BUSH RD

WORKSHEET 1. GENERAL SITE INFORMATION

Date:	October 3, 2016
Project Name:	Bush Road
Municipality:	Loyalhanna Township
County:	Westmoreland
Total Area (acres):	5.17
Major River Basin:	Ohio River
Watershed:	Loyalhanna Creek
Sub Basin:	Trib 43288 of Loyalhanna Creek
Nearest Surface Water to Receive Runoff:	UNT to Loyalhanna Creek
Ch. 93 - Designated Water Use:	WWF

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	
	NO	X

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.

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

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

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			
Floodplains			
Riparian Areas			
Wetlands			
Woodlands			
Natural Drainage Ways			
Steep Slopes, 15% - 25%			
Steep Slopes, over 25%			
Other:	Yes	5.17	4.39
Other:			
TOTAL EXISTING:	Yes	5.17	4.39

WORKSHEET 3. NONSTRUCTURAL BMP CREDITS

PROTECED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2) 4.39 **Ac.**

1.2 Area of Riparian Forest Buffer Protection 0 **Ac.**

3.1 Area of Minimum Disturbance/Reduced Grading 0 **Ac.**

TOTAL 4.39 **Ac.**

Site Area	minus	Protected Area	=	Stormwater Management Area
5.17	-	4.39	=	0.78
				This is the area that requires stormwater management

VOLUME CREDITS

3.1 Minimum Soil Compaction

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

Meadow _____ ft^2 x 1/3 in x 1/12 = _____ **ft^3**

3.3 Protected Existing Trees

For trees within 100 feet of impervious area:

Tree canopy _____ ft^2 x 1/2 in x 1/12 = _____ **ft^3**

5.1 Disconnect Roof Leaders to Vegetated Areas

For runoff directed to areas protected under 5.8.1 and 5.8.2

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

For all other disconnected roof areas

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

5.2 Disconnect Non-Roof impervious to Vegetated Areas

For runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Areas _____ ft^2 x 1/3 in x 1/12 = _____ **ft^3**

For all other disconnected roof areas

Impervious Areas _____ ft^2 x 1/4 in x 1/12 = _____ **ft^3**

TOTAL NON-STRUCTURAL VOLUME CREDIT* _____ **ft^3**

** For use on Workseet 5*

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

PROJECT: Bush Road
Drainage Area: 5.17 acres
2-Year Rainfall: 2.45 in

Total Site Area: 5.17 acres
Protected Site Area: 4.39 acres
Managed Site Area: 0.78 acres

Existing Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff [1] (in)	Runoff Volume[2] (ft^3)
Meadow	C/D	26136	0.60	78	2.82	0.56	0.76	1,646
Woods	C/D	4356	0.10	77	2.99	0.60	0.71	257
Meadow (20% Gravel)	C/D	697	0.02	78	2.82	0.56	0.76	44
Existing Gravel (80%)	C/D	2788	0.06	90	1.11	0.22	1.49	345
TOTAL:		**33,977**	**0.78**					**2,293**

Developed Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff [1] (in)	Runoff Volume[2] (ft^3)
Meadow	C/D	27443	0.63	78	2.82	0.56	0.76	1,728
Gravel - Impervious	C/D	6534	0.15	90	1.11	0.22	1.49	809
TOTAL:		**33,977**	**0.78**					**2,538**

2-Year Volume Increase (ft^3):	**245**

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

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: Bush Road
SUB-BASIN:

Required Control Volume (ft^3) - *from Worksheet 4:* 245

Non-structural Volume Credit (ft3) - *from Worksheet 3:* - N/A

Structural Volume Reqmt (ft^3) 245
(Required Control Volume minus Non-structural Credit)

	Proposed BMP	Area (ft^2)	Storage Volume (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	2,894	1,745
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 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 Provided (ft^3): 1,745

Structural Volume Requirement (ft^3): 245

DIFFERENCE: -1,500

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 equivalent) "provided across the site" is taken to mean the specifications for that BMP set forward in Sections 5 and 6 are satisfied.

Proposed BMPs from PA Stormwater Best Management Practices Manual Chapter 5 & 6

	Yes	No
Primary BMPs for Nitrate:		
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	

STANDARD WORKSHEET #11
Channel Design Data

PROJECT NAME: Sunoco PA Pipeline Project - PCSMP
LOCATION: Bush Road, Westmoreland County, PA
DONE BY: LMD DATE: 10/3/2016
CHECKED BY: RJM DATE: 10/25/2016

CHANNEL OR CHANNEL SECTION		DD 1	DD 2			
TEMPORARY OR PERMANENT?	(T OR P)	P	P			
DESIGN STORM	(2, 5, 10, OR 100 YR)	100	100			
ACRES	(AC)	2.26	0.76			
MULTIPLIER	(1.6, 2.25, or 2.75)[1]	N/A	N/A			
Q_r (REQUIRED CAPACITY)	(CFS)	11.25	4.00			
Q (CALCULATED AT FLOW DEPTH d)	(CFS)	11.25	4.00			
S (BED SLOPE)[3]	(FT/FT)	0.02	0.06			
DESIGN METHOD FOR PROTECTIVE LINING[5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)		V	V			
PROTECTIVE LINING[2]		NAG P300	NAG P300			
n (MANNING'S COEFFICIENT)[2]		0.050	0.060			
V_a (ALLOWABLE VELOCTY)	(FPS)	5.00	5.00			
V (CALCULATED AT FLOW DEPTH)	(FPS)	3.05	3.07			
t_a (MAX ALLOWABLE SHEAR STRESS)	(LB/FT^2)	N/A	N/A			
t_d (CALC'D SHEAR STRESS AT FLOW DEPTH d)	(LB/FT^2)	N/A	N/A			
CHANNEL BOTTOM WIDTH	(FT)	1	1			
CHANNEL LEFT SIDE SLOPE	(_LH:1V)	2	2			
CHANNEL RIGHT SIDE SLOPE	(_RH:1V)	2	2			
D (TOTAL DEPTH)	(FT)	2.00	1.50			
CHANNEL TOP WIDTH @ D	(FT)	9.00	7.00			
d (CALCULATED FLOW DEPTH)	(FT)	1.13	0.60			
CHANNEL TOP WIDTH @ FLOW DEPTH d	(FT)	5.52	3.40			
BOTTOM WIDTH : FLOW DEPTH RATIO	(12:1 MAX)	0.88	1.67			
d_{50} STONE SIZE	(IN)	N/A	N/A			
A (CROSS-SECTIONAL AREA)	(SQ. FT.)	3.68	1.32			
R (HYDRAULIC RADIUS)		0.61	0.36			
S_c (CRITICAL SLOPE)	(FT/FT)	0.047	0.080			
$.7S_c$	(FT/FT)	0.033	0.056			
$1.3S_c$	(FT/FT)	0.061	0.104			
STABLE FLOW?	(Y/N)	Y	Y			
FREEBOARD BASED ON UNSTABLE FLOW	(FT)	N/A	N/A			
FREEBOARD BASED ON STABLE FLOW	(FT)	0.87	0.90			
MINIMUM REQUIRED FREEBOARD[4]		0.5	0.5			

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft or 1/4 Total Channel Depth, whichever is greater.,
5. Permissible velocity lining design methods is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

PCSM - DESIGN CALCULATIONS
BUSH RD

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By:	LMD	Date:	10/3/2016	Subject:	Sunoco PA Pipeline Project	Sheet No.:	of
Chkd. By:	RJM	Date:	1/29/2017		Bush Road	Proj. No.:	112IC05958

Post Construction Stormwater Management Plan - Design Calculations
Bush Road

PURPOSE

The purpose of these calculations is to design a Post-Construction Stormwater Management (PCSM) Plan for the Bush Road Block Valve Site as part of the Sunoco Pipeline L.P. Pennsylvania Pipeline Project. The Bush Road Block Valve Site is located in Loyalhanna Township,Westmoreland County, PA. Permanent stormwater controls will be developed to satisfy PADEP and local stormwater control regulations. (*No applicable Act 167 or local regulations*)

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).

Chapter 3 of the BMP Manual, Stormwater Management Principles and Recommended Control Guidelines, outlines the recommended control guidelines referenced for this design, as follows:

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 project will utilize an infiltration berm 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 1-year through 100-year events (at minimum); as necessary, provide additional peak rate control as required by applicable and approved Act 167 plans. *(No applicable Act 167 Plans)*

This project will utilize infiltration berms to manage the one-year through 100-year peak rate increases. These BMPs, in conjunction with diversion channels and collection channels, will also help to increase the time of concentration.

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 PCSM Package.

Loading Ratio

In general, the following Loading Ratio guidelines are recommended:
• Maximum Impervious Loading Ratio of 5:1 relating impervious drainage area to infiltration area.

Disturbed Area

To meet PADEP PCSM Worksheet 10 guidelines, 90% of the disturbed area must be contained by BMP's.

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RAINFALL DEPTHS

SCS Storms: Storm routing for all storm events will be performed using the TR-55 SCS method with a 24-hour, Type II rainfall distribution. The following depths were obtained from the NOAA Point Precipitation Frequency Estimates for the site (Reference #6, Attachment A):

Storm Frequency	Depth (Inches)
2-yr	2.45
10-yr	3.44
50-yr	4.59
100-yr	5.13

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RUNOFF VOLUME CALCULATION

2-YEAR DESIGN STORM RUNOFF VOLUME

The change in runoff volume for a 2-yr storm event will be calculated for the project area.

2-Year Rainfall (P)	2.45	in
Total Site Area :	5.17	acres
Protected Site Area:	4.39	acres
Stormwater Management Area	0.78	acres

Pre-Development Condition within LOD

Cover Type/Condition	Soil Type	Area (ac)	CN	S	Ia	Q (in)	Runoff Volume (cf)
Meadow	C/D	0.60	78	2.82	0.56	0.76	1,646
Woods	C/D	0.10	77	2.99	0.60	0.71	257
Meadow (20% Gravel)	C/D	0.02	78	2.82	0.56	0.76	44
Existing Gravel (80%)	C/D	0.06	90	1.11	0.22	1.49	345
Total		0.78					2,293

Post-Development Condition within LOD

Cover Type/Condition	Soil Type	Area (ac)	CN	S	Ia	Q (in)	Runoff Volume (cf)
Meadow	C/D	0.63	78	2.82	0.56	0.76	1,728
Gravel - Impervious	C/D	0.15	90	1.11	0.22	1.49	809
Total		0.78					2,538

2-Year Volume Increase (cf):	**245**

1. Runoff (in) = $Q = (P - 0.2S)^2 / (P + 0.8S)$ where [eq. 2-3, Ref. #2]

   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.)

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IMPERVIOUS LOADING RATE

	Area (ac)	Area (sf)	
Detained Impervious Area (Gravel & Pavement):	0.15	6534.0	
Maximum Impervous Ratio:	5	:1	
Minimum Infiltration Area (sf):		1306.8	
Design Infiltration Area (sf):		2934.8	
Design Impervious Ratio:	2	:1	OK

TOTAL WATERSHED LOADING RATE

	Area (ac)	Area (sf)	
Detained Watershed Area (to Infiltration BMP):	0.53	23016.5	
Maximum Total Watershed Ratio Ratio:	8	:1	
Minimum Infiltration Area (sf):		2877.1	
Design Infiltration Area (sf):		2934.8	
Design Total Watershed Ratio:	7.8	:1	OK

DISTURBED AREA

To meet Worksheet #10 guidelines, 90% of the disturbed area must be detained by BMP's. The infiltration berm for the Bush Road Block Valve Site will be located along the northern edge of the pad and 90 percent of the disturbed area will be detained by the BMP.

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INFILTRATION RATE

The design infiltration rate is determined from an average of the results within the footprint and approved vicinity of the proposed infiltration berm.

Design Infiltration Rate (in/hr)	**2.3**

VOLUME CALCULATION FOR STRUCTURAL BMPs

INFILTRATION BERM

Storage Volume

Width (ft)	Length (ft)	Cross Section Area (sf)	Surface Area (sf)	Depth to Overflow (ft)	Storage Volume (cf)
49.9	58	50.6	2,894	2.00	2935

Note: The Ponding Area is an irregular shape. The Width and Length are average measurements to obtain plan area.

VOLUME CREDIT FOR STRUCTURAL BMPs

The Volume Credit for each structural BMP will be the minimum of the follow three volumes: Runoff to BMP from a 2 year-24 hour storm event, Storage Volume of the BMP, Infiltration Volume of the BMP within 72 hours.

Infiltration BMP	2-Year Runoff Volume (cf)	Storage Volume (cf)	Infiltration Volume - 72 Hours (cf)	Structural Volume Credit (cf)
Infiltration Berm	1745	2935	2935	1745
			Total Structural Credit (cf) (Worksheet 5)	**1745**

Note: The Infiltration Volume is capped by the Storage Volume of the BMP.

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WATERSHED CHARACTERISTICS

The total watershed area for the project site is 5.17 acres. Based upon the soil survey of Westmoreland County, Pennsylvania (Ref. #3, Attachment B), the primary soil types within the watershed area are of the Ernest silt loam (ErC), Gilpin channery silt loam (GcD), Gilpin-Rock outcrop complex (GoF), and Wharton silt loam (WrC) series which are primarily classified as HSG C/D, C, C, and C/D, respectively. See the project drawings for watershed mapping.

Pre-Development Condition

Hydrologic Group	Soil Name	Cover Description	Curve Number	Area (acres)
C	GcD	Woods	70	0.82
C/D	WrC	Woods	77	0.07
C/D	WrC	Meadow	78	1.91
C/D	ErC	Woods	77	0.32
C/D	ErC	Existing Gravel (80%)	91	0.06
C/D	ErC	Meadow (20% Gravel)	78	0.02
C/D	ErC	Meadow	78	1.44
C	GoF	Woods	70	0.53
			Totals	5.17

CN	76

Post-Development Condition - Undetained 1

Hydrologic Group	Soil Name	Cover Description	Curve Number	Area (acres)
C/D	ErC	Meadow	78	0.08
C/D	ErC	Gravel - Impervious	91	0.02
			Totals	0.10

CN	81

Post-Development Condition - Undetained 2

Hydrologic Group	Soil Name	Cover Description	Curve Number	Area (acres)
C/D	ErC	Meadow	78	0.73
C/D	ErC	Woods	77	0.18
C	GoF	Woods	70	0.53
			Totals	1.44

CN	75

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Post-Development Condition - Diversion Channel 1

Hydrologic Group	Soil Name	Cover Description	Curve Number	Area (acres)
C	GcD	Woods	70	0.67
C/D	WrC	Woods	77	0.05
C/D	WrC	Meadow	78	1.32
C/D	ErC	Meadow	78	0.22
			Totals	2.26

CN	76

Post-Development Condition - Diversion Channel 2

Hydrologic Group	Soil Name	Cover Description	Curve Number	Area (acres)
C	GcD	Woods	70	0.11
C/D	WrC	Woods	77	0.01
C/D	WrC	Meadow	78	0.47
C/D	ErC	Meadow	78	0.17
			Totals	0.76

CN	77

Post-Development Condition - Detained

Hydrologic Group	Soil Name	Cover Description	Curve Number	Area (acres)
C	GcD	Woods	70	0.03
C/D	WrC	Woods	77	0.01
C/D	WrC	Meadow	78	0.13
C/D	ErC	Woods	77	0.04
C/D	ErC	Meadow	78	0.27
C/D	ErC	Gravel	91	0.13
			Totals	0.61

CN	80

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PEAK FLOW CALCULATIONS

The infiltration berms were designed using the Time of Concentration Adjustment method.

HYDRAULIC PATHS

Times of concentration and travel times were evaluated for the pre-development condition as well as post-development conditions (Ref. #2). TR55 methodology was used to determine the Tc as presented in the AutoCAD Civil 3D Hydraflow Hydrographs computer output (Attachment C).

TIME OF CONCENTRATION ADJUSTMENT

The 'Peak Flow for Post-Dev. at the BMP (cfs)' is calculated from the BMP watershed with the Point of Interest at the BMP. The 'Volume Control BMP Storage' is the minimum value of the runoff volume to the BMP or the BMP Storage Volume.

Storm Event (Yr.)	Peak Flow Post-Dev. At the BMP (cfs)	Volume Control BMP Storage (cf)	Additional Residence Time (min.)	Post Development Time of Concentration (w/o BMPs) (min.)	Adjusted Time Of Concentration (min.)
2	0.76	1,745	38.3	6.9	45.2
10	1.40	2,935	35.0	6.9	41.9
50	2.20	2,935	22.2	6.9	29.1
100	2.59	2,935	18.9	6.9	25.8

$$Additional\ Residence\ Time\ (min.) = \frac{Storage\ Volume\ (cf)}{Peak\ Flow\ {}^{W}/_{O}\ BMP} * \frac{1\ min}{60\ sec}$$

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STORMWATER POND ROUTING

The computer program AutoCAD Civil 3D Hydraflow Hydrographs extension (Reference #7) was used to calculate the peak runoff during the pre-development conditions, post-development conditions without BMPs, and post-development conditions with BMPs. The peak discharge for each condition was calculated for the 2-yr, 10-yr, 50-yr, and 100-yr - 24-hr storm events. The following table summarizes the peak discharges for all conditions and the resulting changes. As demonstrated by the table, all the post-development conditions with BMPs produced discharges that were less than the peak runoffs from the pre-development conditions. Hydraflow documentation is included in Attachment C.

	Pre-Development	**Post-Development**			
Storm Frequency	**Peak Runoff (cfs)**	**Peak Outflow (No BMP) (cfs)**	**Watershed Runoff Vol. (with BMPs) (cf)**	**Peak Outflow (with BMP) (cfs)**	**Change (cfs)**
2-yr	5.55	5.49	12,739	4.80	-0.76
10-yr	11.44	11.32	25,115	10.07	-1.37
50-yr	19.05	18.85	41,567	17.26	-1.79
100-yr	22.83	22.54	49,860	20.87	-1.96

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REFERENCES

1) Erosion and Sediment Pollution Control Program Manual, Pennsylvania Department of Environmental Protection, Office of Water Management, March 2012.

2) Urban Hydrology for Small Watersheds, Technical Release Number 55 (TR-55), United States Department of Agriculture, Soil Conservation Service, 2nd Edition, June 1986.

3) Soil Survey of Westmoreland County, PA, United States Department of Agriculture, Soil Conservation Service, September 2016.

4) Handbook of Hydraulics - Sixth Edition, Brater and King, McGraw-Hill Book Company, 1976.

5) Introduction to Hydraulics and Hydrology with Applications for Stormwater Management - 2nd Edition, Gribbin, Delmar: A Division of Thomson Learning, 2002.

6) NOAA, Point Precipitation Frequency Estimates, Pennsylvania 40.4381 N 79.4349 W 998.4 ft.

7) Hydraflow Hydrographs Extension, AutoCAD Civil 3D, Autodesk, Inc, 2007-2016.

8) Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection, December 2006.

