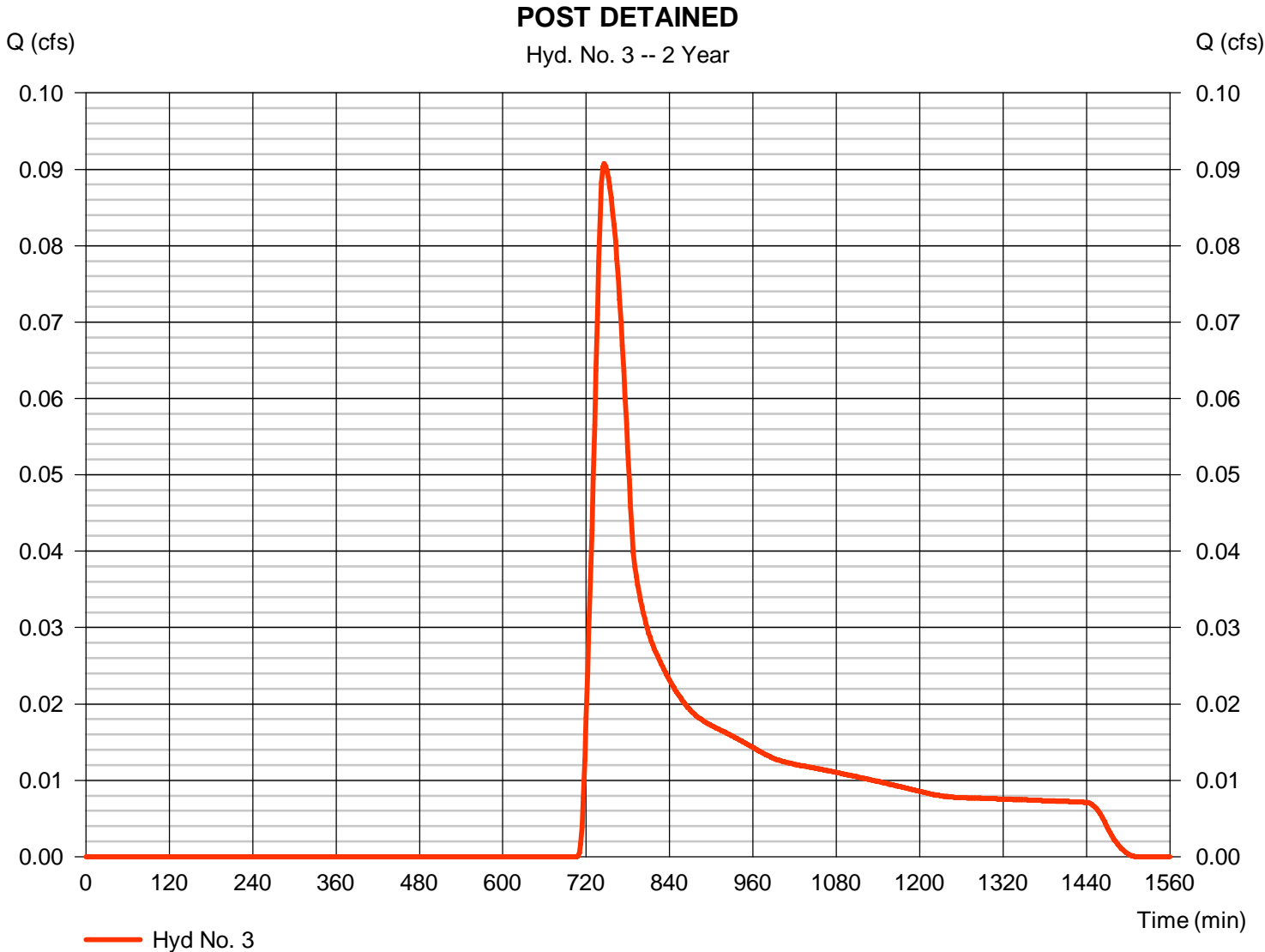
Monday, 01 / 23 / 2017

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.091 cfs
Storm frequency	= 2 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 776 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.74 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# Hydrograph Report

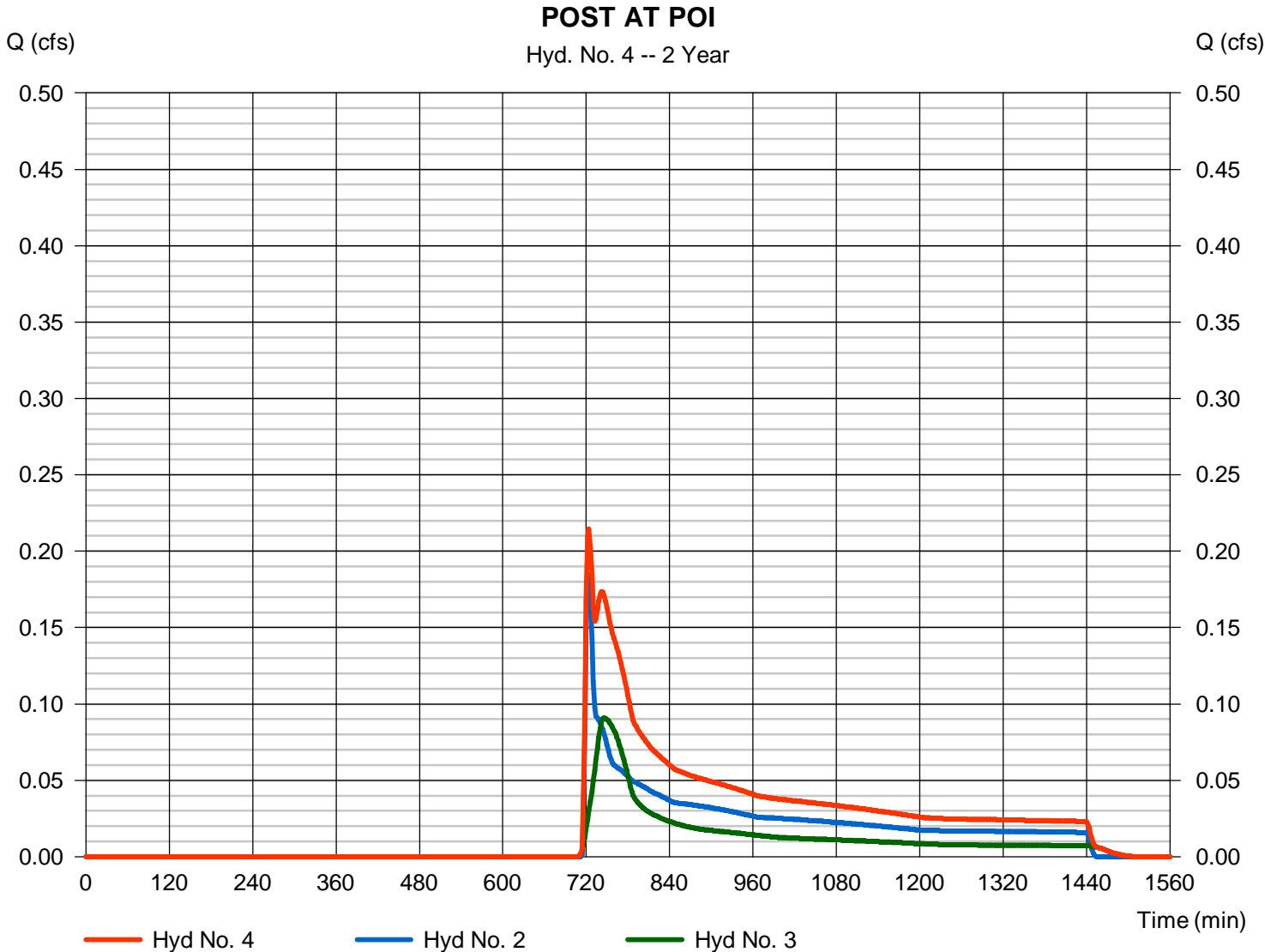
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Monday, 01 / 23 / 2017