ATTACHMENT A

NOAA PRECIPITATION FREQUENCY ESTIMATES

NOAA Atlas 14, Volume 2, Version 3
Location name: Loyalhanna Twp, Pennsylvania, USA*
Latitude: 40.4381°, Longitude: -79.4349°
Elevation: 998.4 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	0.313 (0.283-0.346)	0.374 (0.338-0.413)	0.452 (0.409-0.499)	0.514 (0.463-0.566)	0.592 (0.533-0.651)	0.652 (0.584-0.716)	0.710 (0.634-0.778)	0.771 (0.685-0.845)	0.851 (0.752-0.932)	0.911 (0.801-0.996)
10-min	0.487 (0.440-0.537)	0.583 (0.527-0.645)	0.703 (0.636-0.776)	0.793 (0.715-0.873)	0.905 (0.815-0.996)	0.988 (0.886-1.09)	1.07 (0.955-1.17)	1.15 (1.02-1.26)	1.25 (1.10-1.37)	1.33 (1.17-1.45)
15-min	0.597 (0.539-0.659)	0.713 (0.645-0.789)	0.863 (0.781-0.953)	0.976 (0.880-1.07)	1.12 (1.01-1.23)	1.22 (1.10-1.34)	1.33 (1.19-1.46)	1.43 (1.27-1.57)	1.56 (1.38-1.71)	1.66 (1.46-1.81)
30-min	0.790 (0.713-0.871)	0.954 (0.863-1.05)	1.18 (1.07-1.30)	1.35 (1.22-1.49)	1.58 (1.42-1.74)	1.75 (1.57-1.92)	1.92 (1.71-2.10)	2.09 (1.86-2.29)	2.31 (2.04-2.53)	2.48 (2.19-2.72)
60-min	0.964 (0.871-1.06)	1.17 (1.06-1.29)	1.48 (1.34-1.64)	1.72 (1.55-1.90)	2.05 (1.84-2.25)	2.30 (2.06-2.53)	2.56 (2.29-2.81)	2.83 (2.52-3.10)	3.20 (2.83-3.50)	3.49 (3.07-3.82)
2-hr	1.12 (1.02-1.23)	1.36 (1.24-1.49)	1.72 (1.56-1.88)	2.00 (1.81-2.19)	2.38 (2.16-2.61)	2.70 (2.43-2.94)	3.02 (2.71-3.29)	3.36 (3.00-3.65)	3.83 (3.40-4.16)	4.21 (3.71-4.56)
3-hr	1.20 (1.09-1.31)	1.45 (1.32-1.59)	1.82 (1.65-2.00)	2.12 (1.92-2.33)	2.53 (2.29-2.77)	2.88 (2.59-3.14)	3.23 (2.89-3.52)	3.60 (3.21-3.92)	4.13 (3.65-4.48)	4.55 (3.99-4.93)
6-hr	1.43 (1.30-1.59)	1.72 (1.57-1.92)	2.15 (1.95-2.38)	2.50 (2.26-2.76)	2.99 (2.70-3.30)	3.40 (3.06-3.74)	3.83 (3.42-4.21)	4.29 (3.80-4.70)	4.94 (4.34-5.40)	5.47 (4.76-5.96)
12-hr	1.72 (1.56-1.91)	2.06 (1.87-2.29)	2.55 (2.31-2.83)	2.95 (2.67-3.27)	3.54 (3.18-3.90)	4.02 (3.60-4.42)	4.54 (4.03-4.98)	5.09 (4.49-5.57)	5.89 (5.14-6.43)	6.55 (5.67-7.13)
24-hr	2.05 (1.91-2.22)	2.45 (2.27-2.65)	2.99 (2.77-3.24)	3.44 (3.18-3.72)	4.07 (3.75-4.39)	4.59 (4.22-4.94)	5.13 (4.70-5.51)	5.70 (5.19-6.11)	6.50 (5.88-6.96)	7.15 (6.43-7.65)
2-day	2.39 (2.22-2.58)	2.84 (2.65-3.07)	3.45 (3.21-3.72)	3.94 (3.65-4.25)	4.62 (4.28-4.97)	5.17 (4.77-5.56)	5.74 (5.27-6.16)	6.33 (5.79-6.78)	7.15 (6.50-7.64)	7.80 (7.05-8.33)
3-day	2.57 (2.40-2.76)	3.05 (2.85-3.28)	3.67 (3.42-3.94)	4.17 (3.88-4.47)	4.86 (4.52-5.21)	5.42 (5.02-5.80)	6.00 (5.54-6.41)	6.59 (6.07-7.03)	7.41 (6.77-7.89)	8.05 (7.32-8.57)
4-day	2.75 (2.57-2.94)	3.25 (3.05-3.48)	3.88 (3.64-4.15)	4.40 (4.12-4.70)	5.11 (4.77-5.44)	5.68 (5.28-6.04)	6.26 (5.80-6.66)	6.86 (6.33-7.29)	7.67 (7.05-8.14)	8.30 (7.60-8.81)
7-day	3.29 (3.10-3.50)	3.88 (3.65-4.13)	4.58 (4.31-4.87)	5.13 (4.82-5.46)	5.89 (5.52-6.25)	6.48 (6.06-6.88)	7.08 (6.60-7.50)	7.68 (7.14-8.13)	8.47 (7.85-8.97)	9.08 (8.38-9.60)
10-day	3.80 (3.60-4.01)	4.47 (4.24-4.73)	5.23 (4.95-5.52)	5.82 (5.51-6.15)	6.62 (6.25-6.99)	7.24 (6.83-7.64)	7.86 (7.39-8.28)	8.48 (7.94-8.92)	9.29 (8.66-9.77)	9.89 (9.20-10.4)
20-day	5.33 (5.06-5.62)	6.25 (5.94-6.59)	7.20 (6.84-7.60)	7.95 (7.55-8.39)	8.94 (8.47-9.41)	9.69 (9.18-10.2)	10.4 (9.85-11.0)	11.1 (10.5-11.7)	12.1 (11.3-12.7)	12.7 (11.9-13.4)
30-day	6.72 (6.41-7.05)	7.85 (7.49-8.25)	8.96 (8.55-9.42)	9.84 (9.37-10.3)	11.0 (10.5-11.5)	11.8 (11.3-12.4)	12.7 (12.0-13.3)	13.5 (12.8-14.1)	14.5 (13.7-15.2)	15.2 (14.4-16.0)
45-day	8.61 (8.24-9.01)	10.0 (9.60-10.5)	11.3 (10.8-11.9)	12.3 (11.8-12.9)	13.6 (13.0-14.2)	14.5 (13.9-15.2)	15.4 (14.7-16.1)	16.2 (15.4-17.0)	17.2 (16.4-18.0)	18.0 (17.0-18.8)
60-day	10.4 (9.97-10.8)	12.1 (11.6-12.6)	13.5 (13.0-14.1)	14.6 (14.0-15.3)	16.0 (15.3-16.7)	17.0 (16.3-17.8)	17.9 (17.2-18.7)	18.8 (18.0-19.6)	19.8 (18.9-20.7)	20.6 (19.6-21.5)

[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.

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ATTACHMENT B

USDA SOILS MAP & PROPERTIES

United States Department of Agriculture

NRCS

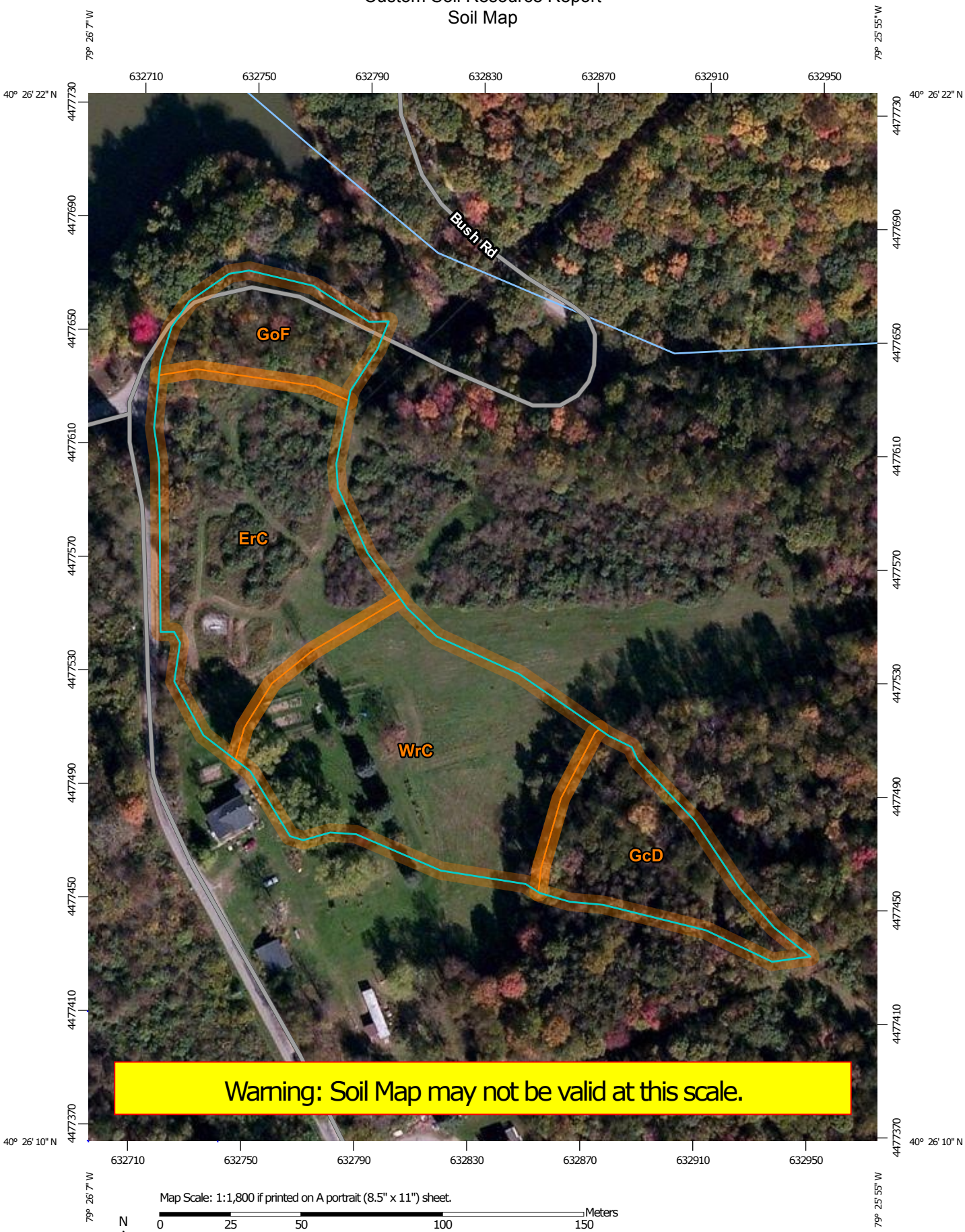
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Westmoreland County, Pennsylvania

October 20, 2016

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,800 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Westmoreland County, Pennsylvania
Survey Area Data: Version 9, Nov 16, 2015

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

Date(s) aerial images were photographed: Mar 27, 2011—Oct 9, 2011

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

Map Unit Legend

Westmoreland County, Pennsylvania (PA129)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
ErC	Ernest silt loam, 8 to 15 percent slopes	1.9	35.8%
GcD	Gilpin channery silt loam, 15 to 25 percent slopes	0.8	15.6%
GoF	Gilpin-Rock outcrop complex, 45 to 100 percent slopes	0.6	10.9%
WrC	Wharton silt loam, 8 to 15 percent slopes	2.0	37.7%
Totals for Area of Interest		**5.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic

classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Westmoreland County, Pennsylvania

ErC—Ernest silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: l8qm
Elevation: 900 to 1,800 feet
Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 41 to 62 degrees F
Frost-free period: 130 to 160 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ernest and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ernest

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Acid fine-loamy colluvium derived from shale and siltstone

Typical profile

Ap - 0 to 8 inches: silt loam
Bt - 8 to 24 inches: silty clay loam
Btx - 24 to 50 inches: channery silt loam
C - 50 to 74 inches: channery silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.33 in/hr)
Depth to water table: About 17 to 22 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Brinkerton

Percent of map unit: 5 percent
Landform: Draws, hills

Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

Gilpin

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Lobdell

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

GcD—Gilpin channery silt loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2t1kv
Elevation: 790 to 3,120 feet
Mean annual precipitation: 39 to 61 inches
Mean annual air temperature: 46 to 53 degrees F
Frost-free period: 161 to 181 days
Farmland classification: Not prime farmland

Map Unit Composition

Gilpin and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gilpin

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Acid fine-loamy residuum weathered from shale and siltstone

Typical profile

Ap - 0 to 8 inches: channery silt loam
Bt - 8 to 24 inches: channery silt loam

C - 24 to 30 inches: extremely channery loam
R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 30 to 36 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Weikert

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wharton

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

GoF—Gilpin-Rock outcrop complex, 45 to 100 percent slopes

Map Unit Setting

National map unit symbol: l8rr
Elevation: 480 to 3,000 feet
Mean annual precipitation: 30 to 65 inches
Mean annual air temperature: 41 to 62 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Gilpin and similar soils: 45 percent
Rock outcrop: 20 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gilpin

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Acid fine-loamy residuum weathered from shale and siltstone

Typical profile

Oi - 0 to 0 inches: slightly decomposed plant material
Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: channery silt loam
Bt - 6 to 24 inches: channery silt loam
C - 24 to 30 inches: very channery loam
R - 30 to 35 inches: bedrock

Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hillslopes
Landform position (three-dimensional): Free face
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydric soil rating: No

Minor Components

Shelocta

Percent of map unit: 15 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ernest

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Weikert

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

WrC—Wharton silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t5mm
Elevation: 620 to 2,160 feet
Mean annual precipitation: 37 to 51 inches
Mean annual air temperature: 47 to 53 degrees F
Frost-free period: 161 to 205 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Wharton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wharton

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, shoulder

Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Fine-loamy residuum weathered from shale and siltstone

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1 - 9 to 16 inches: silt loam
Bt2 - 16 to 22 inches: silt loam
Bt3 - 22 to 31 inches: silt loam
BC - 31 to 46 inches: silty clay loam
C - 46 to 69 inches: channery silty clay loam
Cr - 69 to 79 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 40 to 71 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: About 16 to 28 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Gilpin

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Rarden

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Ernest

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave

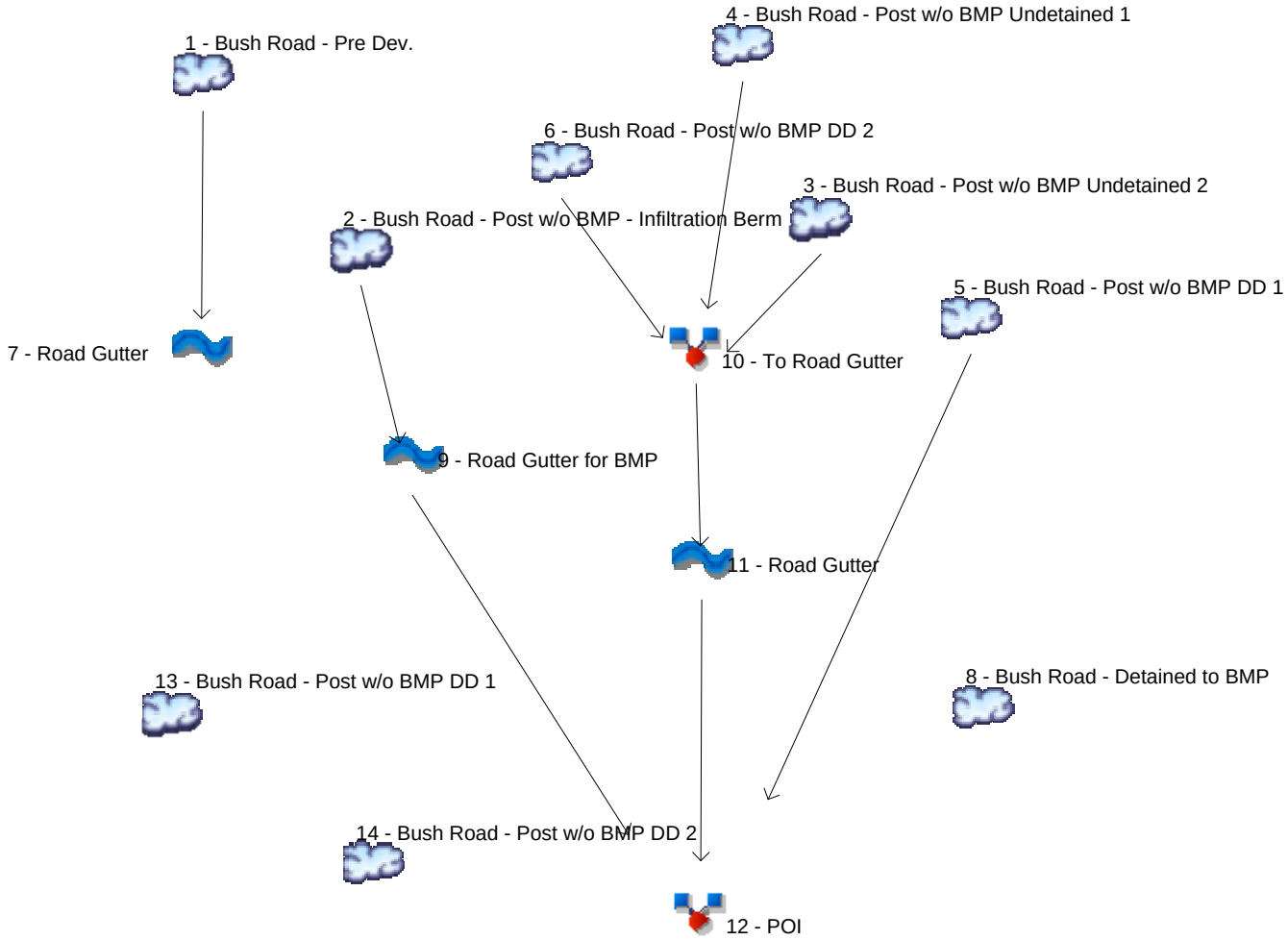
Across-slope shape: Concave
Hydric soil rating: No

ATTACHMENT C
BUSH RD
HYDRAFLOW RESULTS

ATTACHMENT C-1
BUSH RD
2 Year-24 Hour Storm

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	5.591	1	719	12,159	------	------	------	Bush Road - Pre Dev.
2	SCS Runoff	0.870	1	719	1,845	------	------	------	Bush Road - Post w/o BMP - Infiltratio
3	SCS Runoff	1.441	1	719	3,168	------	------	------	Bush Road - Post w/o BMP Undetain
4	SCS Runoff	0.152	1	719	321	------	------	------	Bush Road - Post w/o BMP Undetain
5	SCS Runoff	2.314	1	720	5,451	------	------	------	Bush Road - Post w/o BMP DD 1
6	SCS Runoff	0.885	1	719	1,908	------	------	------	Bush Road - Post w/o BMP DD 2
7	Reach	5.552	1	720	12,158	1	------	------	Road Gutter
8	SCS Runoff	0.760	2	720	1,745	------	------	------	Bush Road - Detained to BMP
9	Reach	0.828	1	721	1,842	2	------	------	Road Gutter for BMP
10	Combine	2.478	1	719	5,396	3, 4, 6,	------	------	To Road Gutter
11	Reach	2.377	1	721	5,395	10	------	------	Road Gutter
12	Combine	5.487	1	720	12,688	5, 9, 11	------	------	POI
13	SCS Runoff	2.721	1	718	5,622	------	------	------	Bush Road - Post w/o BMP DD 1
14	SCS Runoff	0.985	1	718	2,018	------	------	------	Bush Road - Post w/o BMP DD 2

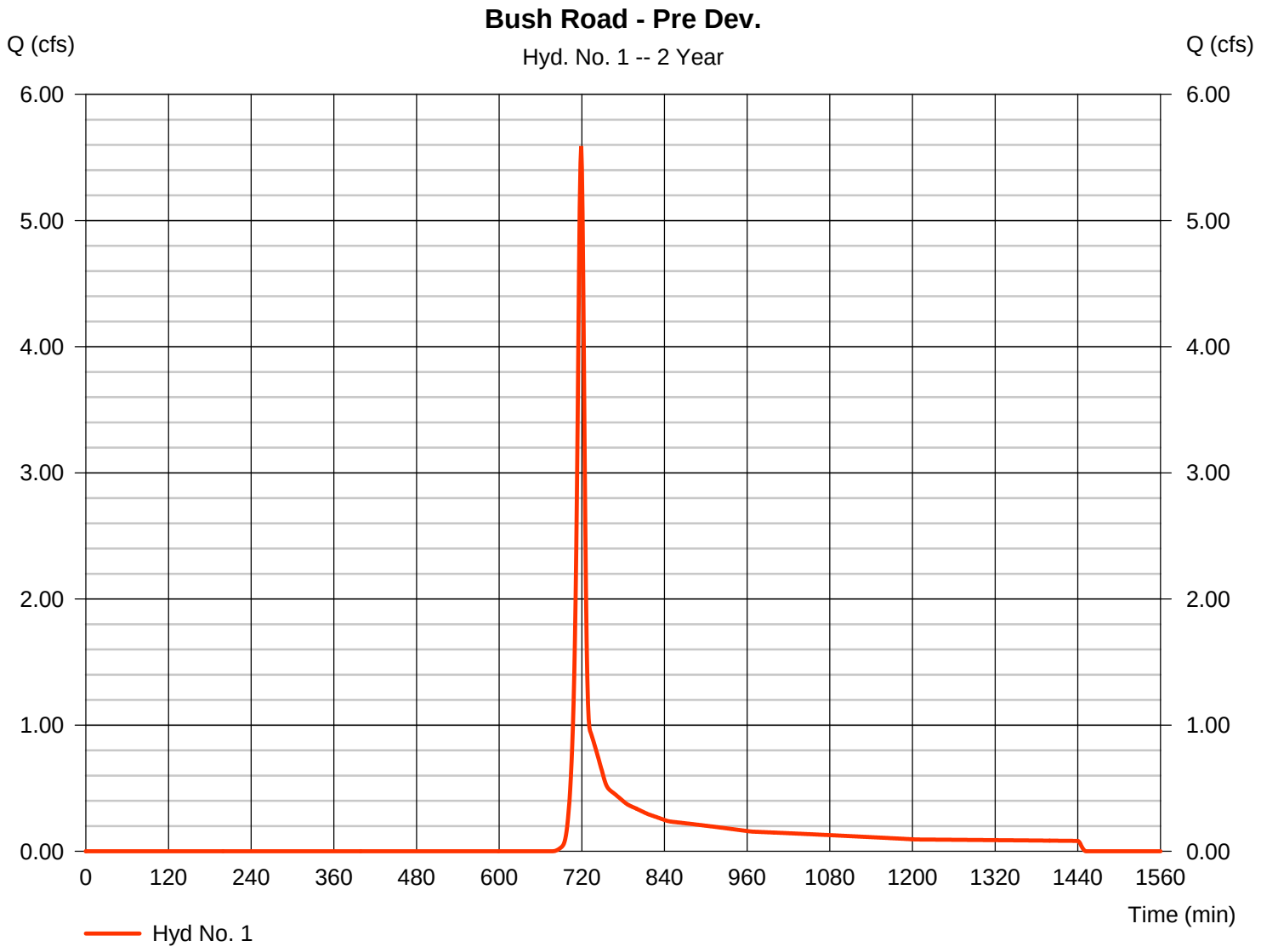
Hydrograph Report

Hyd. No. 1

Bush Road - Pre Dev.

Hydrograph type	= SCS Runoff	Peak discharge	= 5.591 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 12,159 cuft
Drainage area	= 5.170 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.80 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.370 x 78) + (1.350 x 70) + (0.060 x 91) + (0.390 x 77)] / 5.170



TR55 Tc Worksheet

Hyd. No. 1

Bush Road - Pre Dev.

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 243.00		800.00		0.00		
Watercourse slope (%)	= 24.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		5.10		0.00		
Travel Time (min)	**= 0.51**	**+**	**2.61**	**+**	**0.00**	**=**	**3.13**
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 ..... 7.80 min

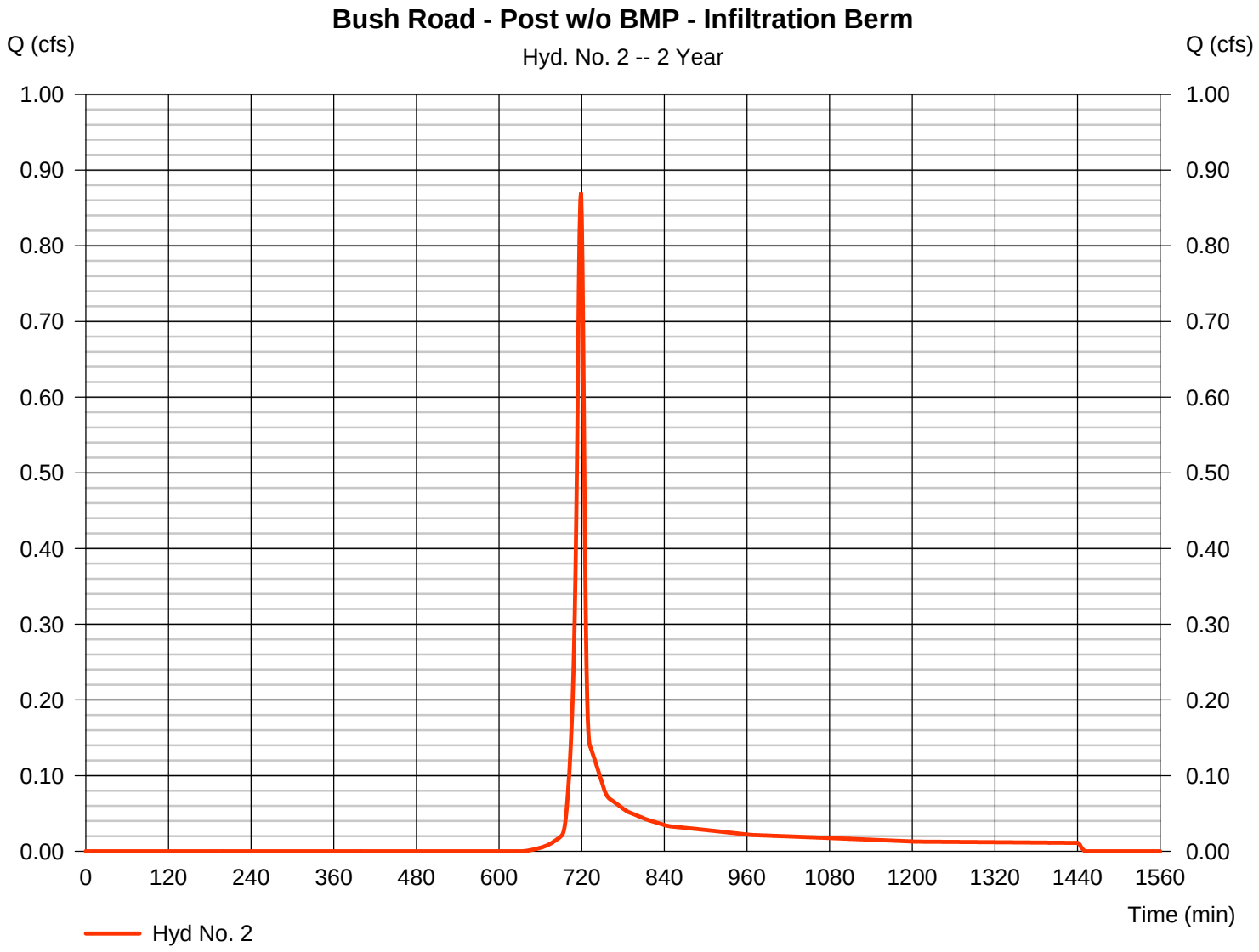
Hydrograph Report

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Hydrograph type	= SCS Runoff	Peak discharge	= 0.870 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 1,845 cuft
Drainage area	= 0.610 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.90 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		629.00		75.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**2.17**	**+**	**0.27**	**=**	**2.79**
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 ..... 6.90 min

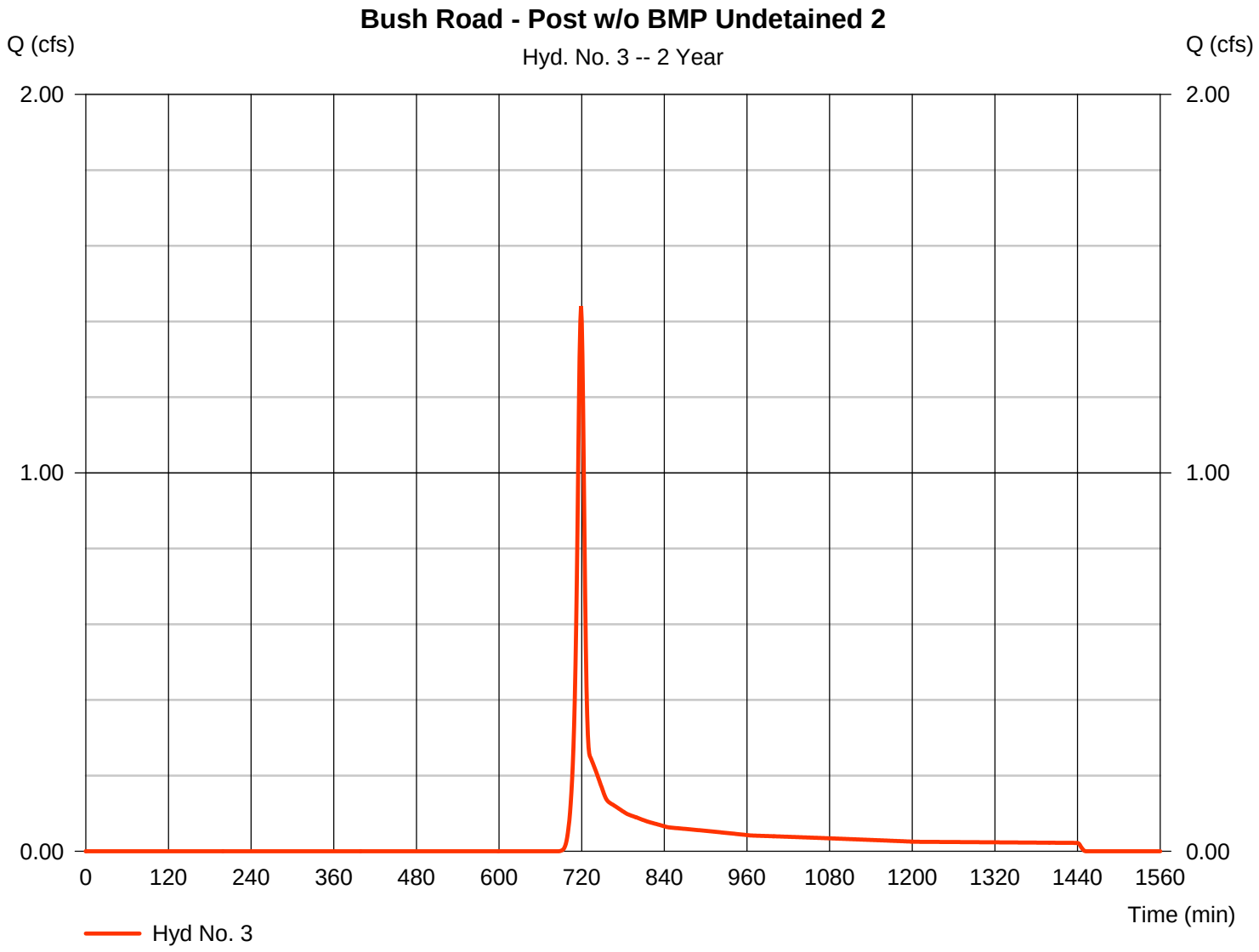
Hydrograph Report

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.441 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 3,168 cuft
Drainage area	= 1.440 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

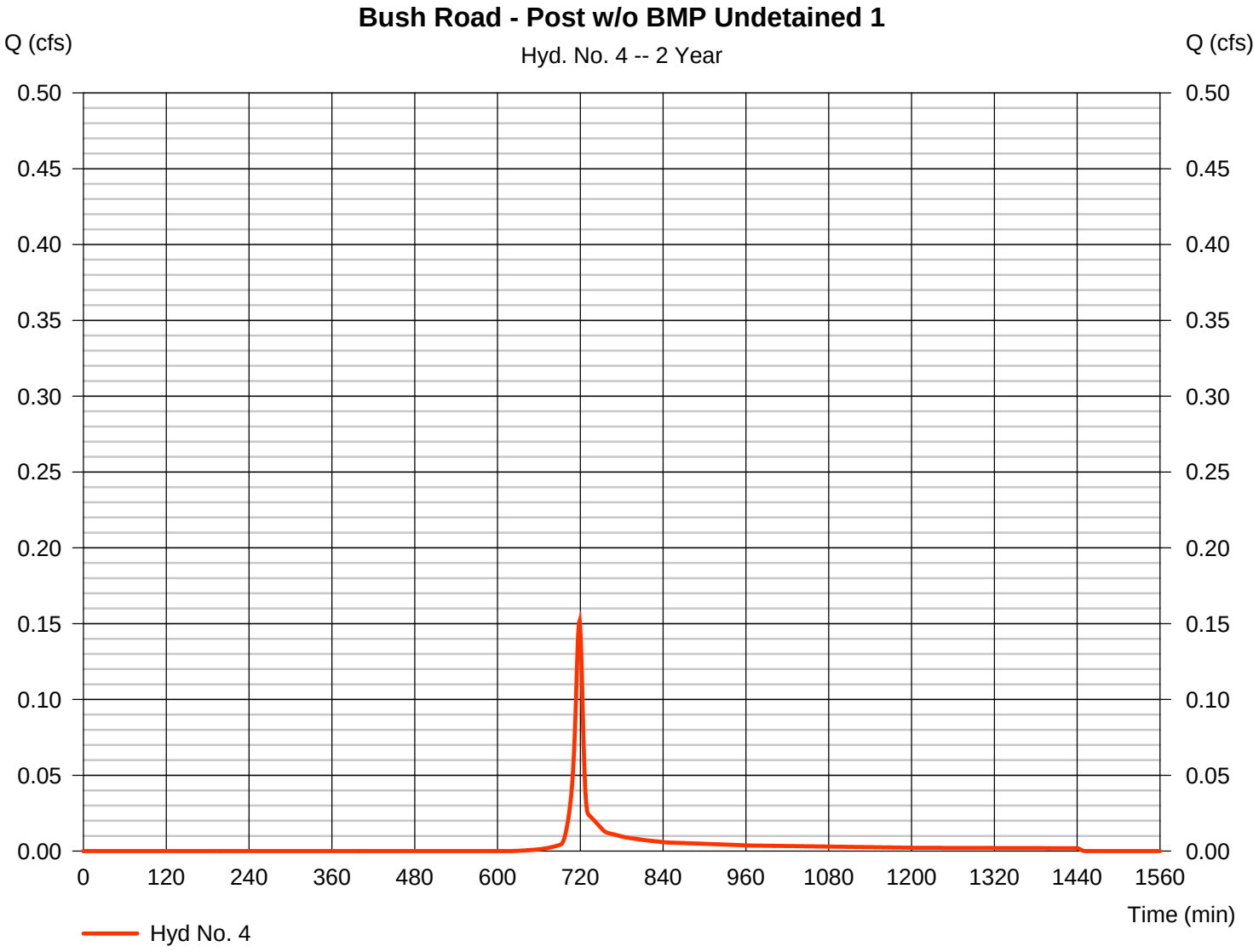
Hydrograph Report

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.152 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 321 cuft
Drainage area	= 0.100 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

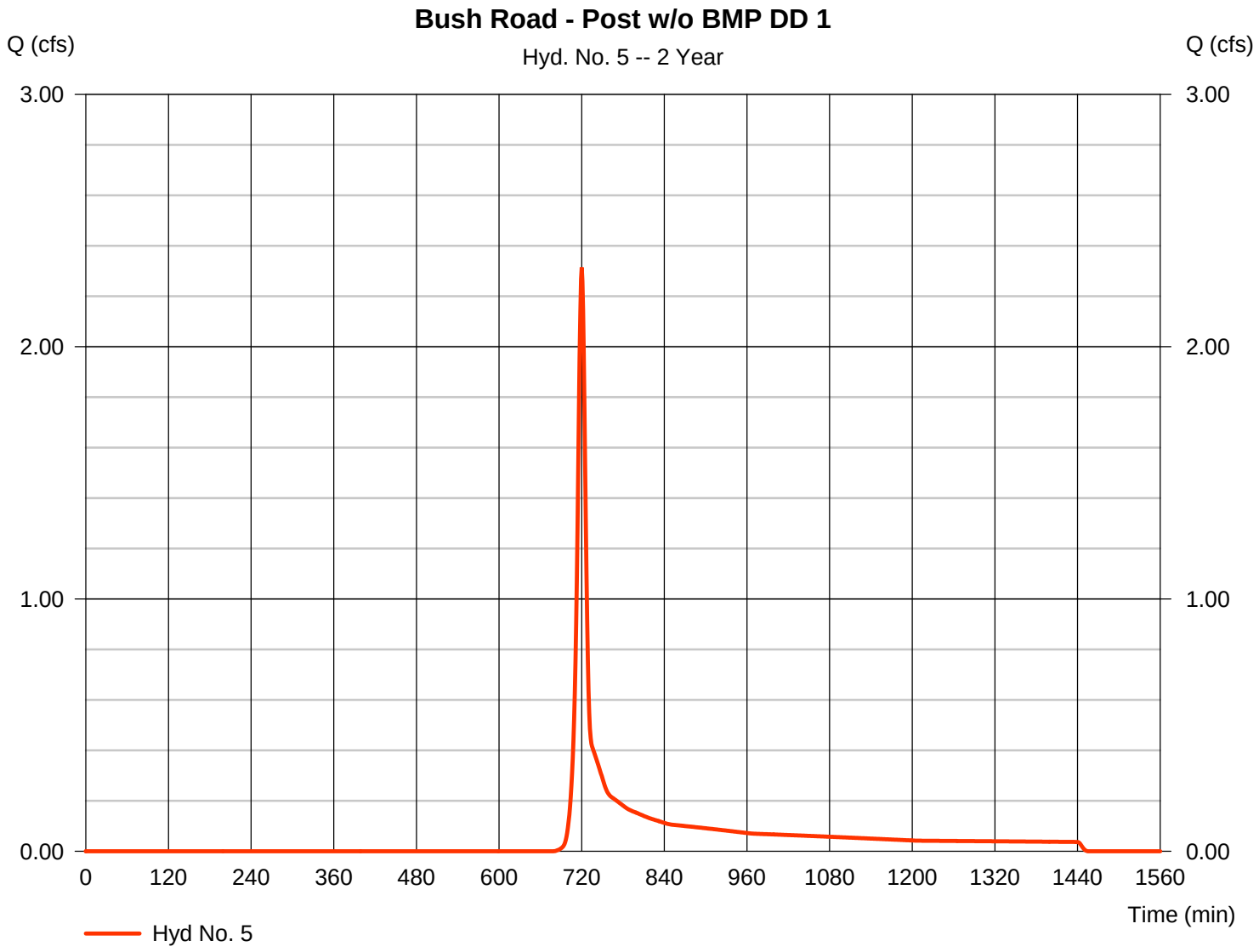
Hydrograph Report

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.314 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	5,451 cuft
Drainage area	=	2.260 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.50 min
Total precip.	=	2.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