## Hyd. No. 4

POST AT POI

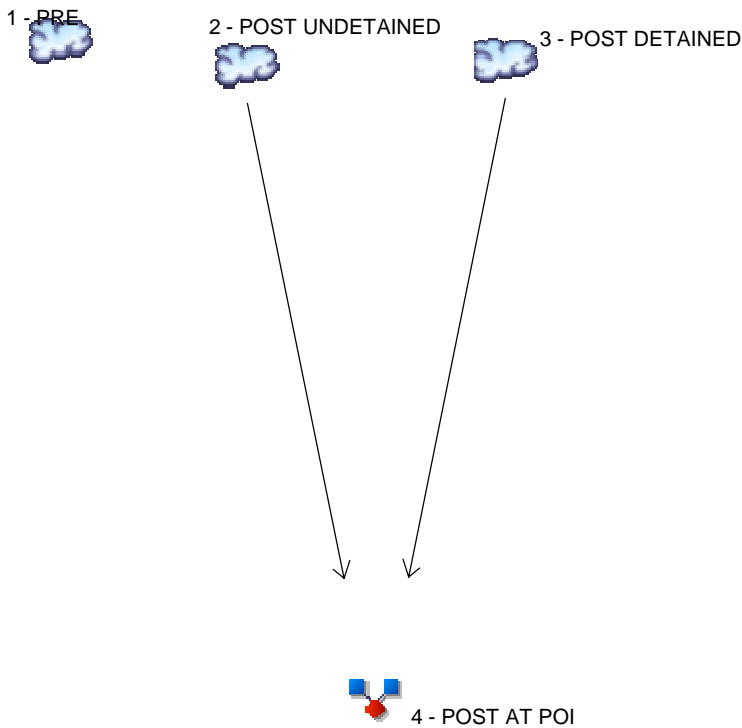
Hydrograph type	= Combine	Peak discharge	= 0.214 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 2,058 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 2.530 ac





# Watershed Model Schematic

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



**Legend**

<u>Hyd. Origin</u>	<u>Description</u>
1	SCS Runoff PRE
2	SCS Runoff POST UNDETAINED
3	SCS Runoff POST DETAINED
4	Combine POST AT POI

# Hydrograph Return Period Recap

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

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	-----	-----	-----	-----	-----	2.141	-----	-----	-----	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	1.546	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	0.473	-----	-----	-----	POST DETAINED
4	Combine	2, 3	-----	-----	-----	-----	1.827	-----	-----	-----	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	2.141	1	720	5,474	-----	-----	-----	PRE	
2	SCS Runoff	1.546	2	720	4,327	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	0.473	2	730	1,989	-----	-----	-----	POST DETAINED	
4	Combine	1.827	2	720	6,316	2, 3	-----	-----	POST AT POI	
10-year.gpw					Return Period: 10 Year			Monday, 01 / 23 / 2017		



# Hydrograph Report

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

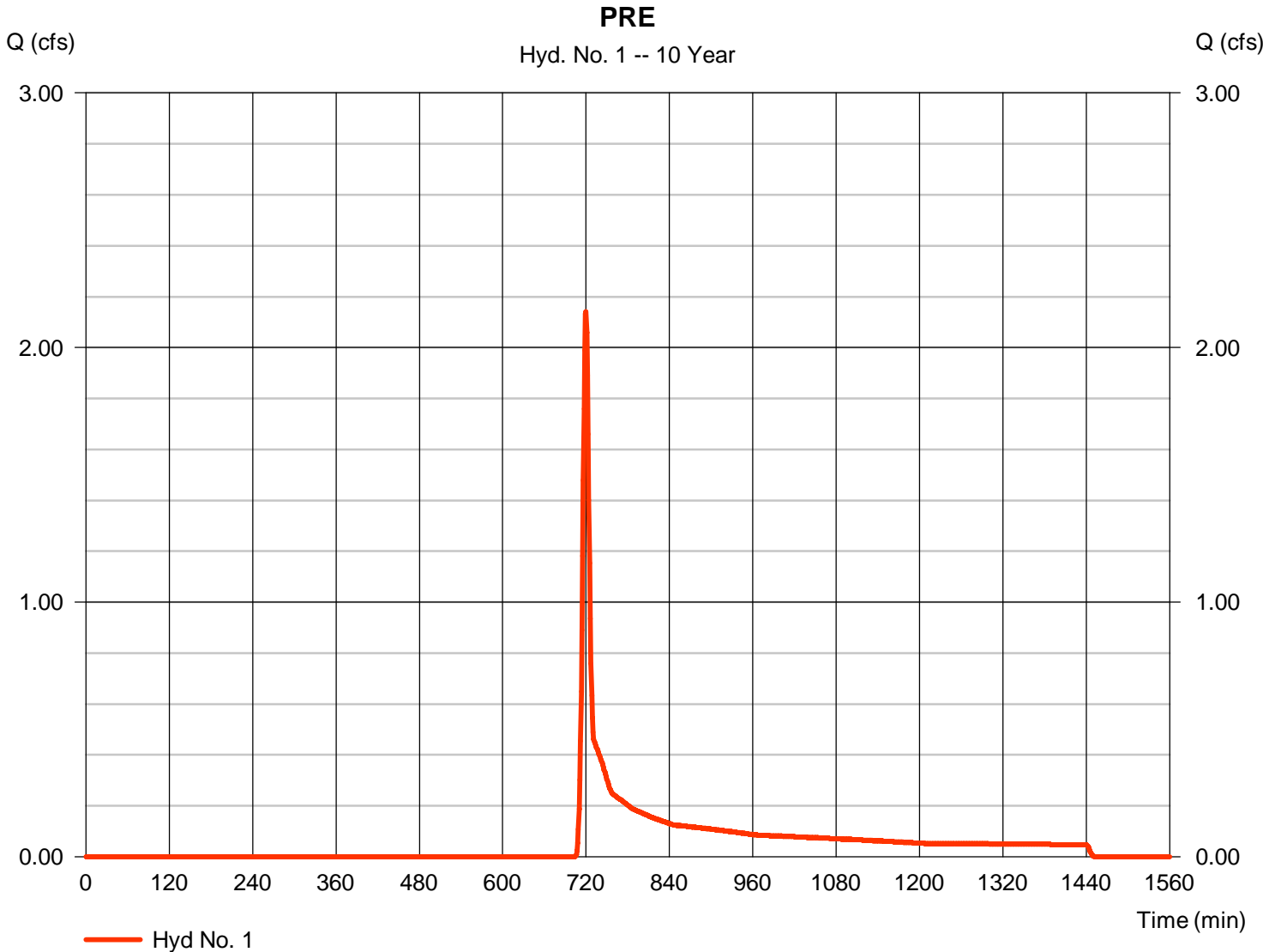
Monday, 01 / 23 / 2017

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 2.141 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 5,474 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 3.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 5.79	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.84</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 5.84</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 671.00	0.00	0.00	
Watercourse slope (%)	= 15.66	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.38	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.75</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.75</b>
<b>Channel Flow</b>				
X sectional flow area (sqft)	= 16.00	0.00	0.00	
Wetted perimeter (ft)	= 28.00	0.00	0.00	
Channel slope (%)	= 0.56	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=5.11	0.00	0.00	
Flow length (ft)	140.0	0.0	0.0	
<b>Travel Time (min)</b>	<b>= 0.46</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.46</b>
<b>Total Travel Time, Tc .....</b>				<b>8.10 min</b>