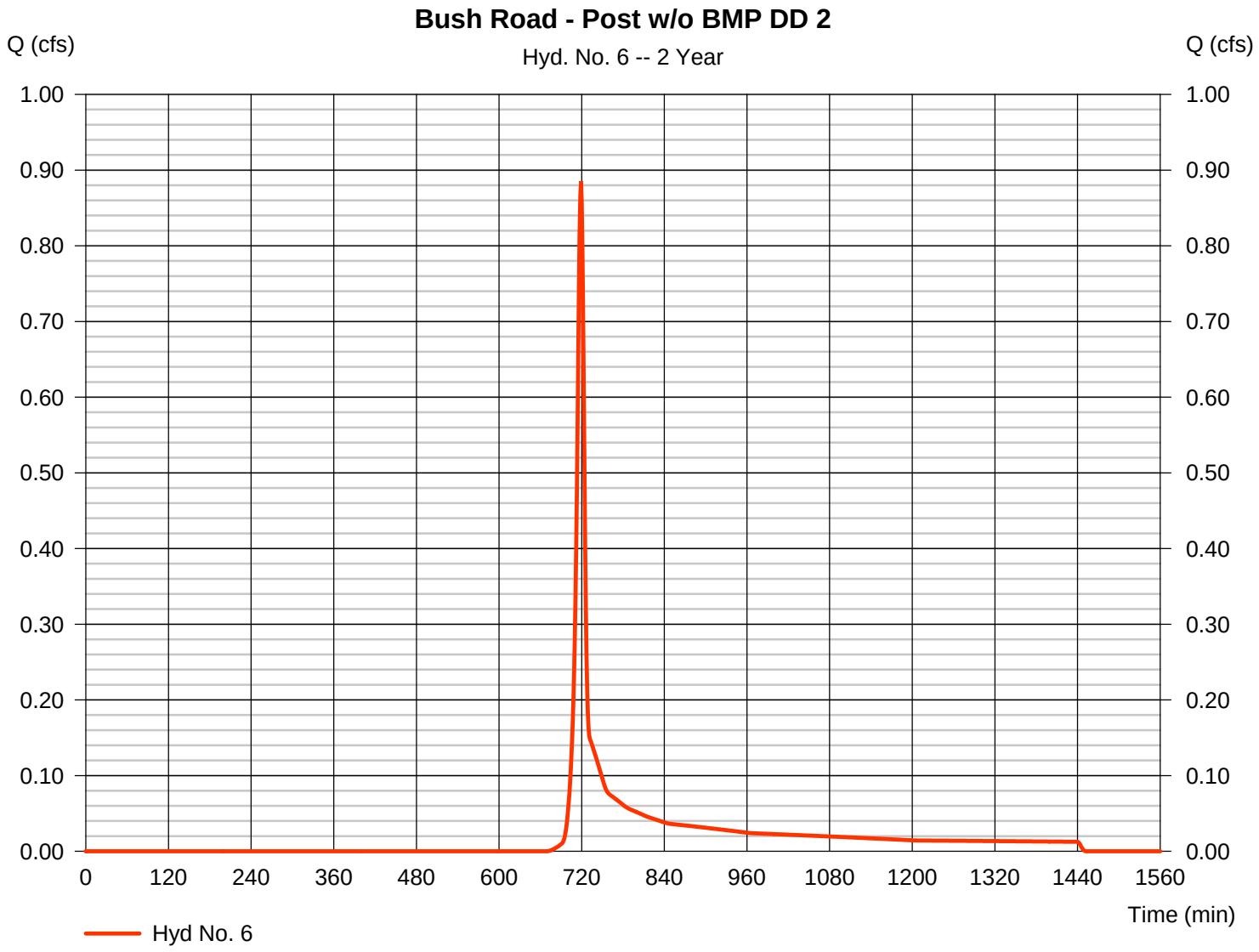
Hydrograph Report

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.885 cfs
Storm frequency	=	2 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	1,908 cuft
Drainage area	=	0.760 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	2.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

Total Travel Time, Tc ..... 6.70 min

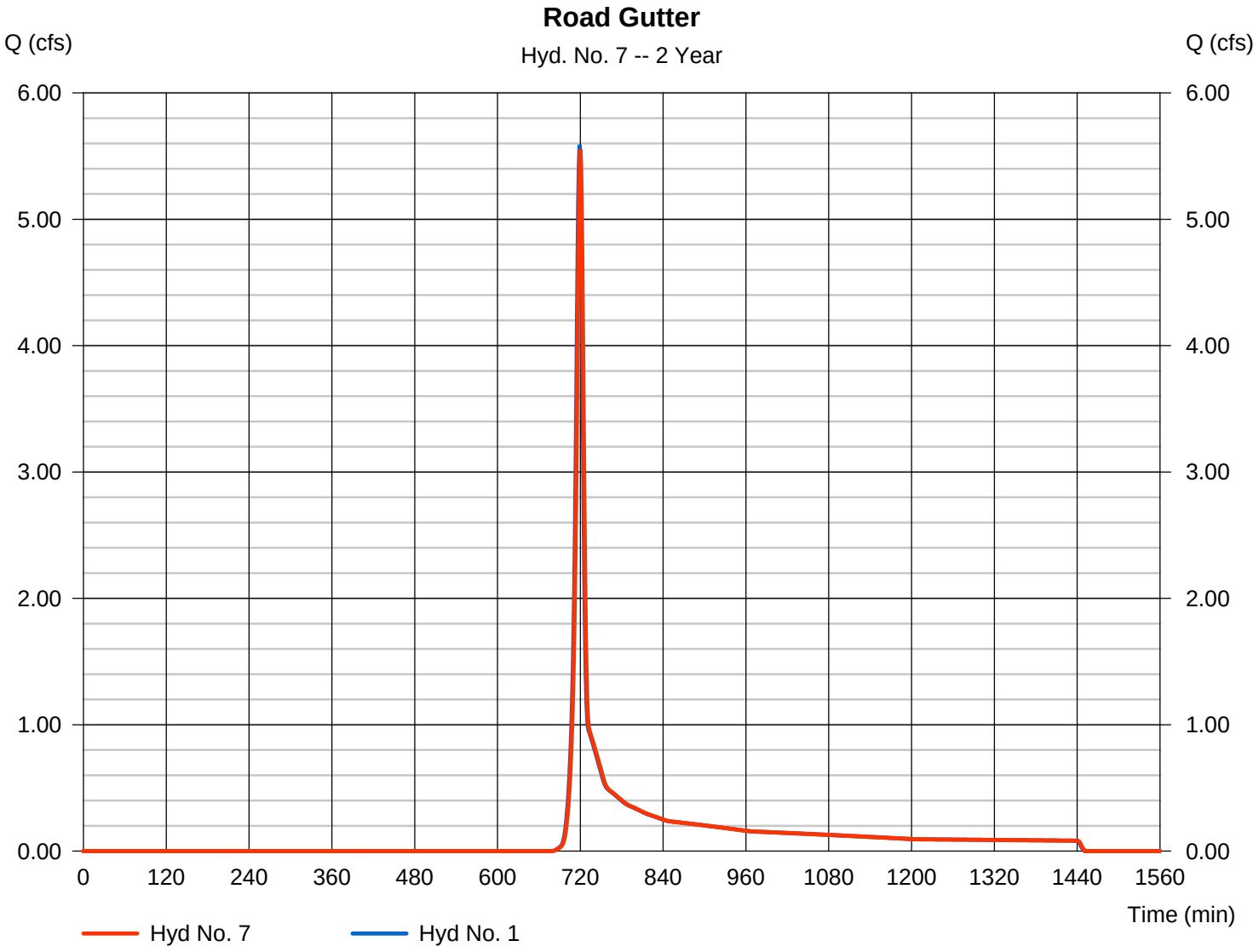
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	5.552 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	12,158 cuft
Inflow hyd. No.	=	1 - Bush Road - Pre Dev.	Section type	=	Triangular
Reach length	=	265.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.308	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.8194

Modified Att-Kin routing method used.



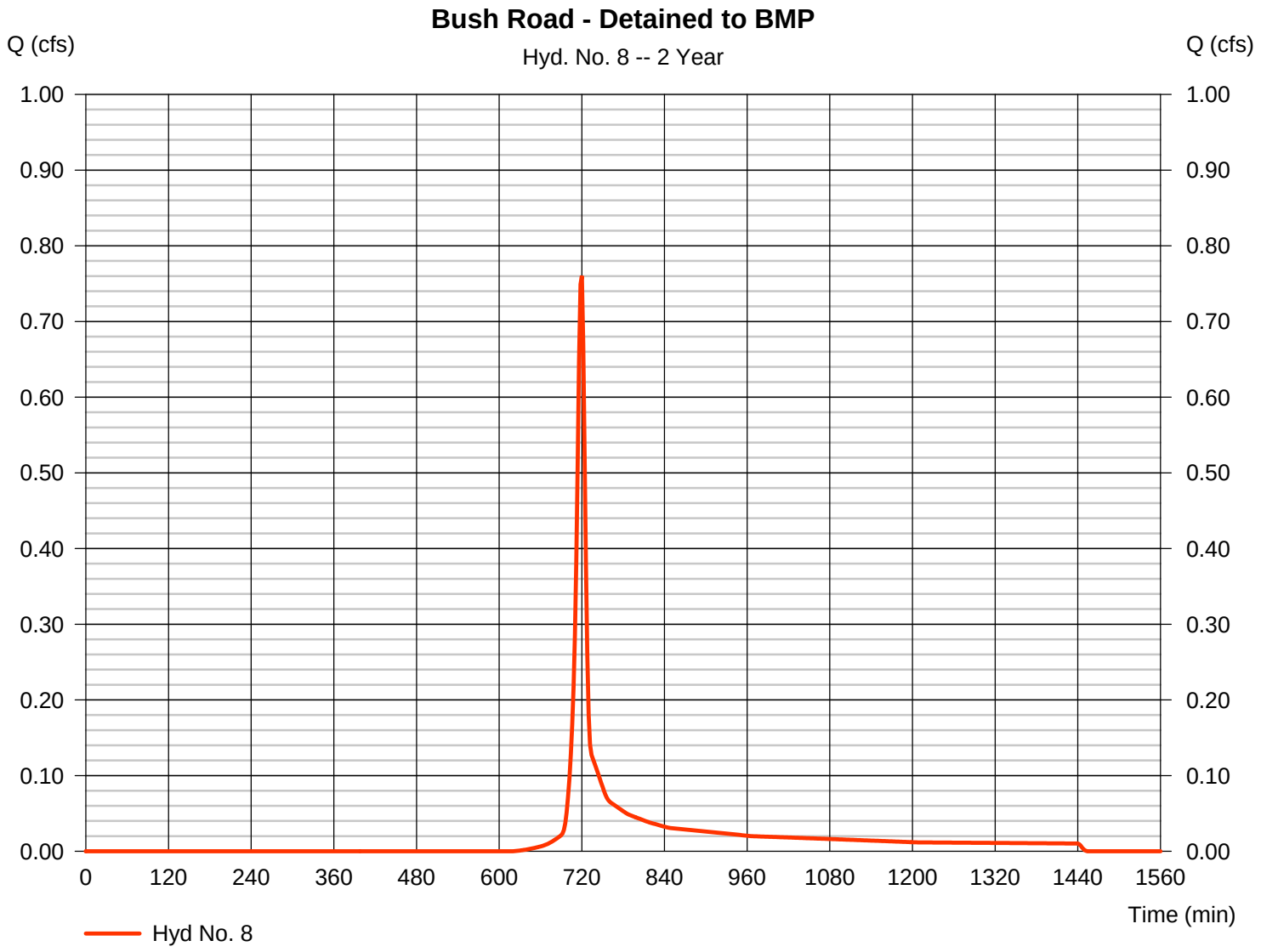
Hydrograph Report

Hyd. No. 8

Bush Road - Detained to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.760 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	1,745 cuft
Drainage area	=	0.530 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	2.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.010 x 77) + (0.360 x 78) + (0.130 x 91)] / 0.530



TR55 Tc Worksheet

Hyd. No. 8

Bush Road - Detained to BMP

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		535.00		70.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**1.84**	**+**	**0.26**	**=**	**2.45**
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 ..... 6.60 min

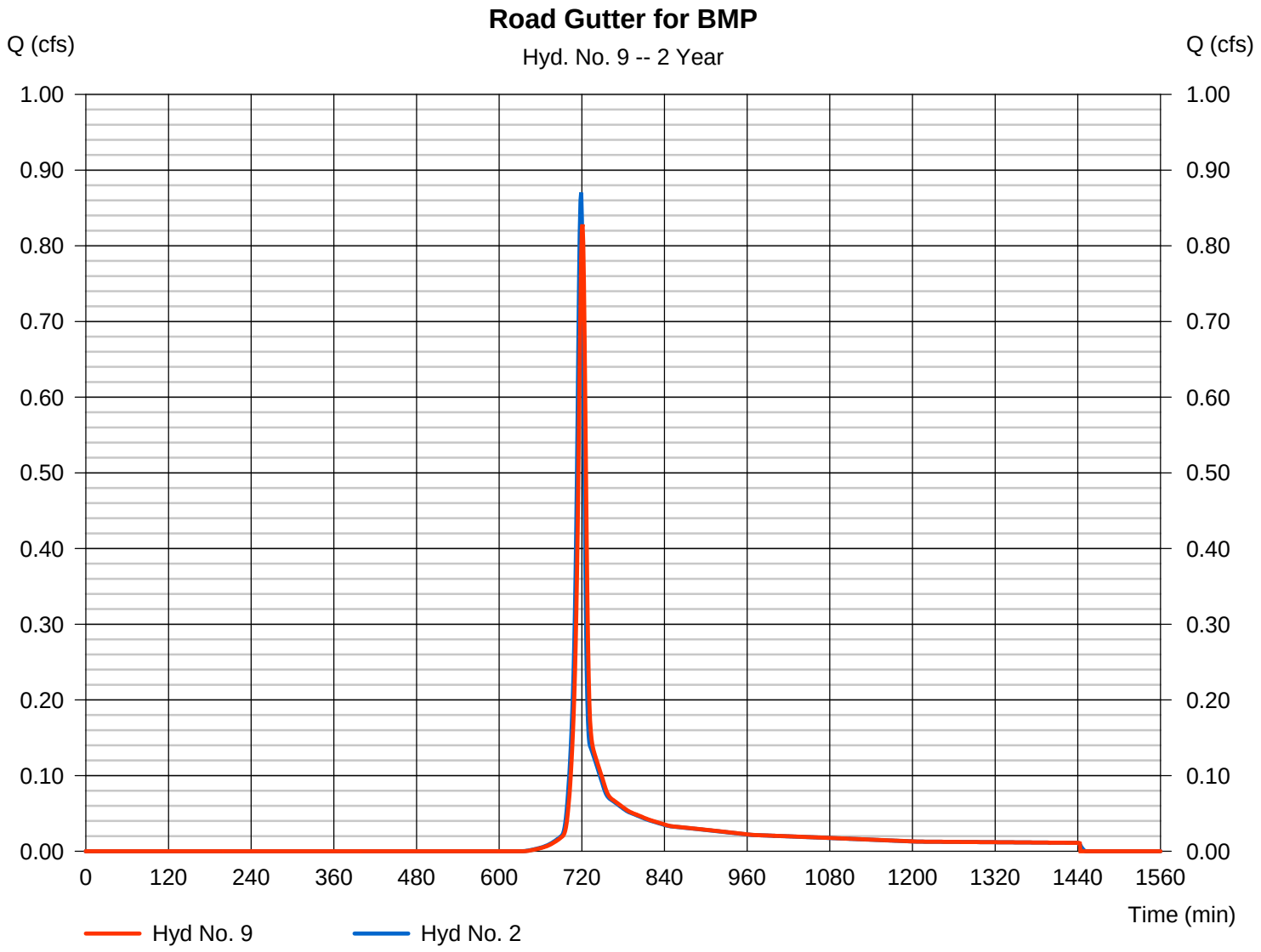
Hydrograph Report

Hyd. No. 9

Road Gutter for BMP

Hydrograph type	=	Reach	Peak discharge	=	0.828 cfs
Storm frequency	=	2 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	1,842 cuft
Inflow hyd. No.	=	2 - Bush Road - Post w/o BMPs	Section type	=	Triangular
Reach length	=	450.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.4448

Modified Att-Kin routing method used.

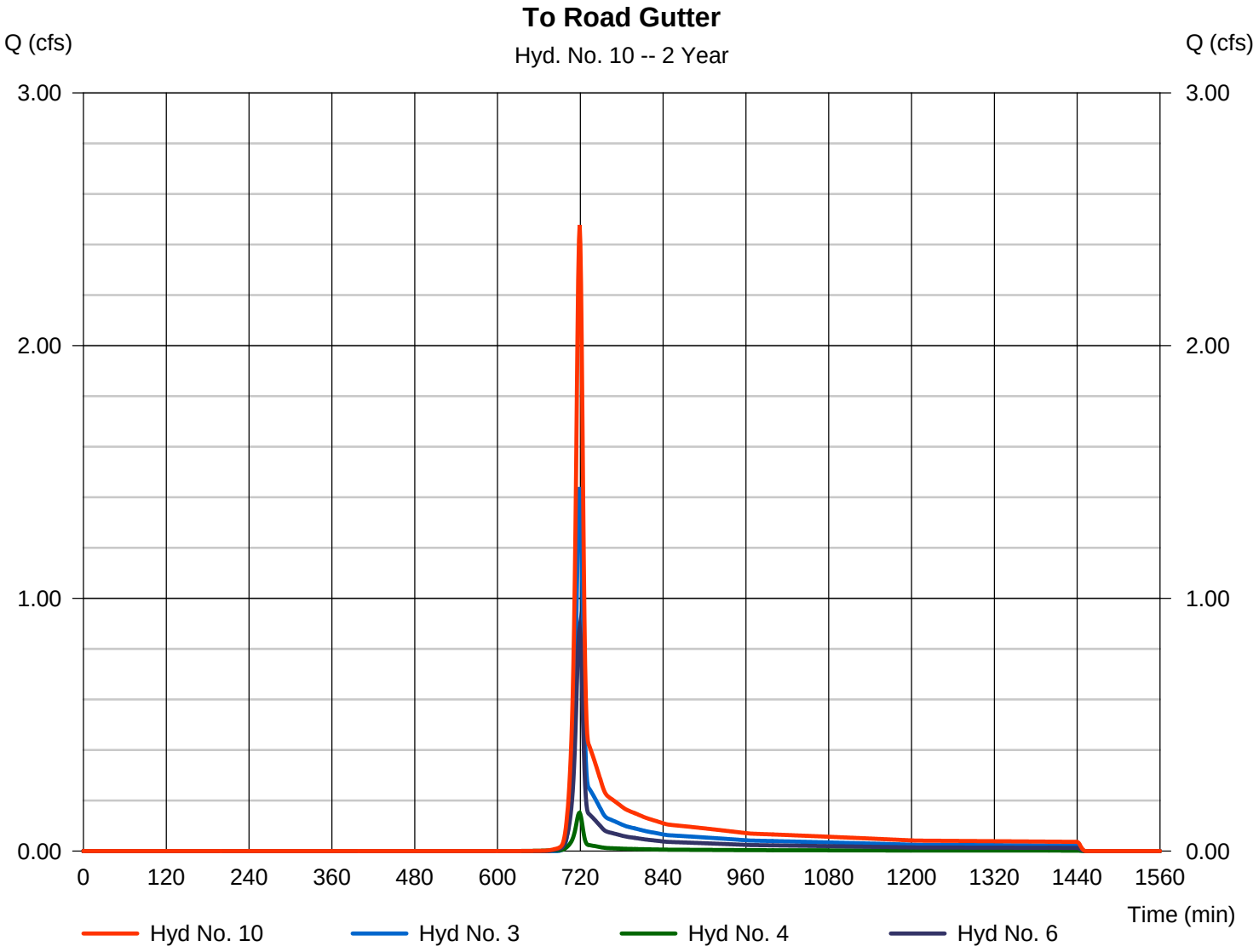


Hydrograph Report

Hyd. No. 10

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 2.478 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 5,396 cuft
Inflow hyds.	= 3, 4, 6	Contrib. drain. area	= 2.300 ac



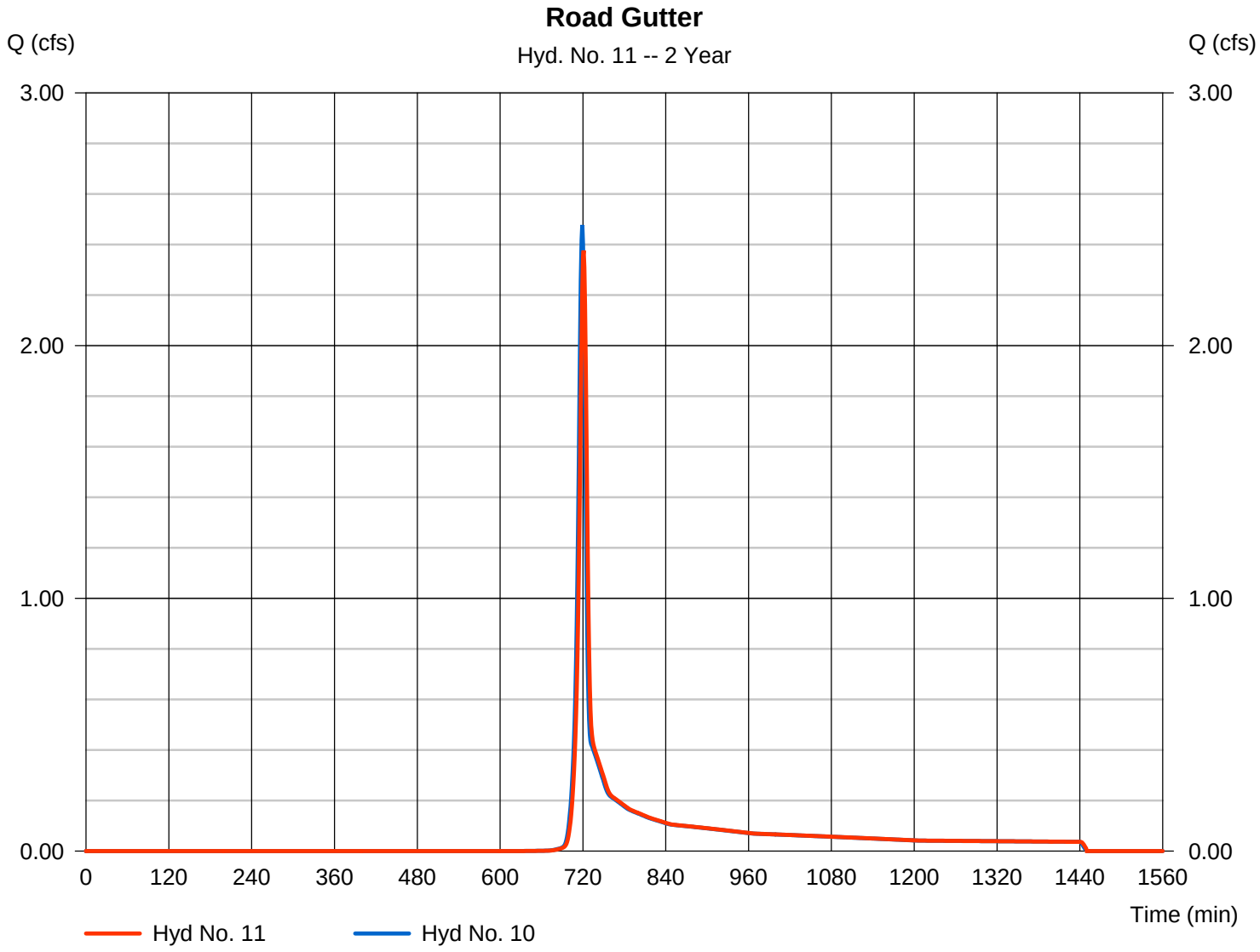
Hydrograph Report

Hyd. No. 11

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	2.377 cfs
Storm frequency	=	2 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	5,395 cuft
Inflow hyd. No.	=	10 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5011

Modified Att-Kin routing method used.