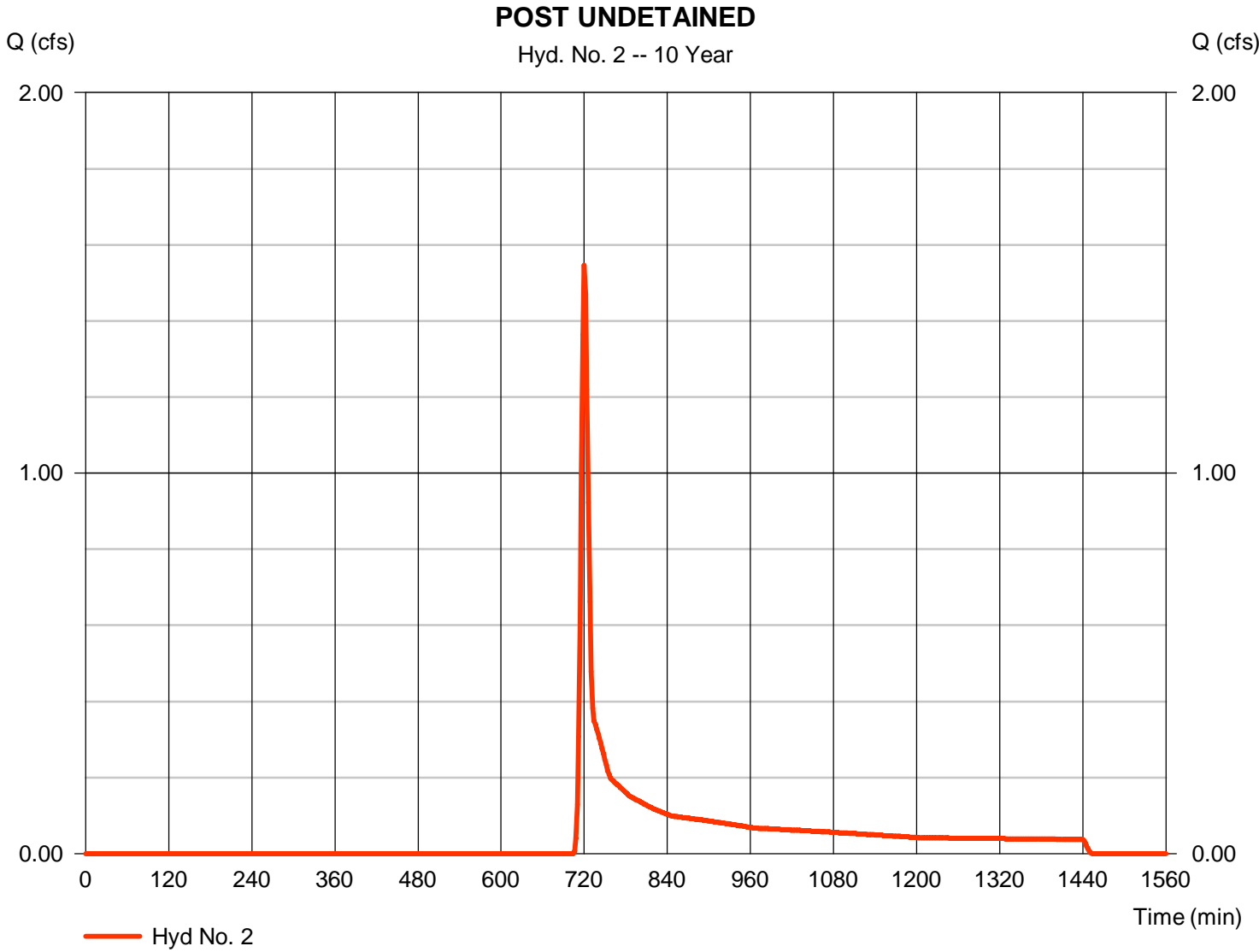
# Hydrograph Report

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.546 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 4,327 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 3.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 7.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.42</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 5.42</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 422.00	43.00	0.00	
Watercourse slope (%)	= 16.00	9.30	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.45	6.20	0.00	
<b>Travel Time (min)</b>	<b>= 1.09</b>	<b>+</b> <b>0.12</b>	<b>+</b> <b>0.00</b>	<b>= 1.21</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>6.60 min</b>

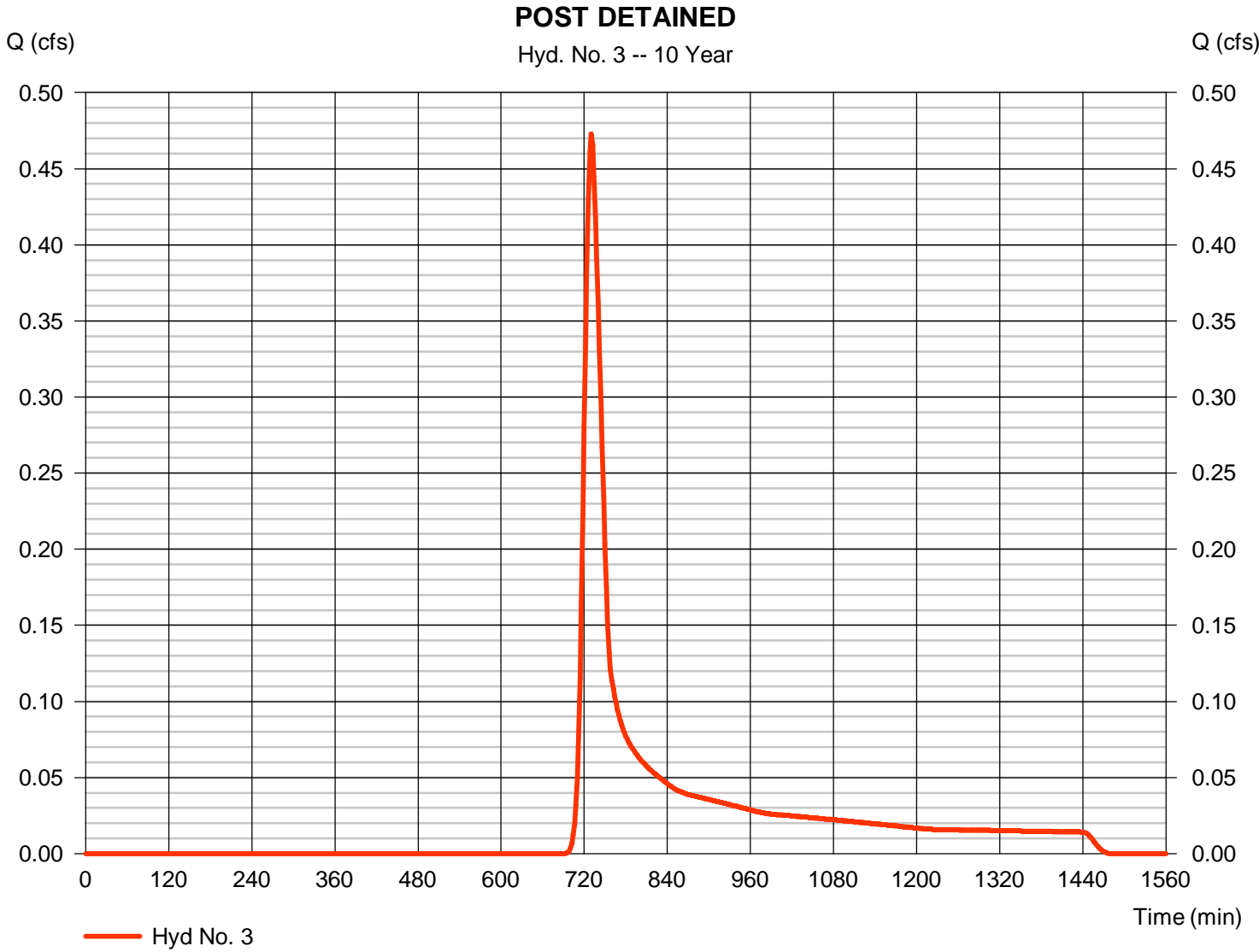
# Hydrograph Report

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.473 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 1,989 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 23.60 min
Total precip.	= 3.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# Hydrograph Report

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

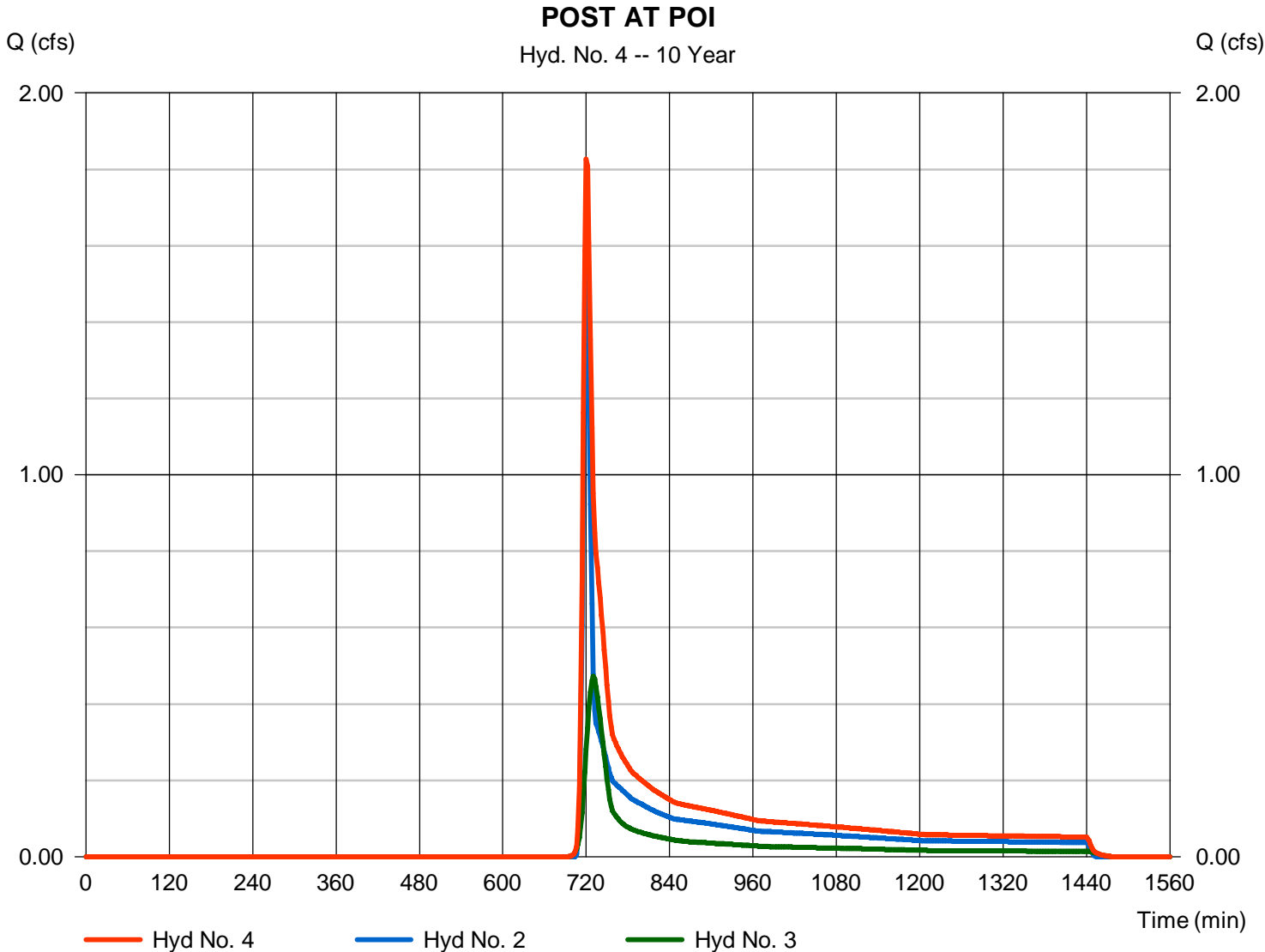
Monday, 01 / 23 / 2017

## Hyd. No. 4

POST AT POI

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

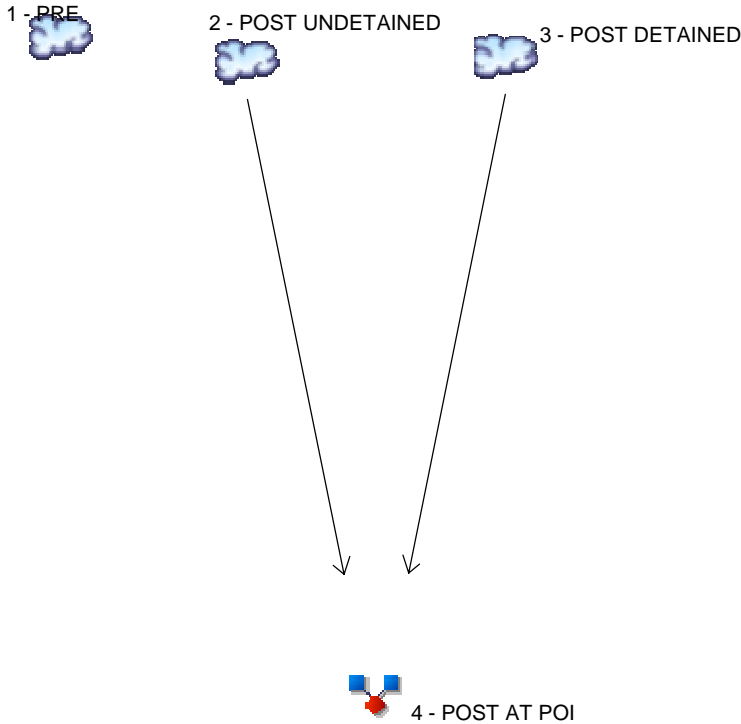
Peak discharge = 1.827 cfs  
Time to peak = 720 min  
Hyd. volume = 6,316 cuft  
Contrib. drain. area = 2.530 ac





# Watershed Model Schematic

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



**Legend**

<u>Hyd. Origin</u>	<u>Description</u>
1 SCS Runoff	PRE
2 SCS Runoff	POST UNDETAINED
3 SCS Runoff	POST DETAINED
4 Combine	POST AT POI



# Hydrograph Return Period Recap

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

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	-----	-----	-----	-----	-----	-----	-----	5.441	-----	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	3.956	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	1.314	-----	POST DETAINED
4	Combine	2, 3	-----	-----	-----	-----	-----	-----	5.173	-----	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	5.441	1	719	11,975	-----	-----	-----	PRE	
2	SCS Runoff	3.956	2	720	9,467	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	1.314	2	724	3,810	-----	-----	-----	POST DETAINED	
4	Combine	5.173	2	720	13,277	2, 3	-----	-----	POST AT POI	
50-year.gpw					Return Period: 50 Year			Monday, 01 / 23 / 2017		