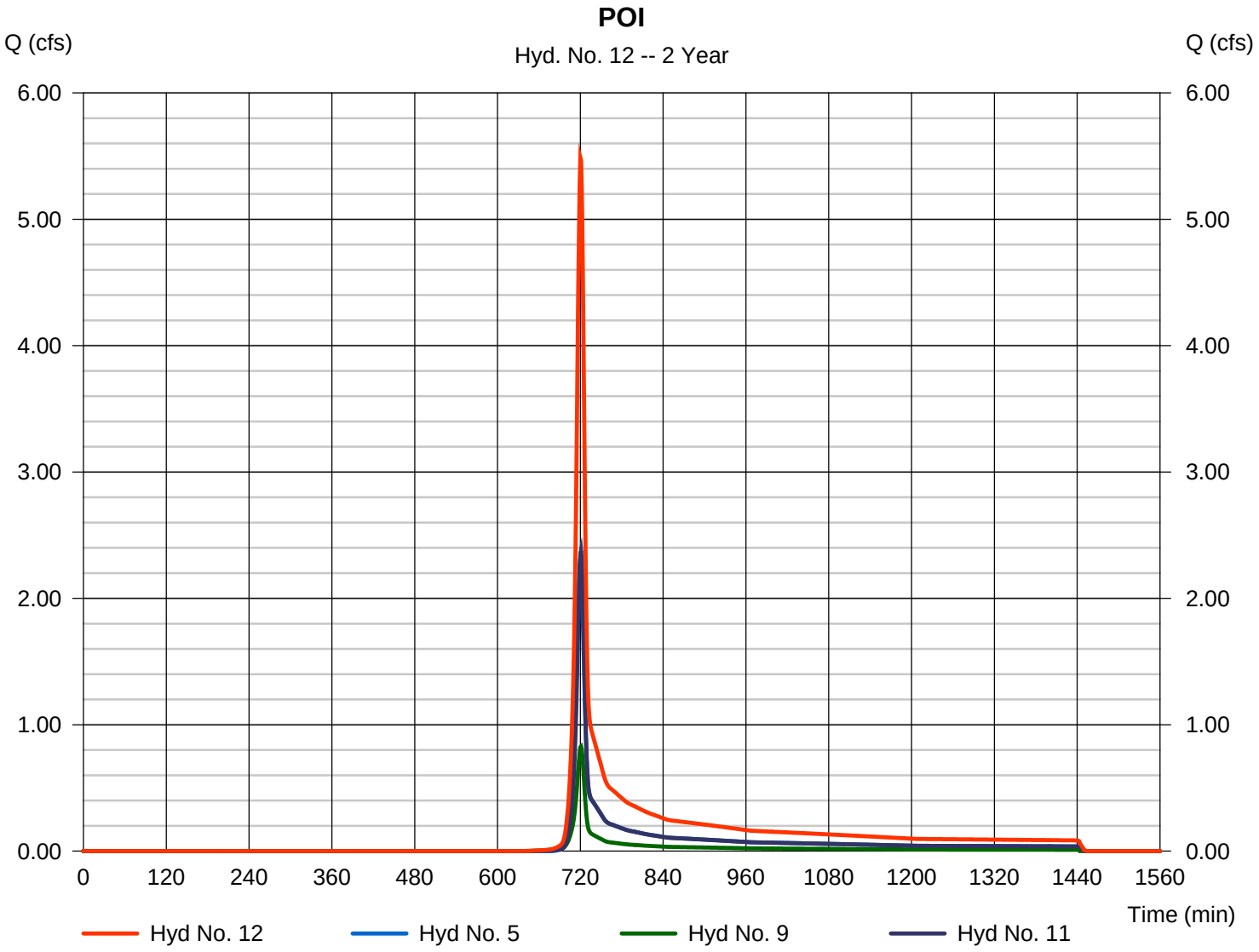


Hydrograph Report

Hyd. No. 12

POI

Hydrograph type	=	Combine	Peak discharge	=	5.487 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	12,688 cuft
Inflow hyds.	=	5, 9, 11	Contrib. drain. area	=	2.260 ac



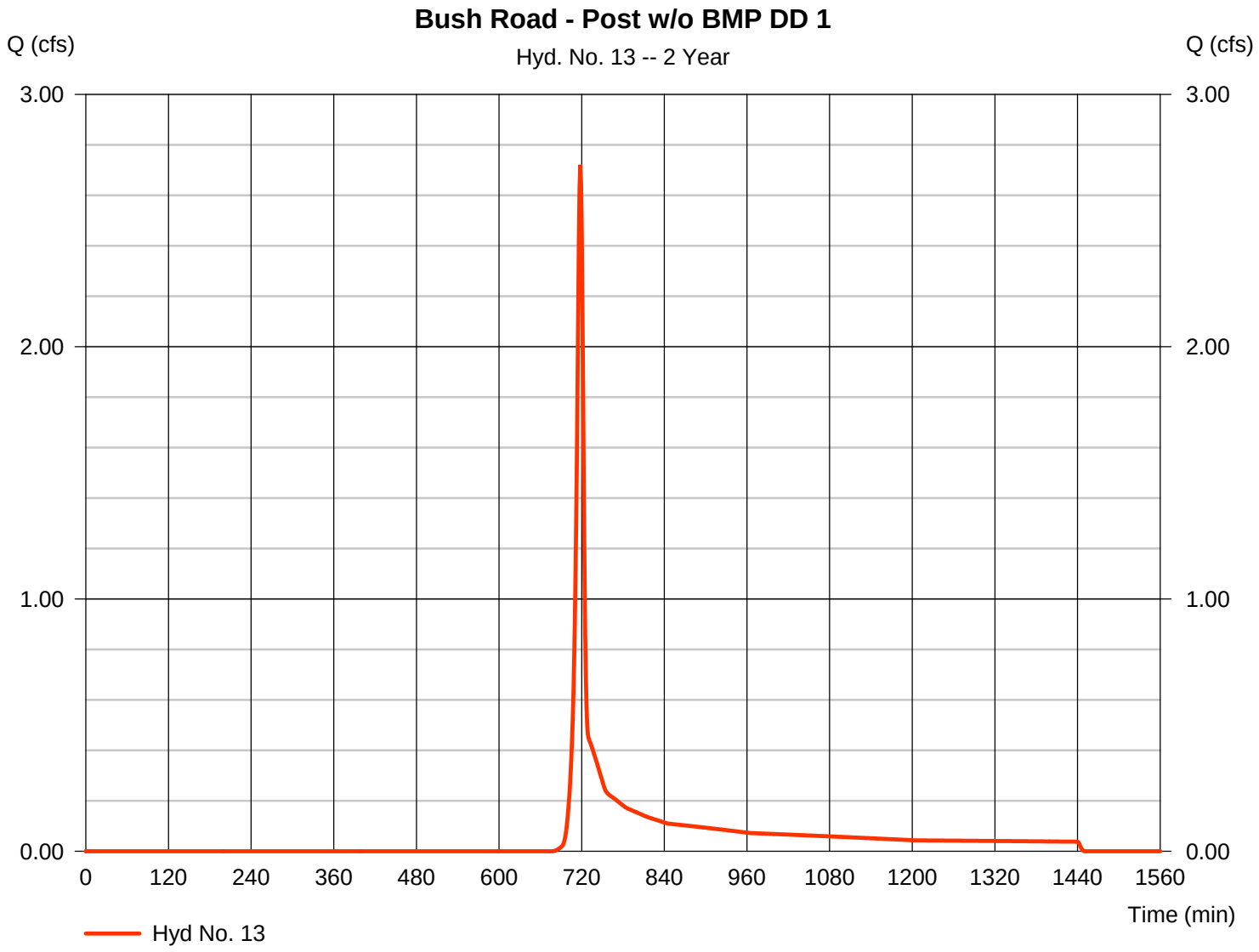
Hydrograph Report

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.721 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	5,622 cuft
Drainage area	=	2.260 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	2.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		0.00		
Watercourse slope (%)	= 23.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		0.00		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.00**	**=**	**1.86**
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	= 0.060		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 ..... 6.50 min

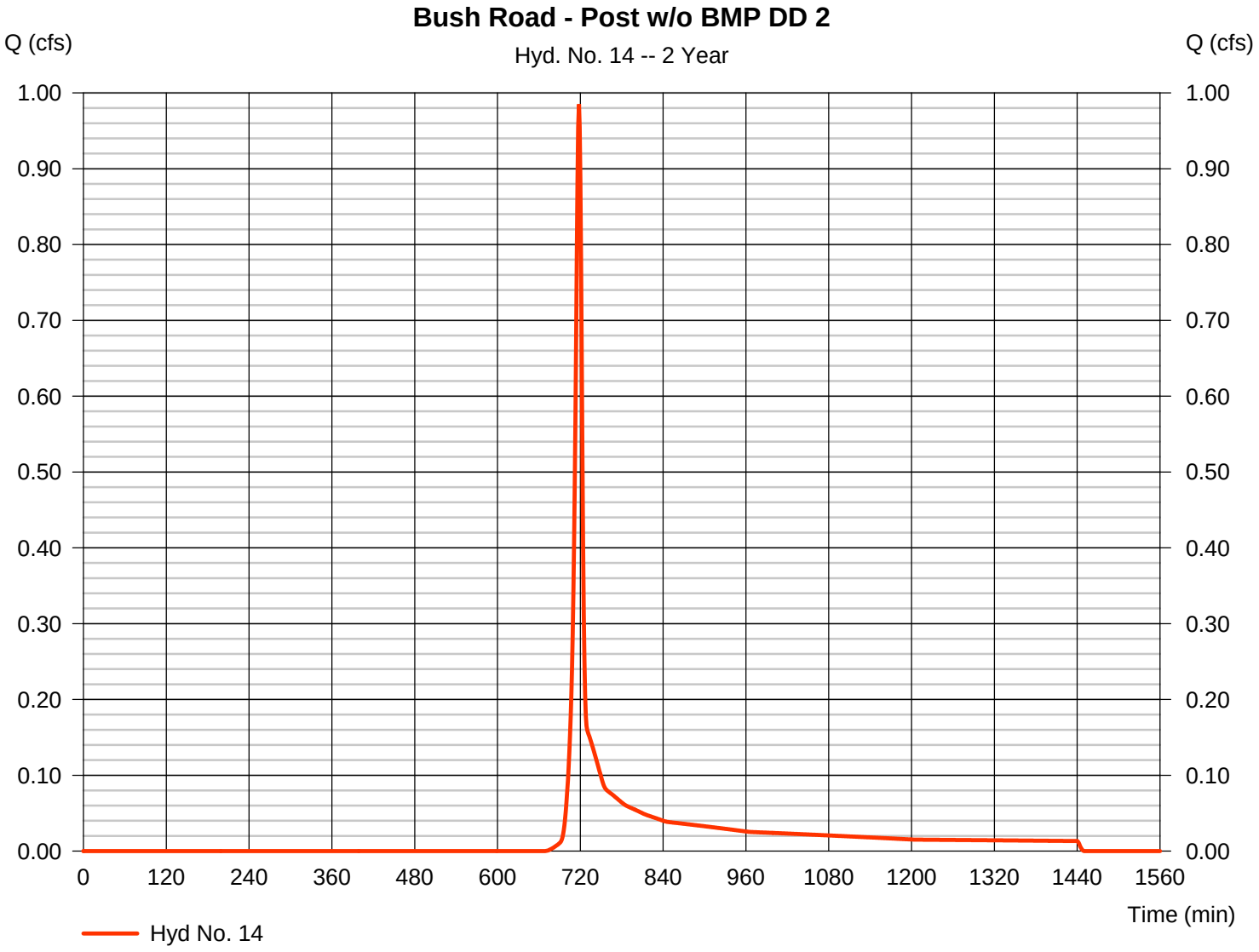
Hydrograph Report

Hyd. No. 14

Bush Road - Post w/o BMP DD 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.985 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 2,018 cuft
Drainage area	= 0.760 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.50 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 14

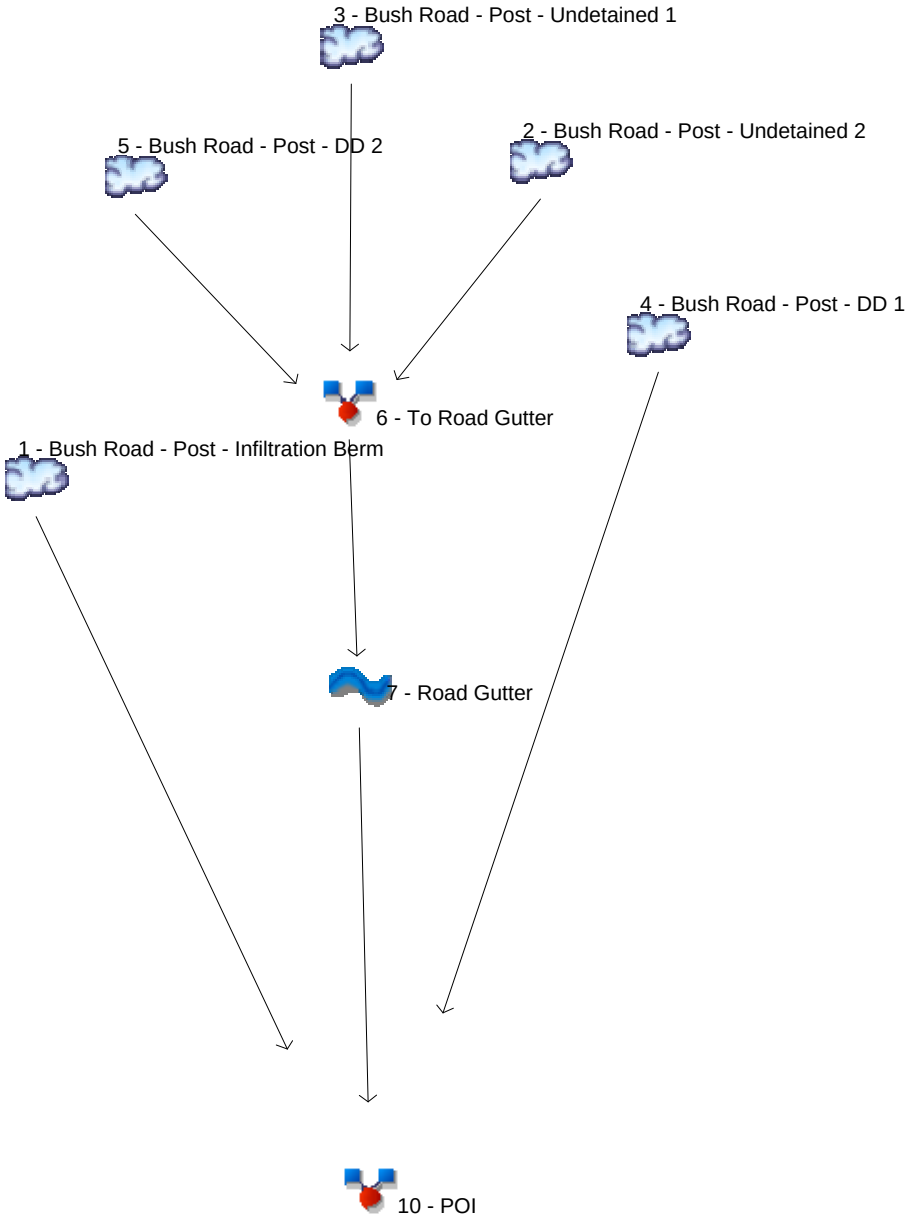
Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
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	= 0.060		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 ..... 6.50 min

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	0.338	1	742	1,892	------	------	------	Bush Road - Post - Infiltration Berm
2	SCS Runoff	1.441	1	719	3,168	------	------	------	Bush Road - Post - Undetained 2
3	SCS Runoff	0.152	1	719	321	------	------	------	Bush Road - Post - Undetained 1
4	SCS Runoff	2.314	1	720	5,451	------	------	------	Bush Road - Post - DD 1
5	SCS Runoff	0.885	1	719	1,908	------	------	------	Bush Road - Post - DD 2
6	Combine	2.478	1	719	5,396	2, 3, 5	------	------	To Road Gutter
7	Reach	2.377	1	721	5,395	6	------	------	Road Gutter
10	Combine	4.797	1	720	12,739	1, 4, 7,	------	------	POI