# Hydrograph Report

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

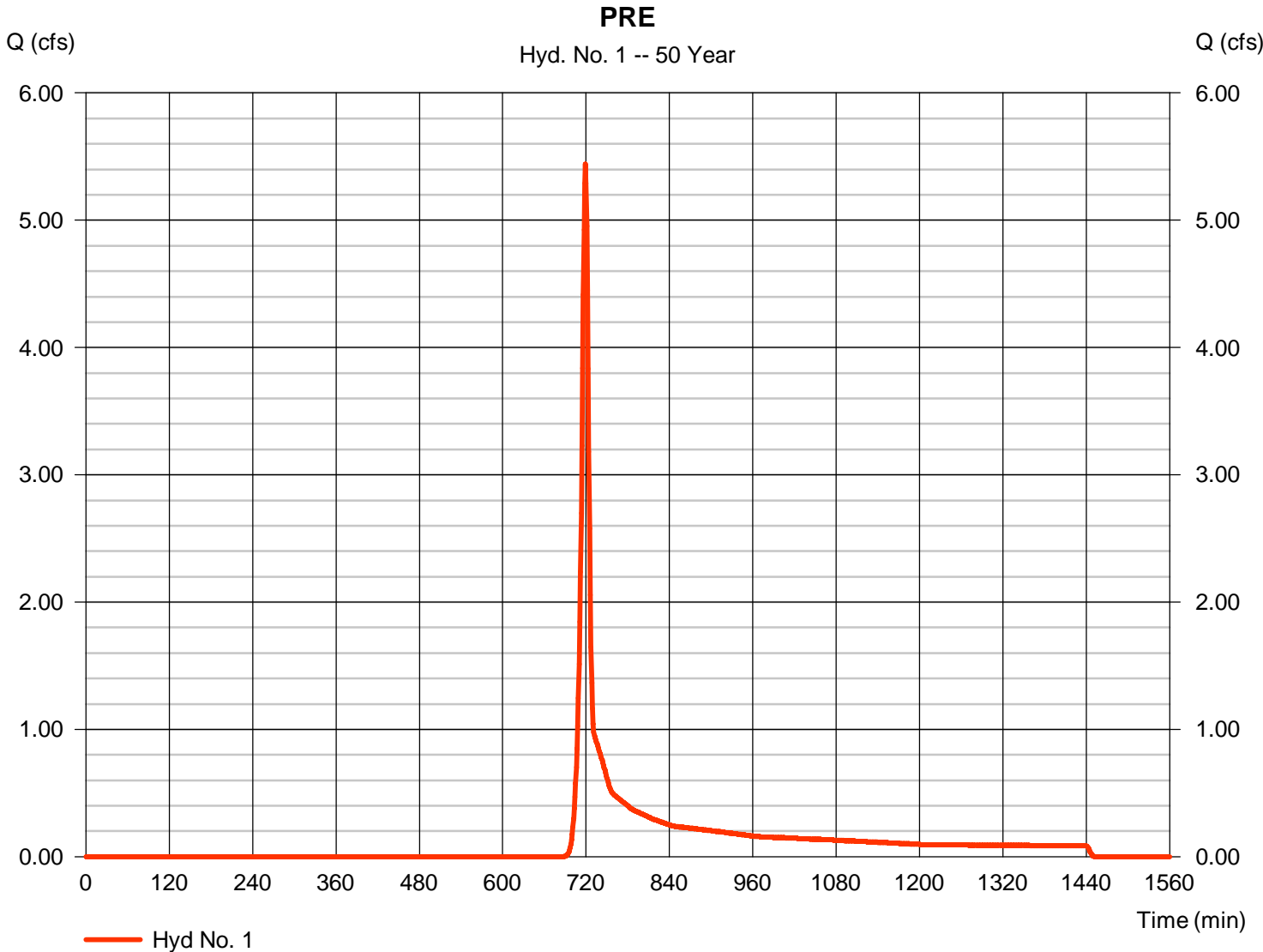
Monday, 01 / 23 / 2017

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 5.441 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 11,975 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 5.79	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.84</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 5.84</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 671.00	0.00	0.00	
Watercourse slope (%)	= 15.66	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.38	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.75</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.75</b>
<b>Channel Flow</b>				
X sectional flow area (sqft)	= 16.00	0.00	0.00	
Wetted perimeter (ft)	= 28.00	0.00	0.00	
Channel slope (%)	= 0.56	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=5.11	0.00	0.00	
Flow length (ft)	140.0	0.0	0.0	
<b>Travel Time (min)</b>	<b>= 0.46</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.46</b>
<b>Total Travel Time, Tc .....</b>				<b>8.10 min</b>

# Hydrograph Report

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

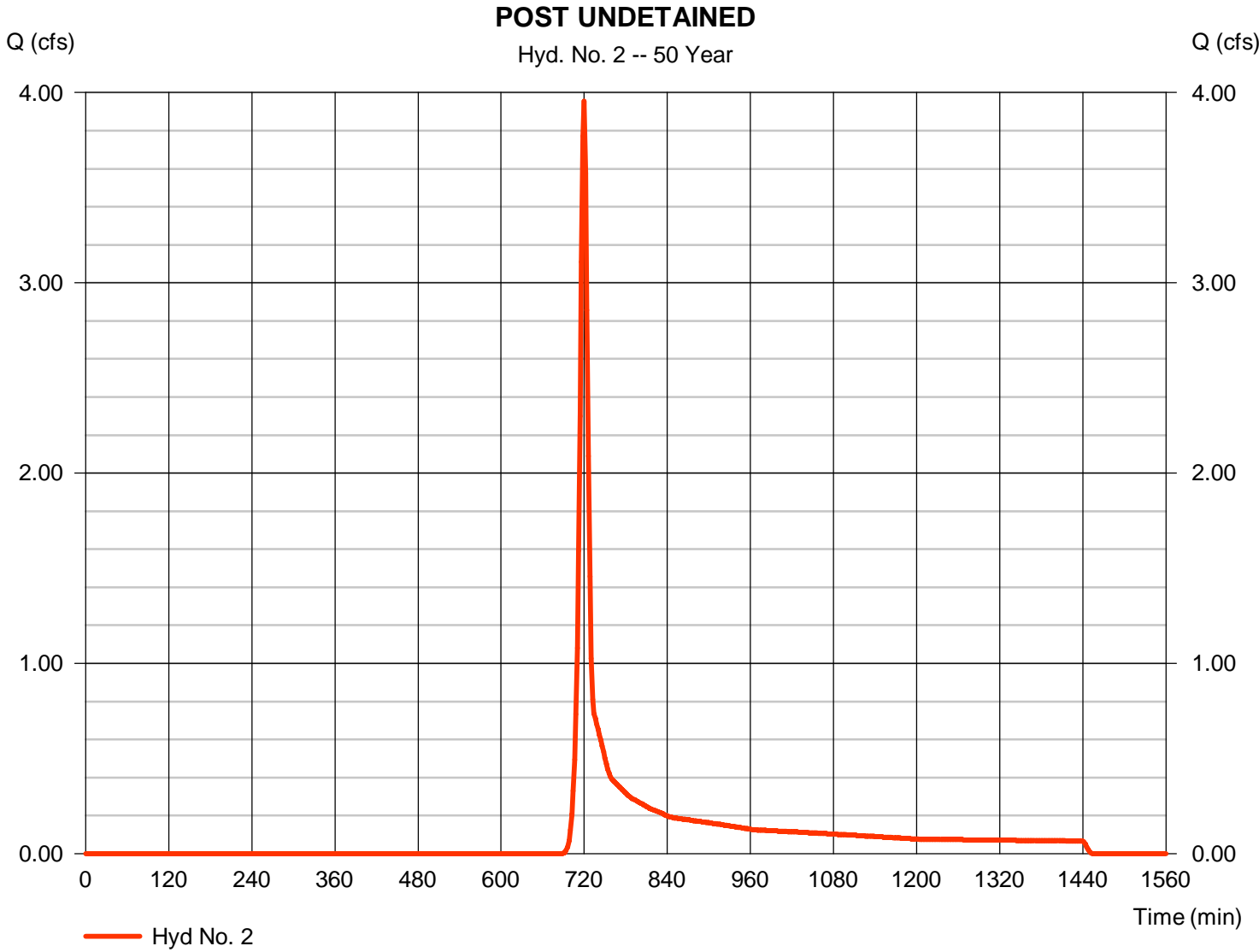
Monday, 01 / 23 / 2017

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 3.956 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 9,467 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 7.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.42</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 5.42</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 422.00	43.00	0.00	
Watercourse slope (%)	= 16.00	9.30	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.45	6.20	0.00	
<b>Travel Time (min)</b>	<b>= 1.09</b>	<b>+</b> <b>0.12</b>	<b>+</b> <b>0.00</b>	<b>= 1.21</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+</b> <b>0.00</b>	<b>+</b> <b>0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>6.60 min</b>