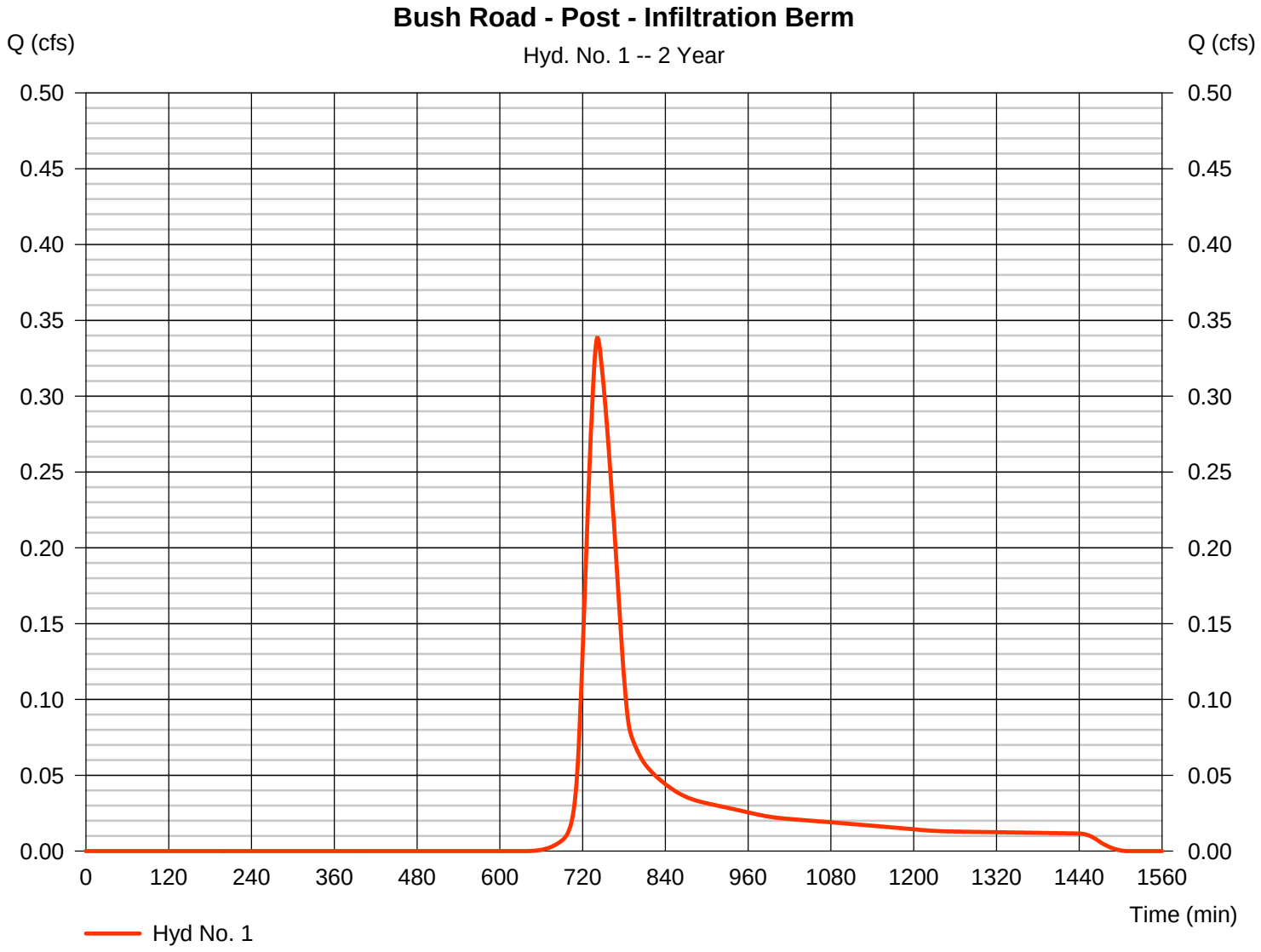
Hydrograph Report

Hyd. No. 1

Bush Road - Post - Infiltration Berm

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.338 cfs
Storm frequency	=	2 yrs	Time to peak	=	742 min
Time interval	=	1 min	Hyd. volume	=	1,892 cuft
Drainage area	=	0.610 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	45.20 min
Total precip.	=	2.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610



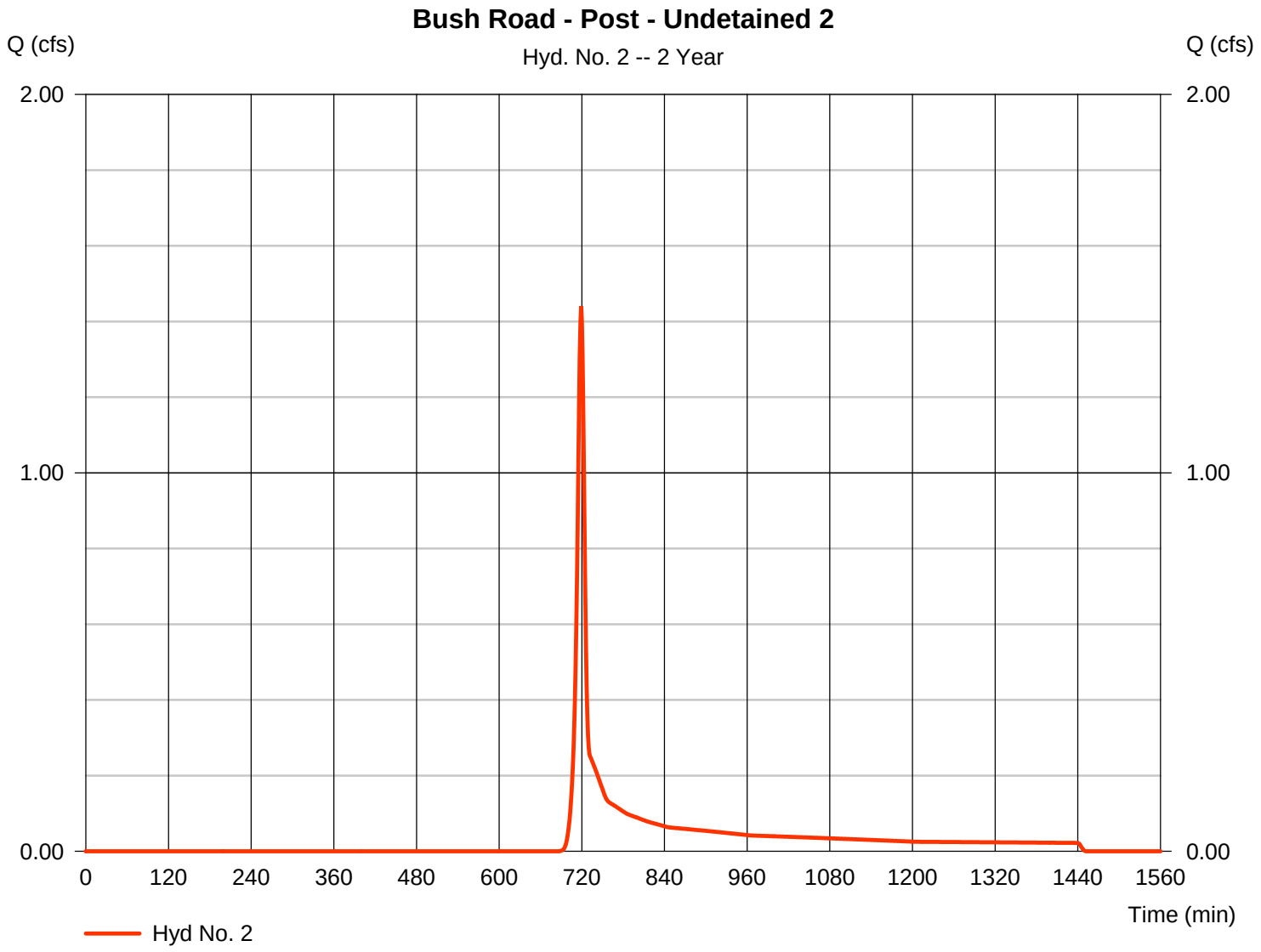
Hydrograph Report

Hyd. No. 2

Bush Road - Post - Undetained 2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.441 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 3,168 cuft
Drainage area	= 1.440 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post - Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

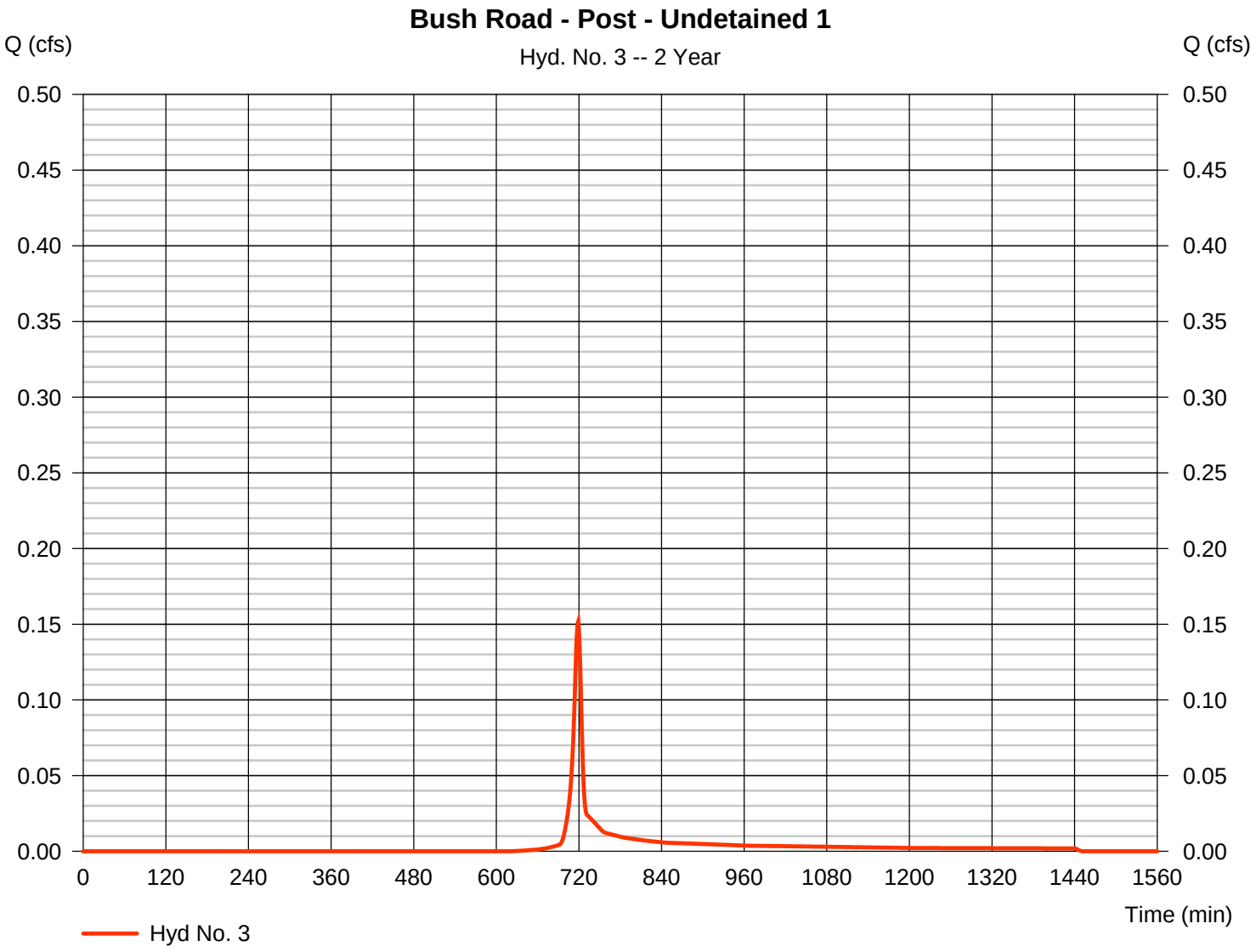
Hydrograph Report

Hyd. No. 3

Bush Road - Post - Undetained 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.152 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 321 cuft
Drainage area	= 0.100 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post - Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

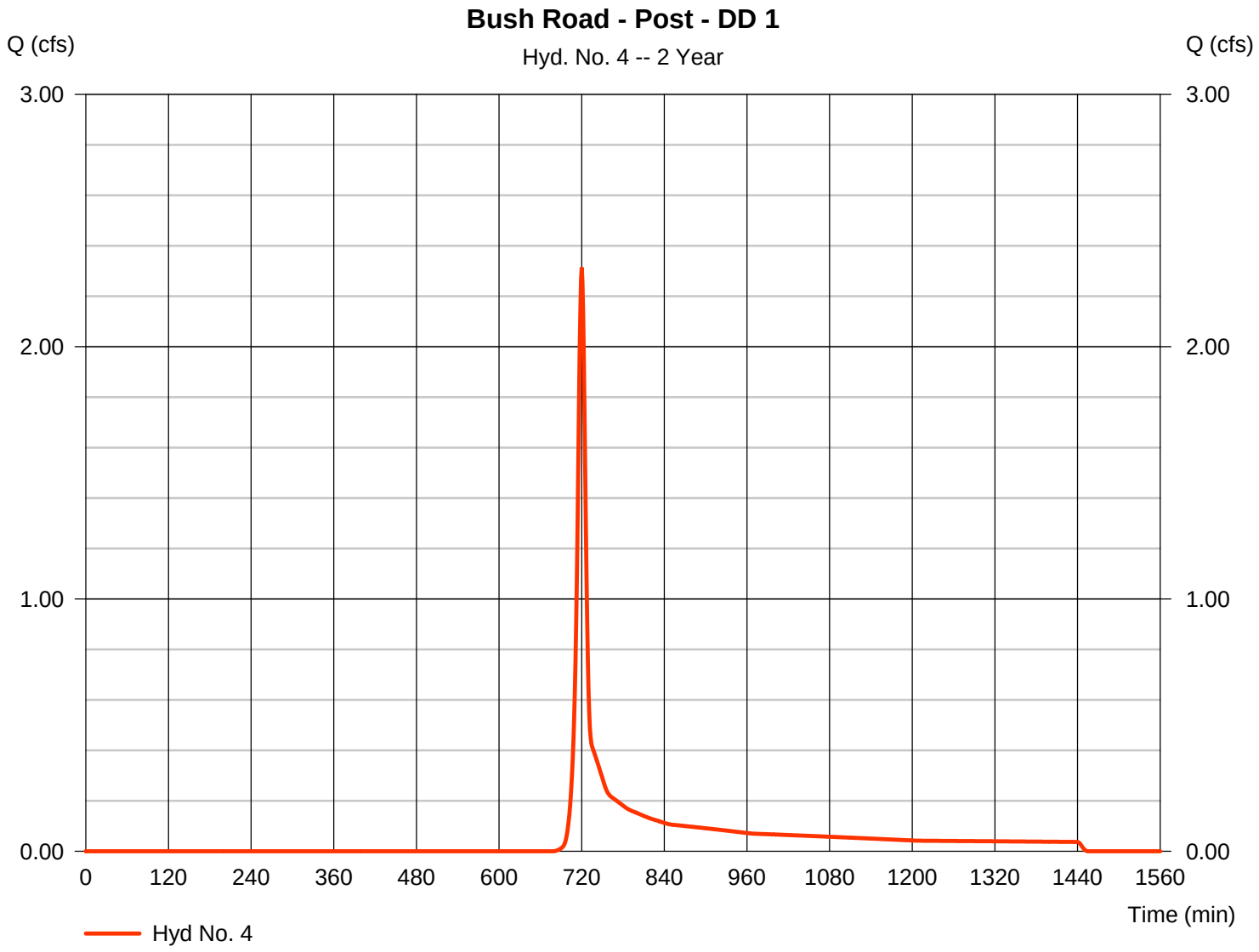
Hydrograph Report

Hyd. No. 4

Bush Road - Post - DD 1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.314 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 5,451 cuft
Drainage area	= 2.260 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.50 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post - DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

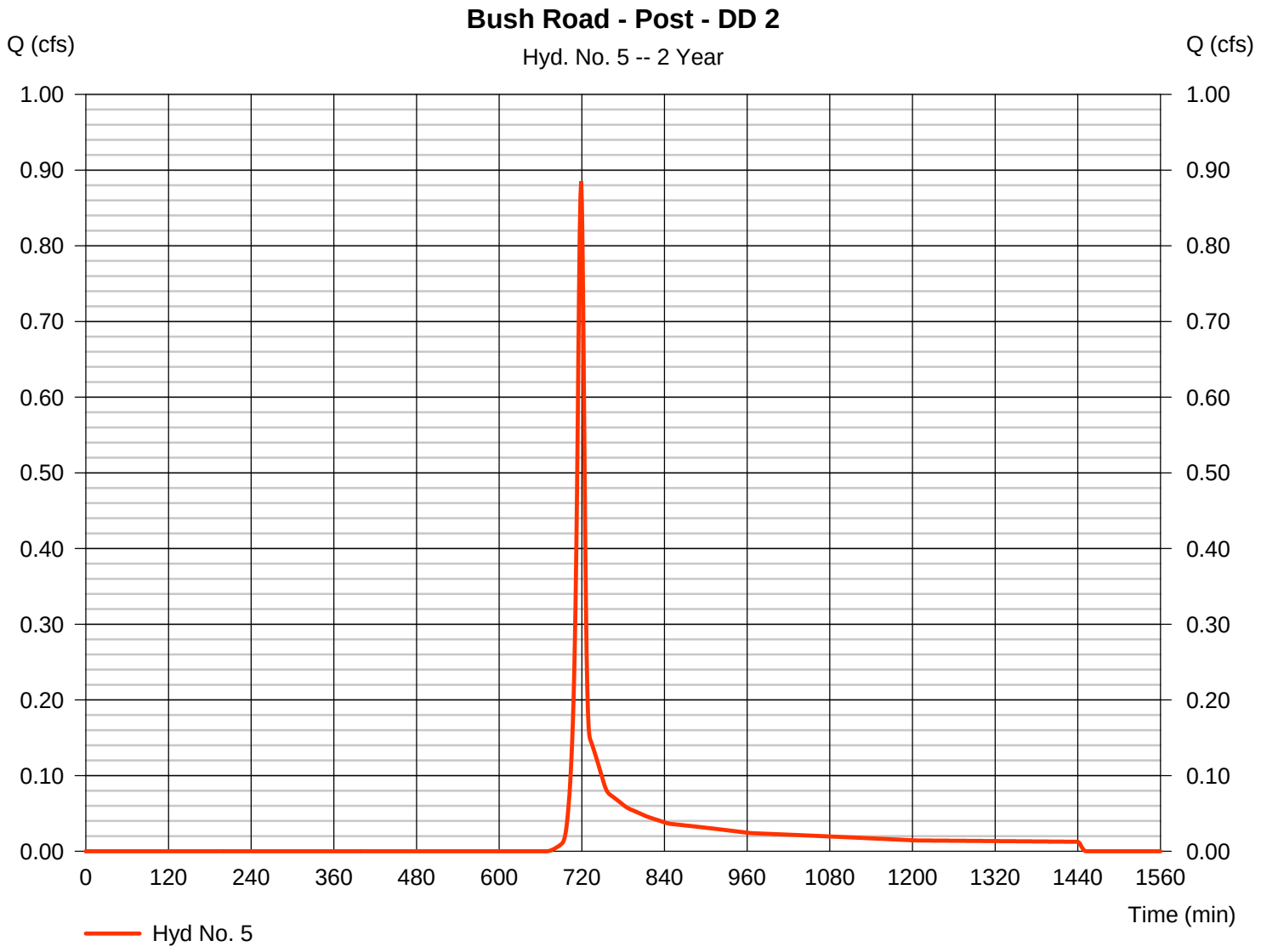
Hydrograph Report

Hyd. No. 5

Bush Road - Post - DD 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.885 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 1,908 cuft
Drainage area	= 0.760 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 2.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post - DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

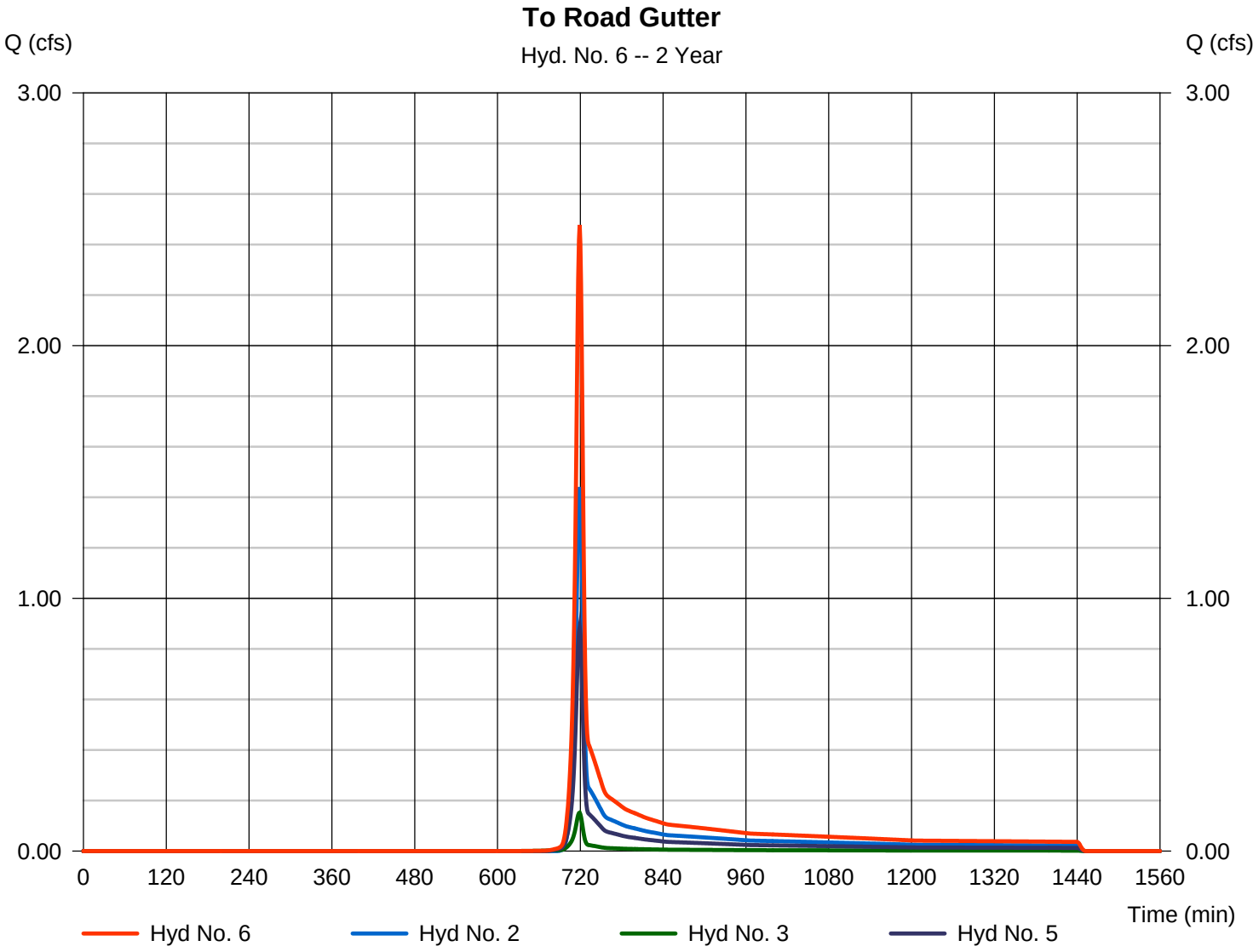
Total Travel Time, Tc ..... 6.70 min

Hydrograph Report

Hyd. No. 6

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 2.478 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 5,396 cuft
Inflow hyds.	= 2, 3, 5	Contrib. drain. area	= 2.300 ac



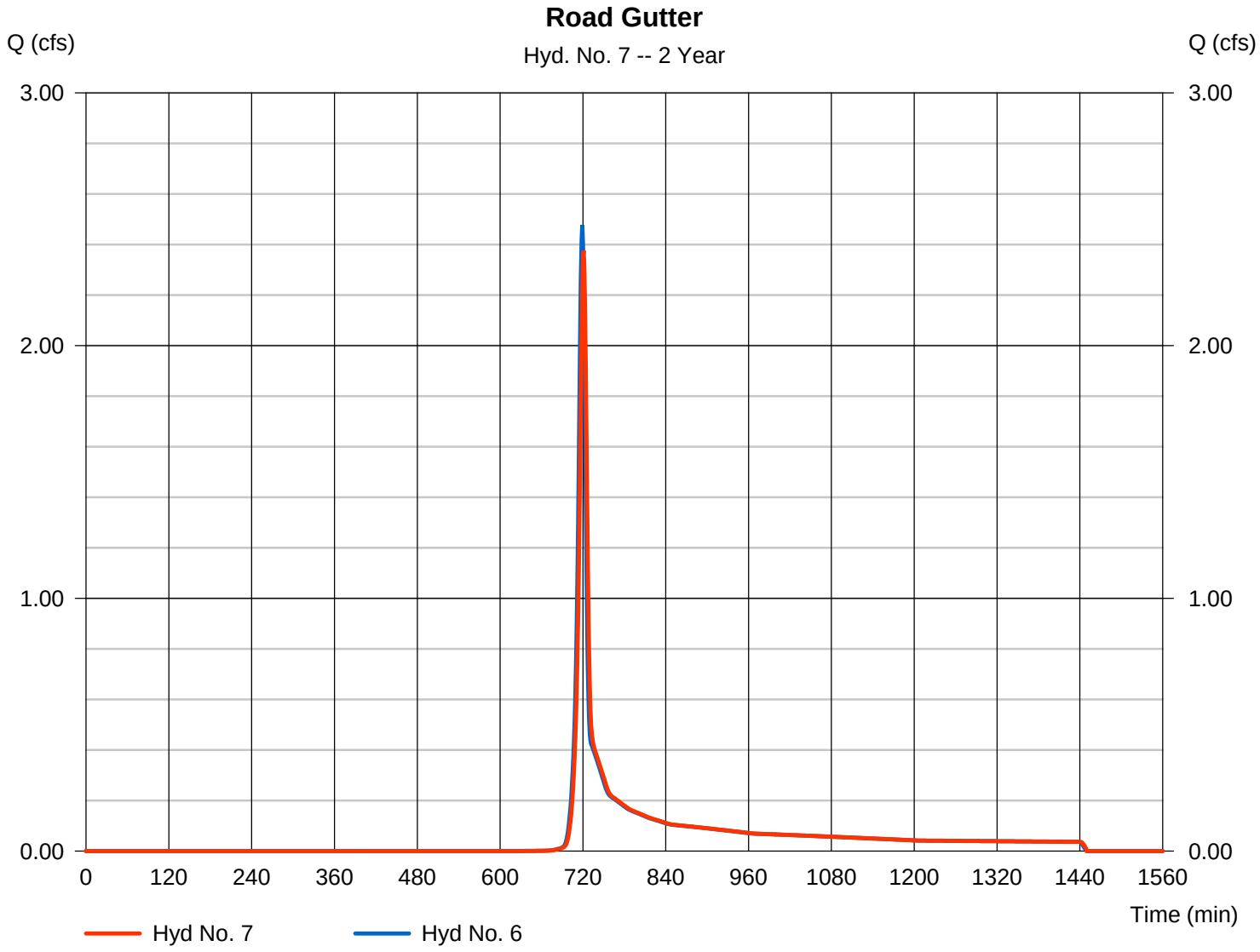
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	2.377 cfs
Storm frequency	=	2 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	5,395 cuft
Inflow hyd. No.	=	6 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5011

Modified Att-Kin routing method used.

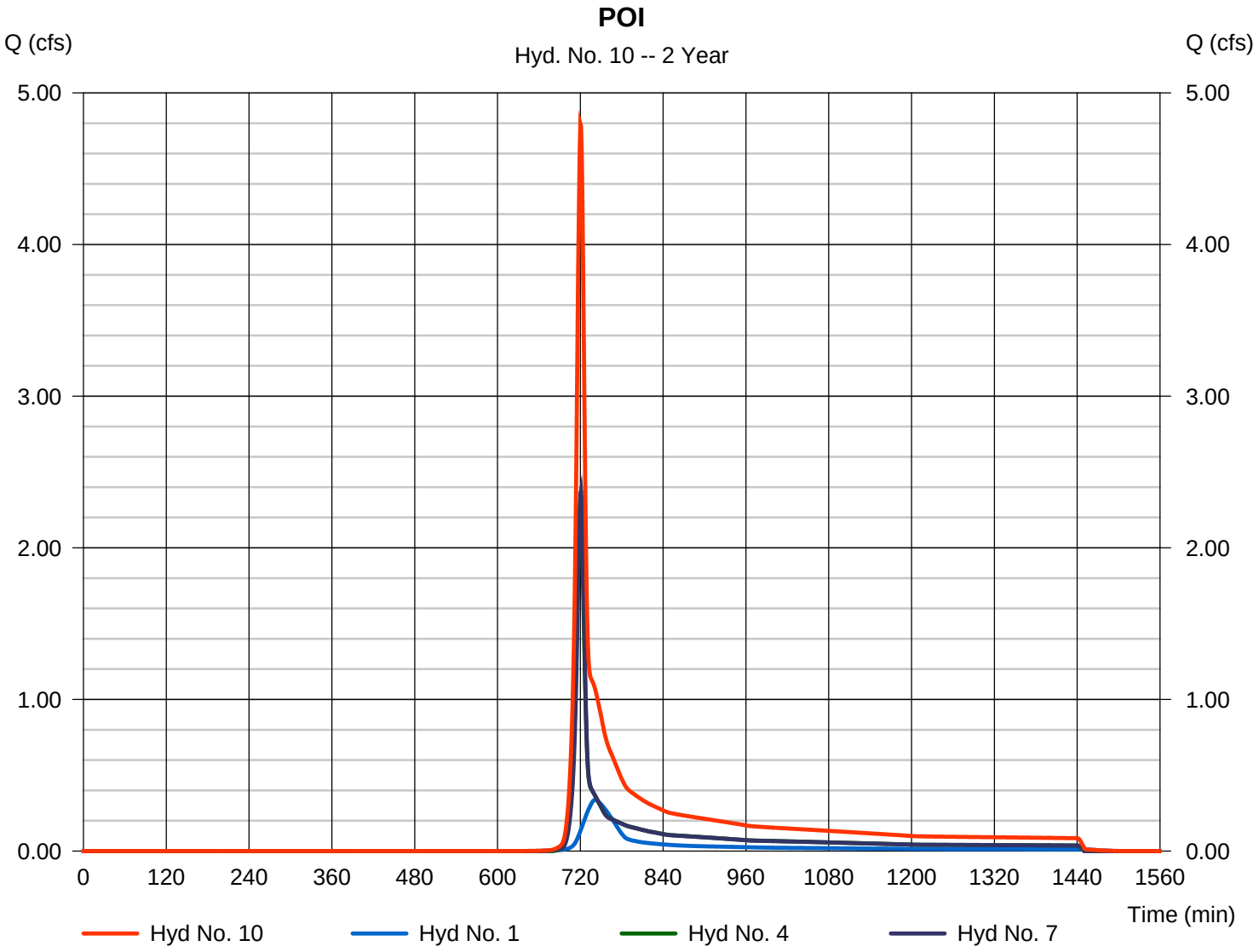


Hydrograph Report

Hyd. No. 10

POI

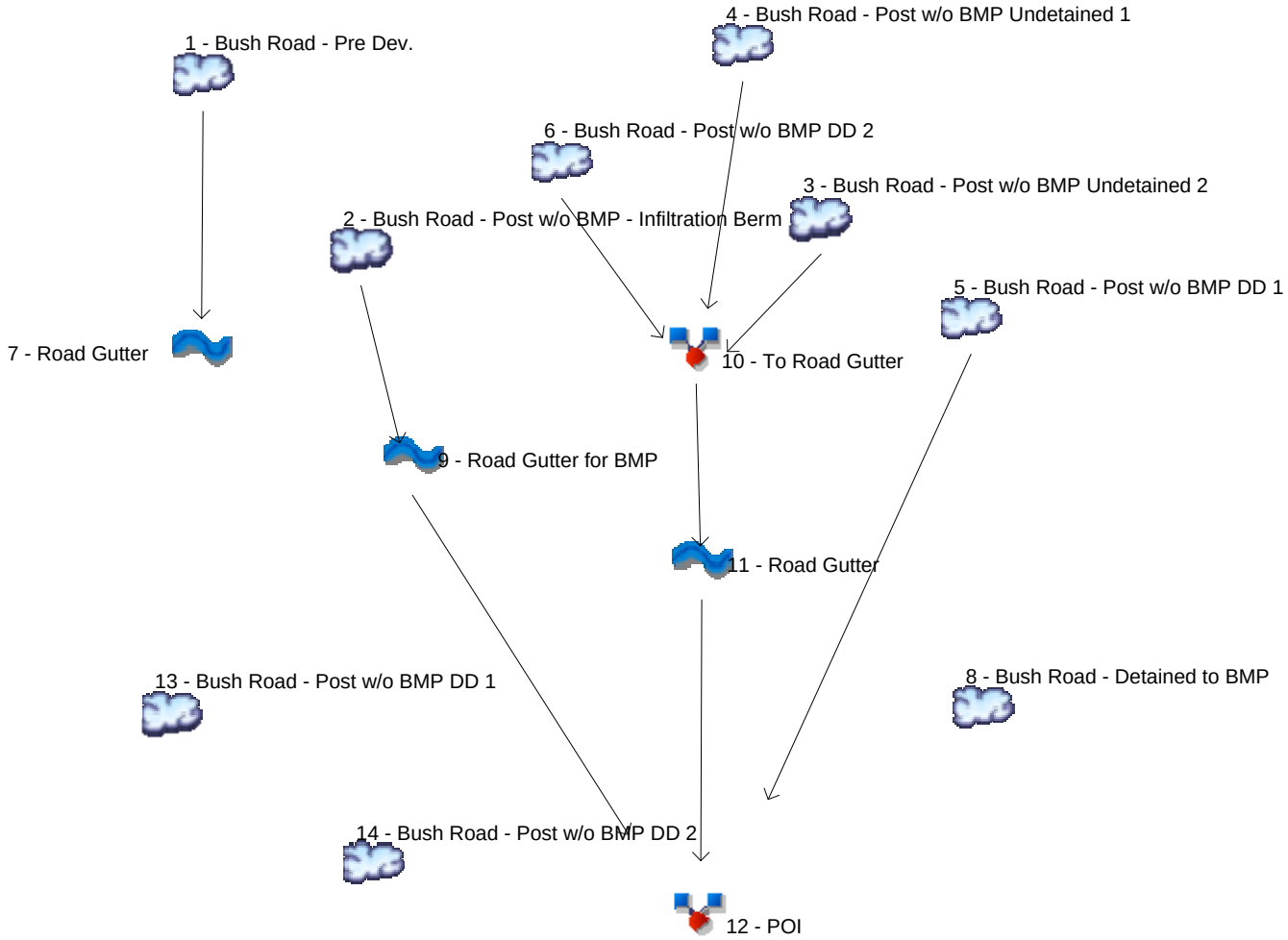
Hydrograph type	=	Combine	Peak discharge	=	4.797 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	12,739 cuft
Inflow hyds.	=	1, 4, 7	Contrib. drain. area	=	2.870 ac



ATTACHMENT C-2
BUSH RD
10 Year-24 Hour Storm

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	11.46	1	719	24,189	------	------	------	Bush Road - Pre Dev.
2	SCS Runoff	1.624	1	719	3,430	------	------	------	Bush Road - Post w/o BMP - Infiltratio
3	SCS Runoff	3.036	1	719	6,419	------	------	------	Bush Road - Post w/o BMP Undetain
4	SCS Runoff	0.278	1	718	588	------	------	------	Bush Road - Post w/o BMP Undetain
5	SCS Runoff	4.778	1	720	10,845	------	------	------	Bush Road - Post w/o BMP DD 1
6	SCS Runoff	1.768	1	719	3,728	------	------	------	Bush Road - Post w/o BMP DD 2
7	Reach	11.44	1	720	24,188	1	------	------	Road Gutter
8	SCS Runoff	1.396	2	718	3,194	------	------	------	Bush Road - Detained to BMP
9	Reach	1.576	1	720	3,428	2	------	------	Road Gutter for BMP
10	Combine	5.081	1	719	10,735	3, 4, 6,	------	------	To Road Gutter
11	Reach	4.962	1	720	10,734	10	------	------	Road Gutter
12	Combine	11.32	1	720	25,008	5, 9, 11	------	------	POI
13	SCS Runoff	5.566	1	718	11,184	------	------	------	Bush Road - Post w/o BMP DD 1
14	SCS Runoff	1.964	1	718	3,943	------	------	------	Bush Road - Post w/o BMP DD 2

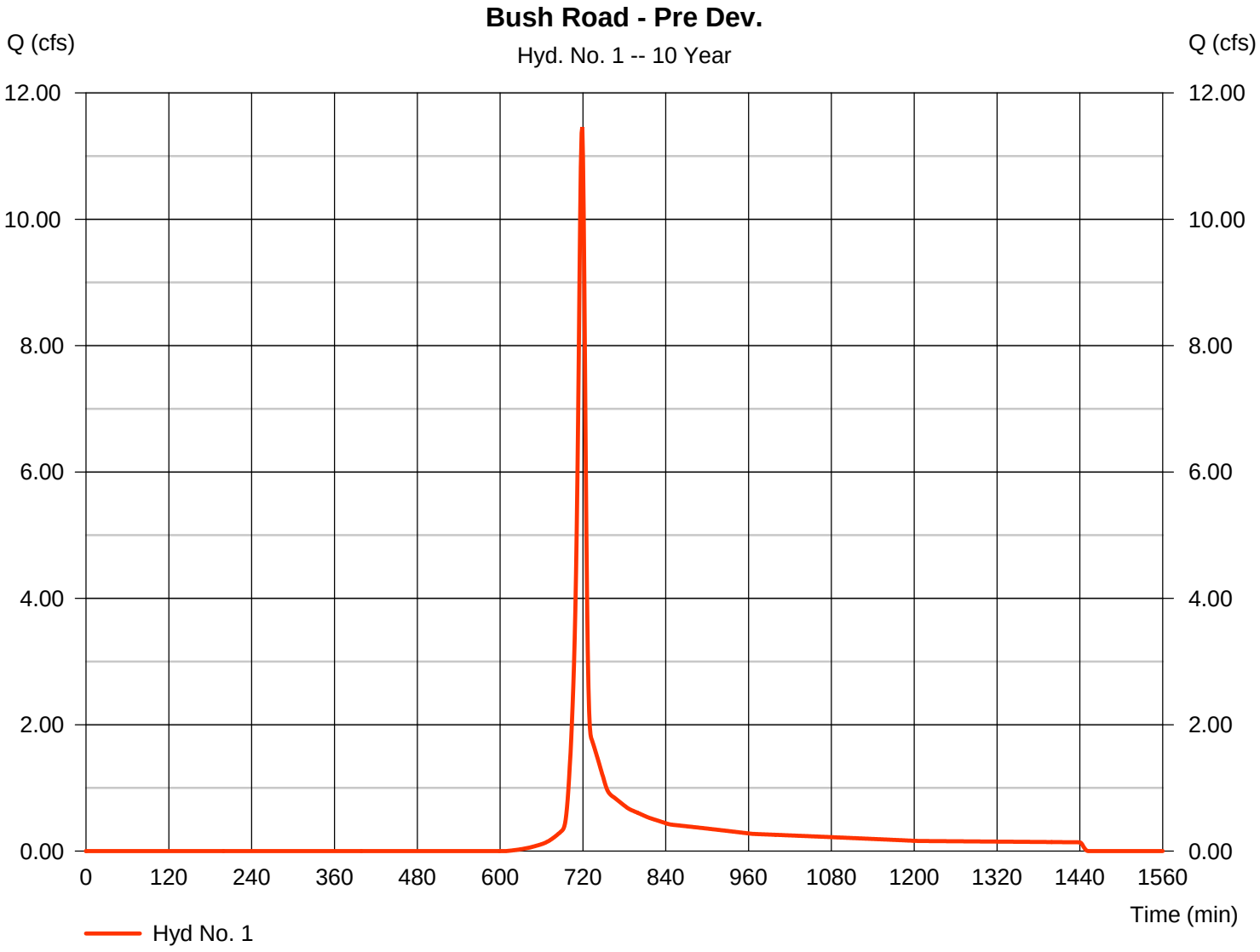
Hydrograph Report

Hyd. No. 1

Bush Road - Pre Dev.