# Hydrograph Report

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

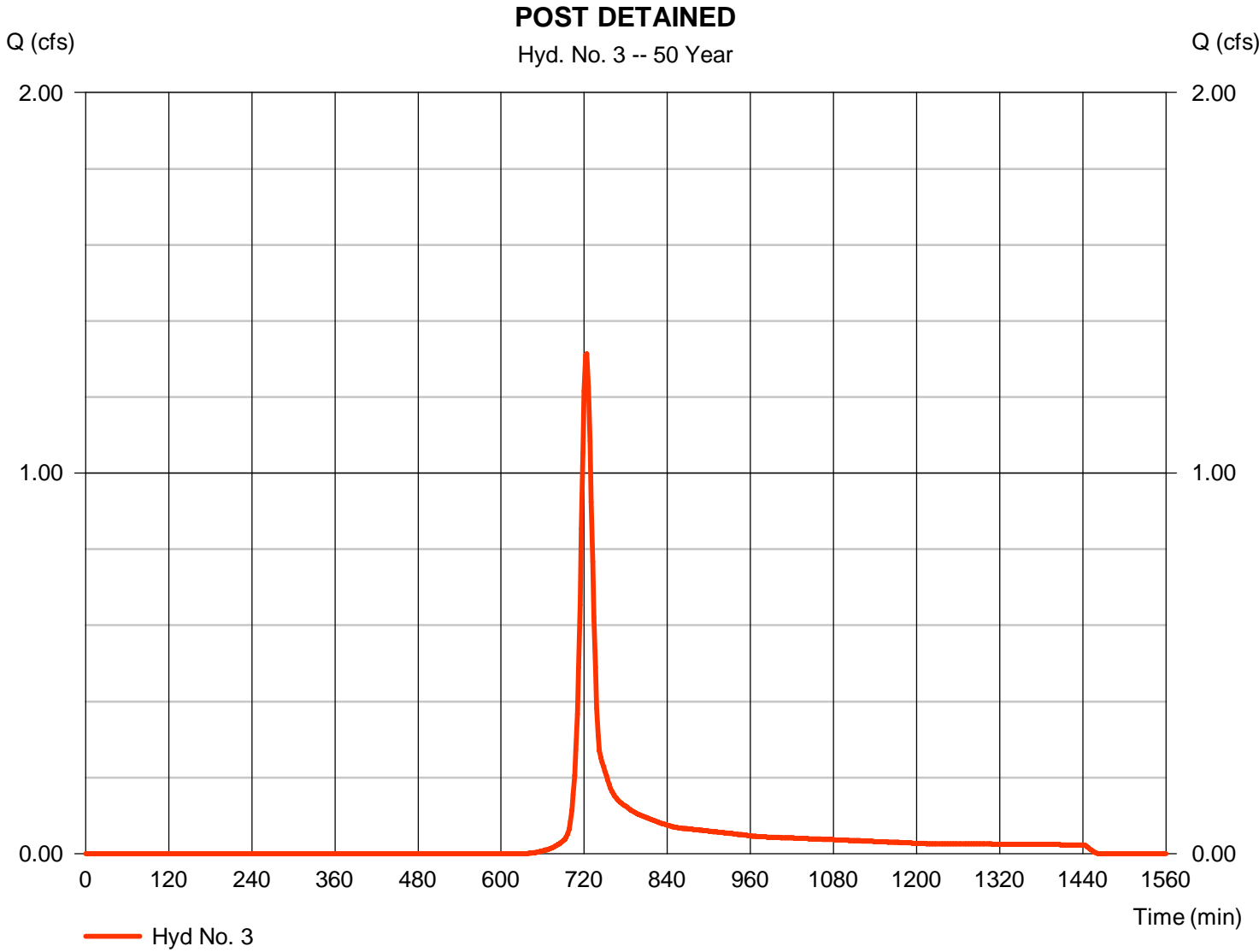
Monday, 01 / 23 / 2017

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.314 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 3,810 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.93 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# Hydrograph Report

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

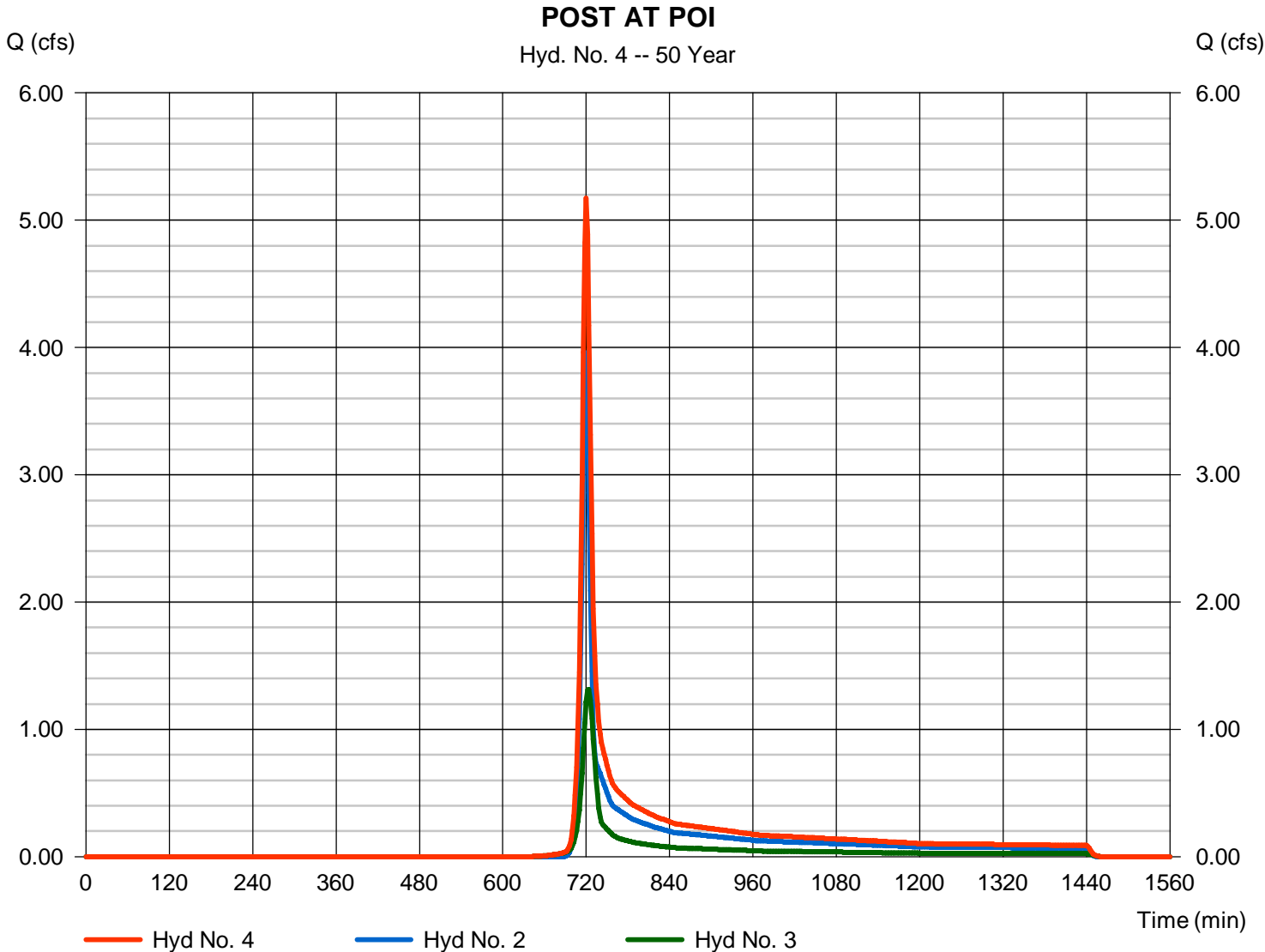
Monday, 01 / 23 / 2017

## Hyd. No. 4

POST AT POI

Hydrograph type = Combine  
Storm frequency = 50 yrs  
Time interval = 2 min  
Inflow hyds. = 2, 3

Peak discharge = 5.173 cfs  
Time to peak = 720 min  
Hyd. volume = 13,277 cuft  
Contrib. drain. area = 2.530 ac

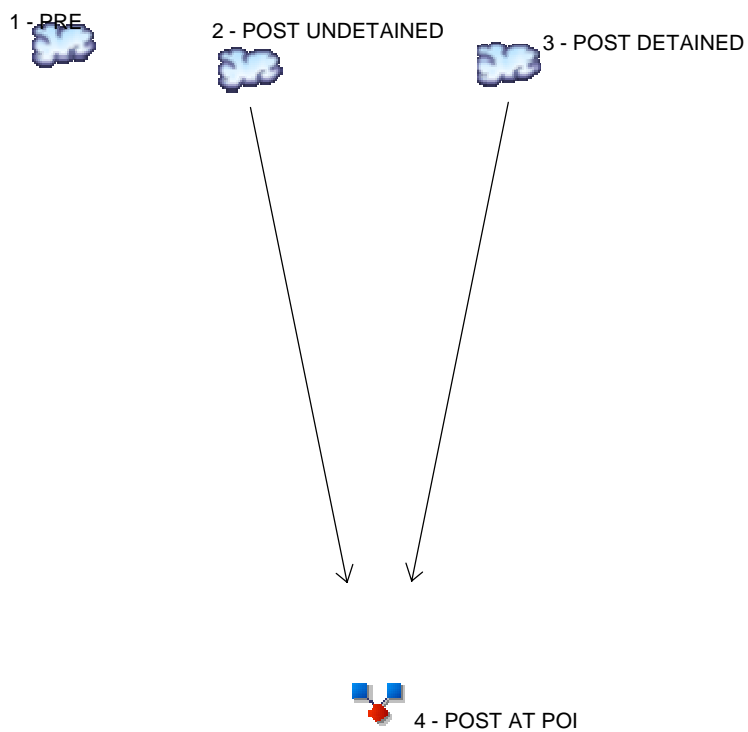






# Watershed Model Schematic

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



## Legend

<u>Hyd. Origin</u>	<u>Description</u>
1	SCS Runoff PRE
2	SCS Runoff POST UNDETAINED
3	SCS Runoff POST DETAINED
4	Combine POST AT POI

# Hydrograph Return Period Recap

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

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	-----	-----	-----	-----	-----	-----	-----	-----	7.280	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	-----	5.297	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	-----	1.937	POST DETAINED
4	Combine	2, 3	-----	-----	-----	-----	-----	-----	-----	7.224	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	7.280	1	719	15,675	-----	-----	-----	PRE	
2	SCS Runoff	5.297	2	720	12,391	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	1.937	2	722	5,089	-----	-----	-----	POST DETAINED	
4	Combine	7.224	2	720	17,481	2, 3	-----	-----	POST AT POI	
100-year.gpw					Return Period: 100 Year			Monday, 01 / 23 / 2017		

# Hydrograph Report

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

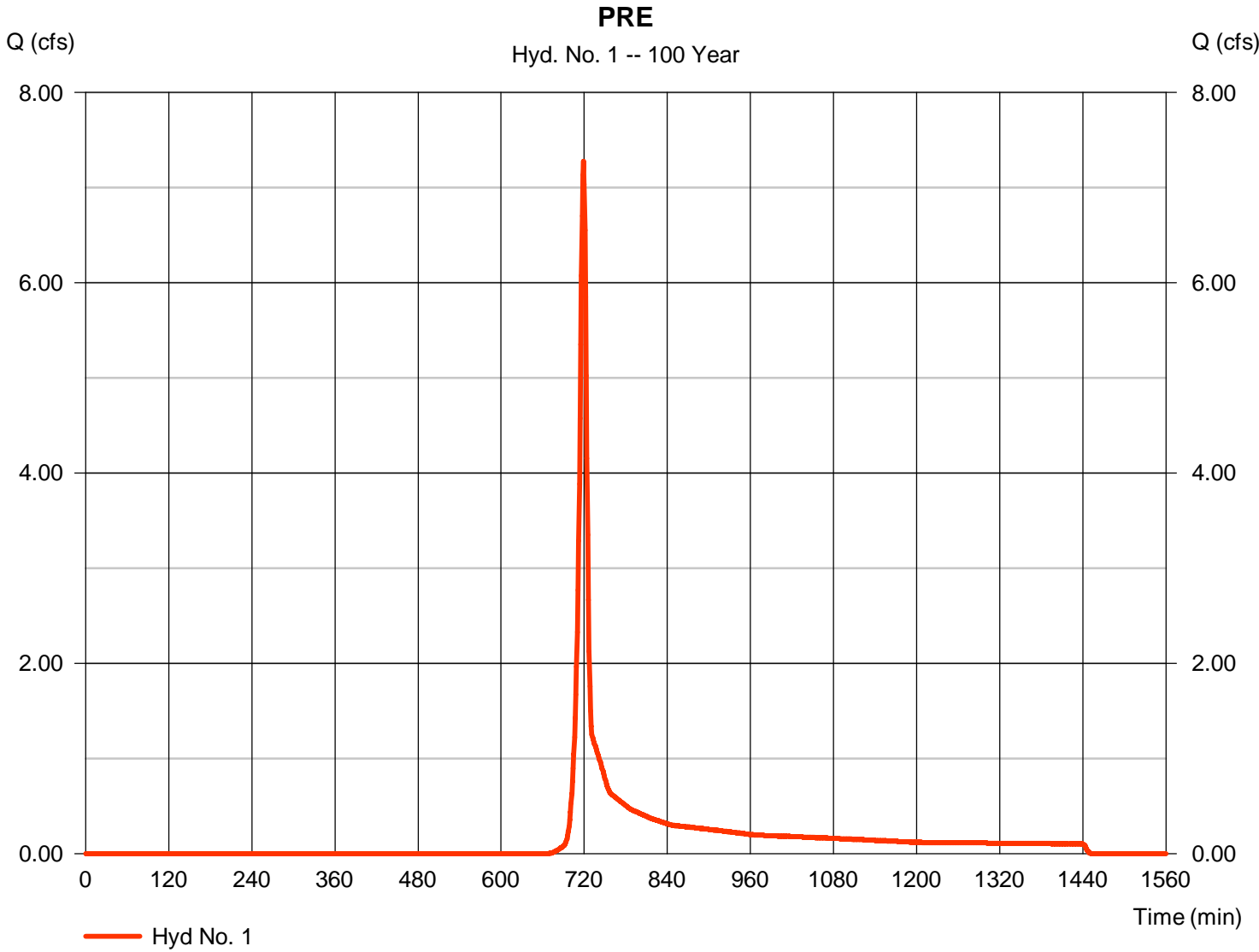
Monday, 01 / 23 / 2017

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 7.280 cfs
Storm frequency	= 100 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 15,675 cuft
Drainage area	= 2.530 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(2.530 x 58)] / 2.530



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 5.79	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.84</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 5.84</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 671.00	0.00	0.00	
Watercourse slope (%)	= 15.66	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.38	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.75</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.75</b>
<b>Channel Flow</b>				
X sectional flow area (sqft)	= 16.00	0.00	0.00	
Wetted perimeter (ft)	= 28.00	0.00	0.00	
Channel slope (%)	= 0.56	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=5.11	0.00	0.00	
Flow length (ft)	140.0	0.0	0.0	
<b>Travel Time (min)</b>	<b>= 0.46</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.46</b>
<b>Total Travel Time, Tc .....</b>				<b>8.10 min</b>

# Hydrograph Report

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

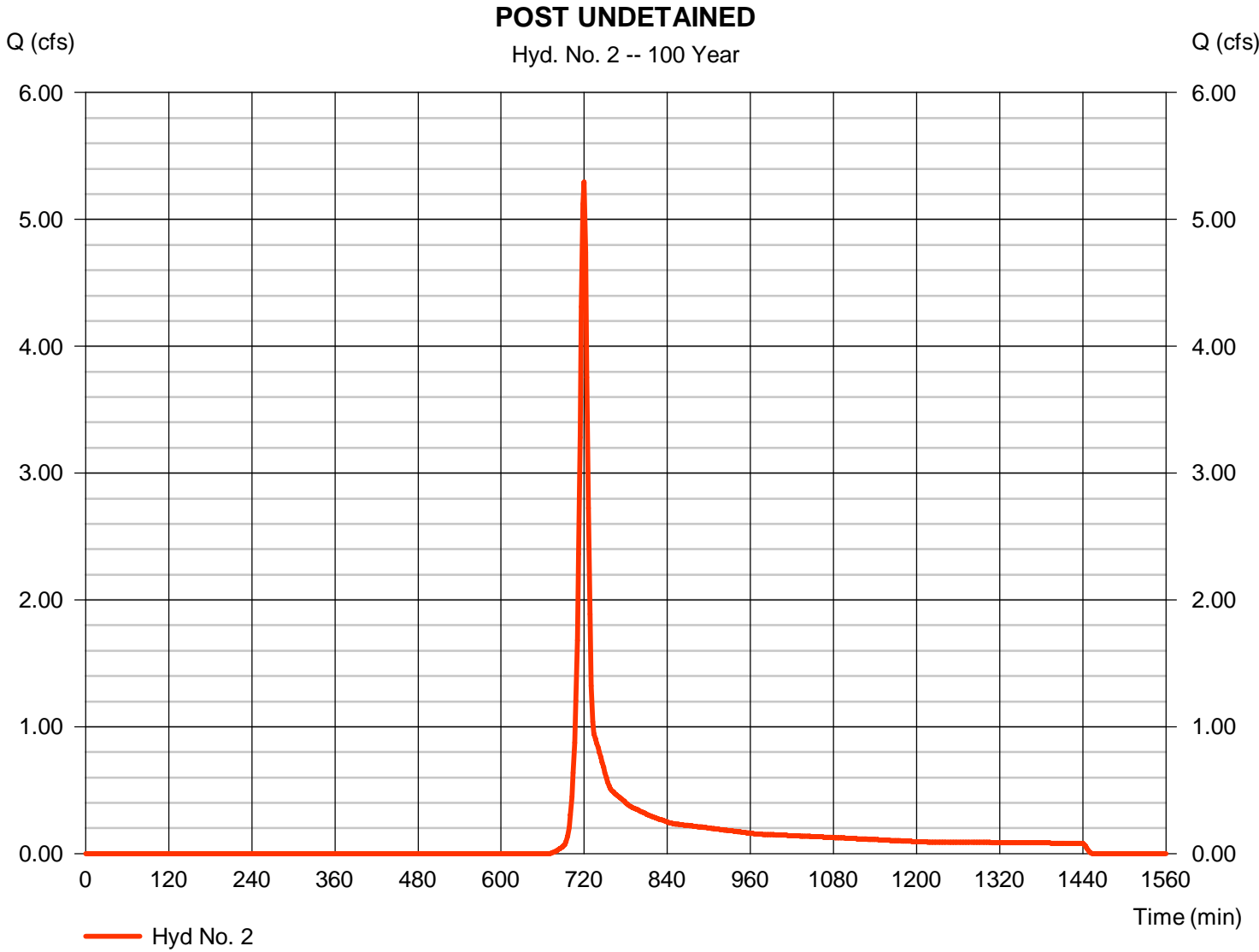
Monday, 01 / 23 / 2017

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 5.297 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 12,391 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.69	0.00	0.00	
Land slope (%)	= 7.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 5.42</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 5.42</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 422.00	43.00	0.00	
Watercourse slope (%)	= 16.00	9.30	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.45	6.20	0.00	
<b>Travel Time (min)</b>	<b>= 1.09</b>	<b>+ 0.12</b>	<b>+ 0.00</b>	<b>= 1.21</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>6.60 min</b>



# Hydrograph Report

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

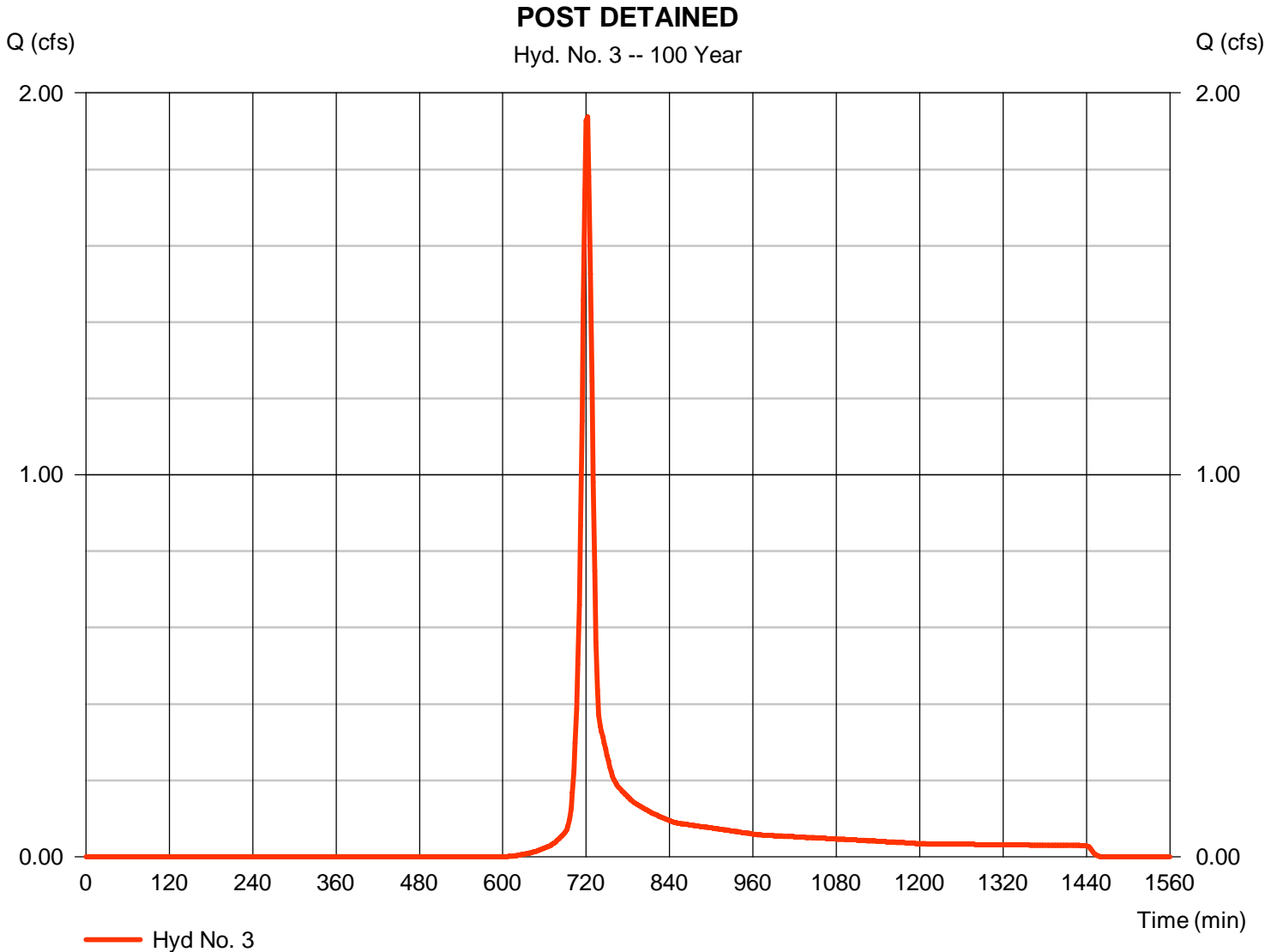
Monday, 01 / 23 / 2017

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.937 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 5,089 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.09 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



# Hydrograph Report

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

Monday, 01 / 23 / 2017

## Hyd. No. 4

POST AT POI

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Time interval = 2 min  
Inflow hyds. = 2, 3

Peak discharge = 7.224 cfs  
Time to peak = 720 min  
Hyd. volume = 17,481 cuft  
Contrib. drain. area = 2.530 ac