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.46 cfs
Storm frequency	=	10 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	24,189 cuft
Drainage area	=	5.170 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	7.80 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.370 x 78) + (1.350 x 70) + (0.060 x 91) + (0.390 x 77)] / 5.170



TR55 Tc Worksheet

Hyd. No. 1

Bush Road - Pre Dev.

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 243.00		800.00		0.00		
Watercourse slope (%)	= 24.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		5.10		0.00		
Travel Time (min)	**= 0.51**	**+**	**2.61**	**+**	**0.00**	**=**	**3.13**
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 ..... 7.80 min

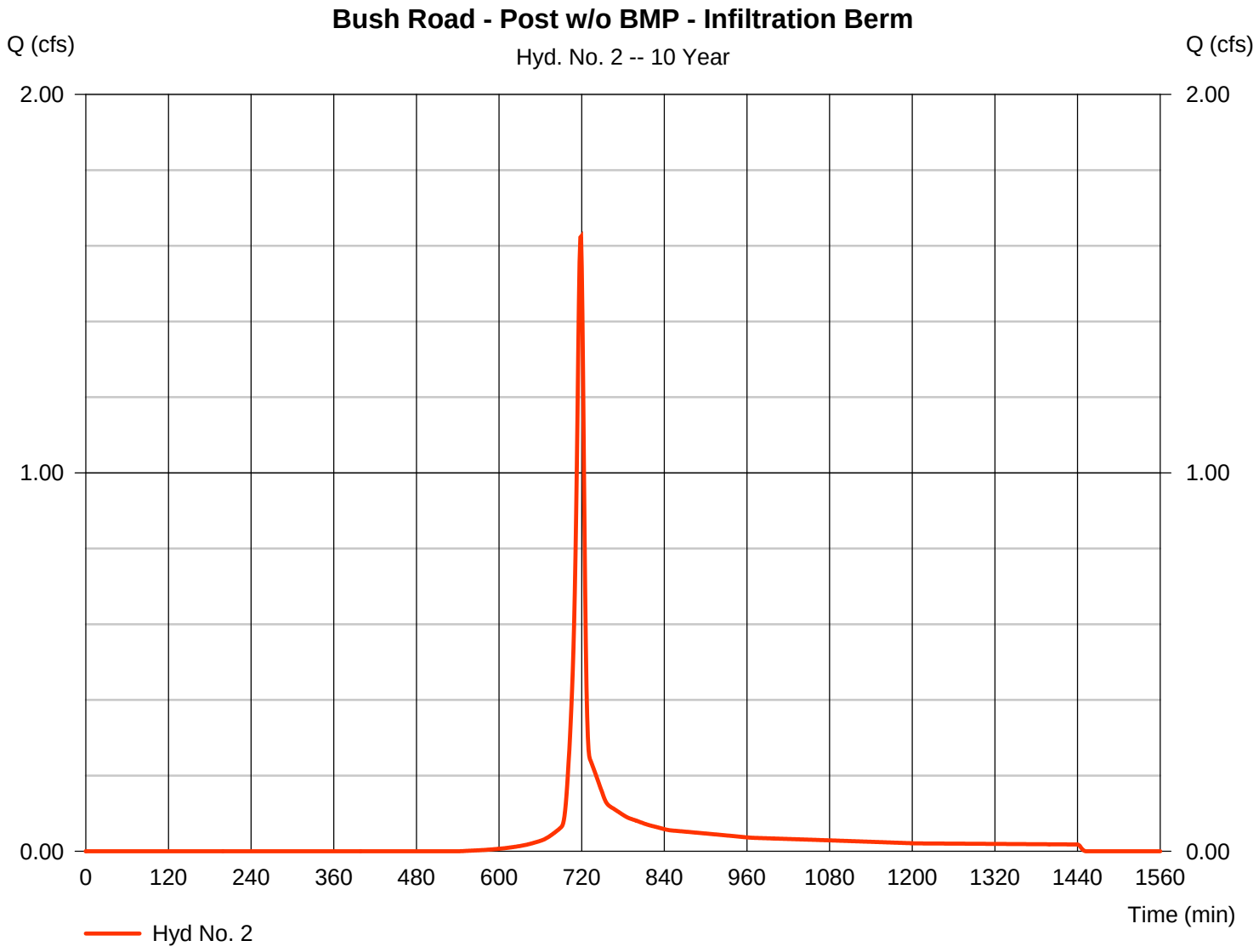
Hydrograph Report

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.624 cfs
Storm frequency	=	10 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	3,430 cuft
Drainage area	=	0.610 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.90 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		629.00		75.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**2.17**	**+**	**0.27**	**=**	**2.79**
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 ..... 6.90 min

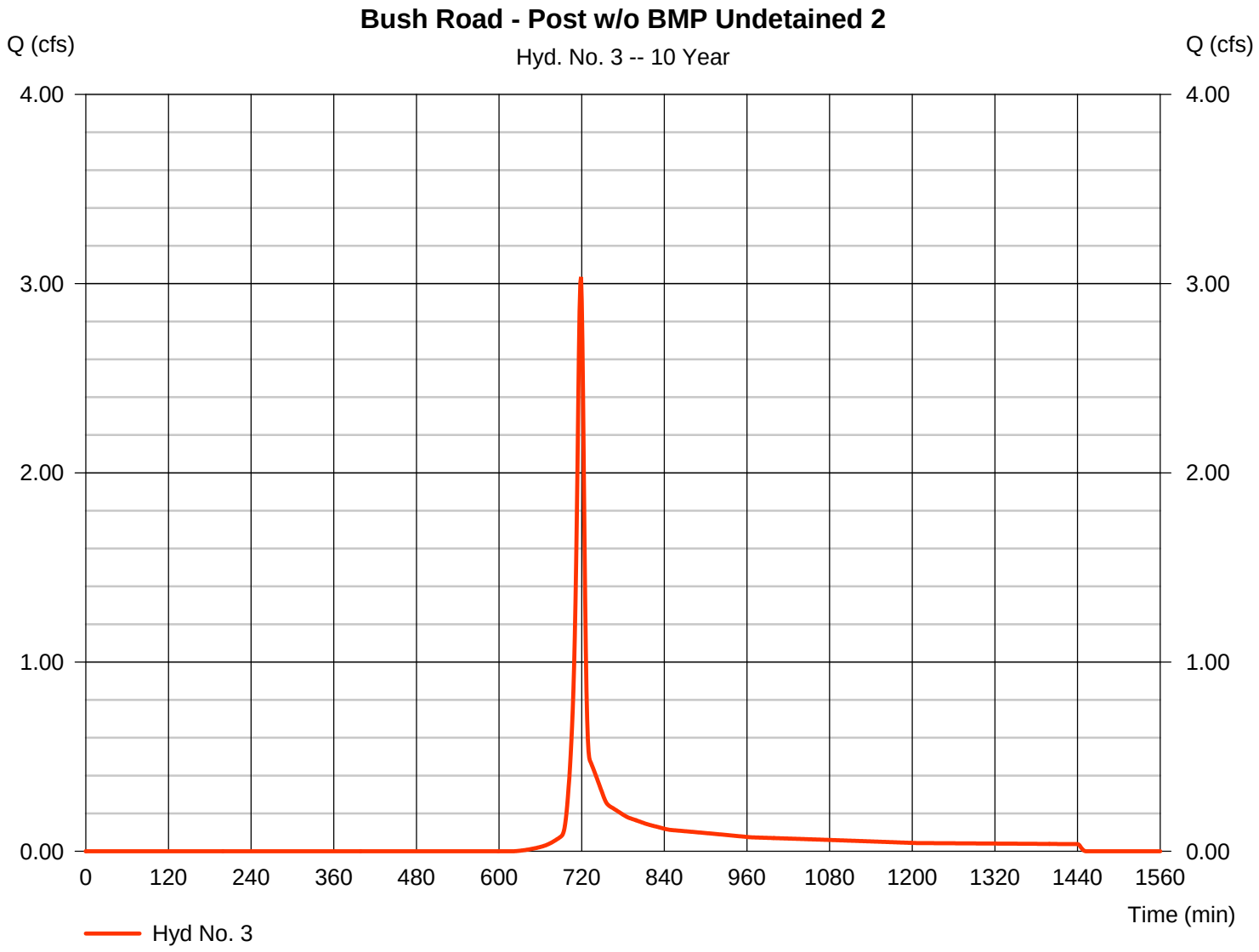
Hydrograph Report

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.036 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 6,419 cuft
Drainage area	= 1.440 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 3.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

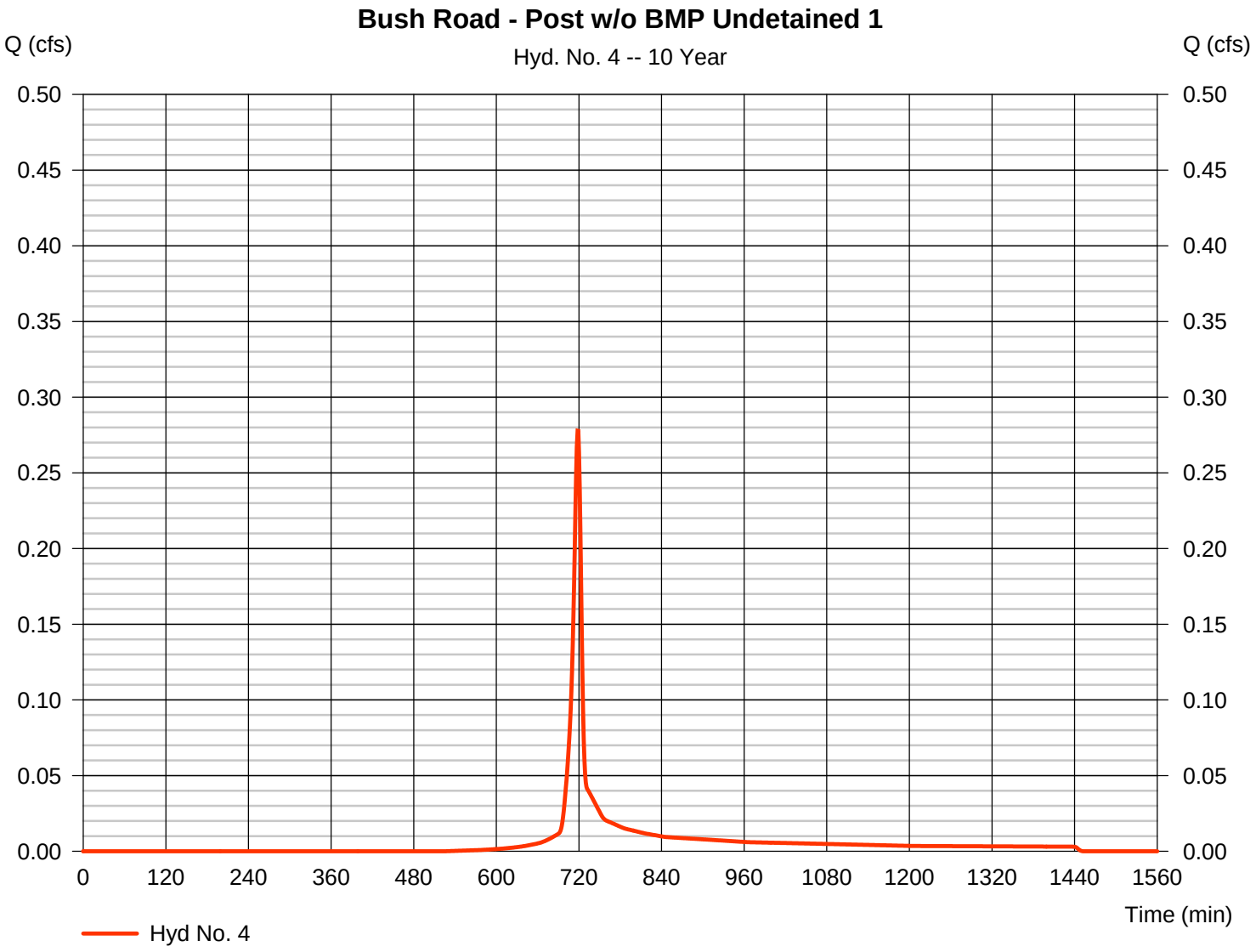
Hydrograph Report

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.278 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 588 cuft
Drainage area	= 0.100 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 3.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

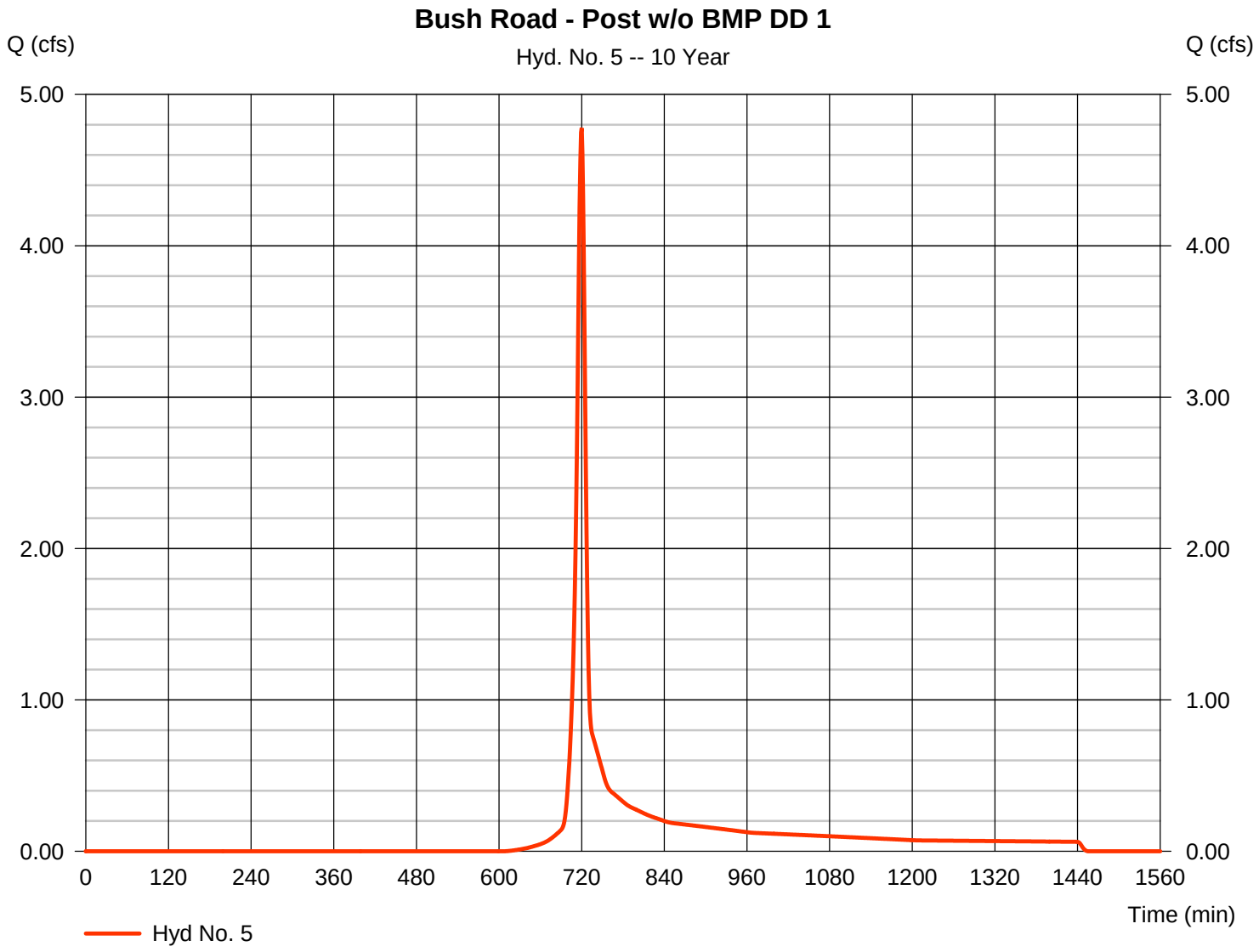
Hydrograph Report

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.778 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	10,845 cuft
Drainage area	=	2.260 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.50 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

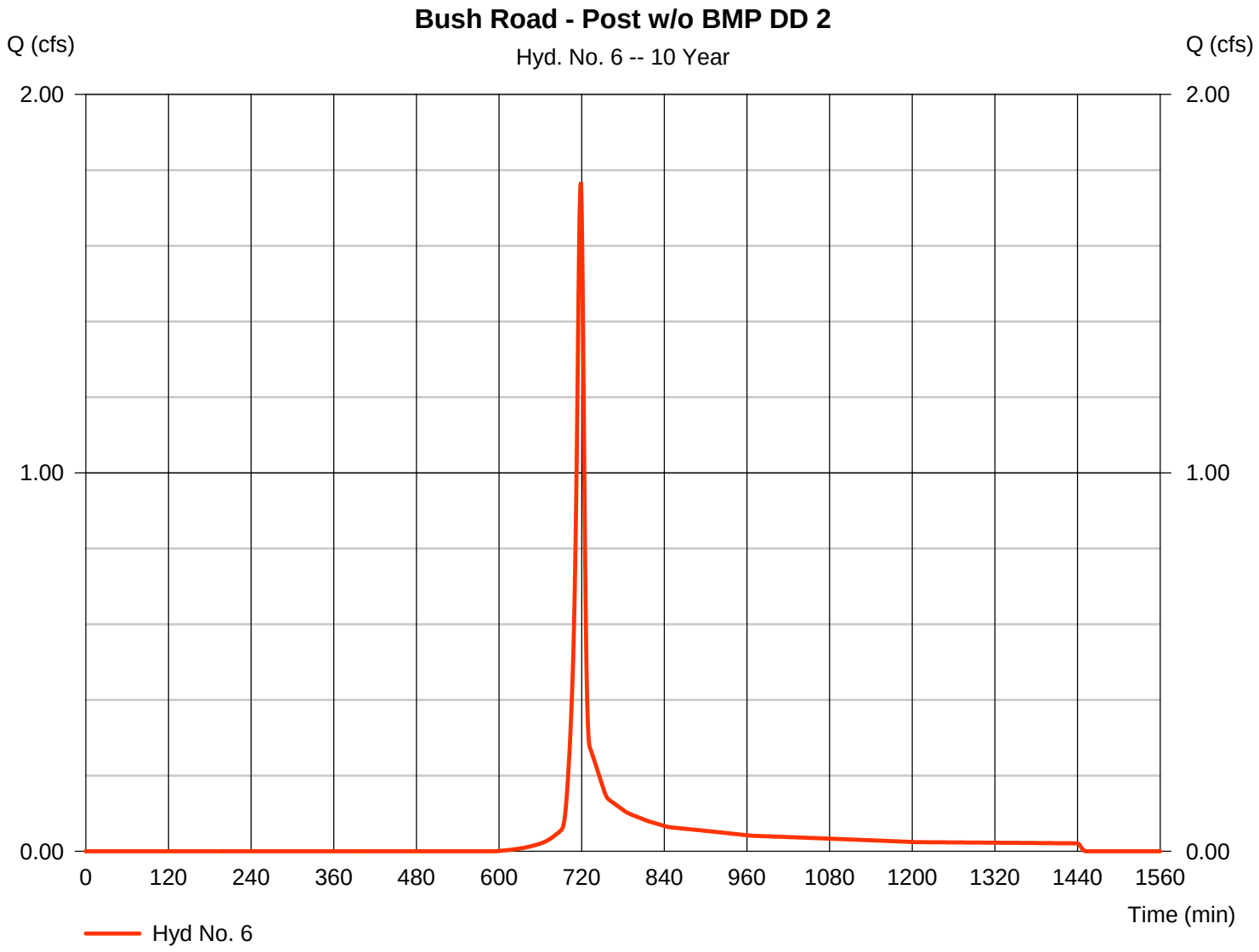
Hydrograph Report

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.768 cfs
Storm frequency	=	10 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	3,728 cuft
Drainage area	=	0.760 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

Total Travel Time, Tc ..... 6.70 min

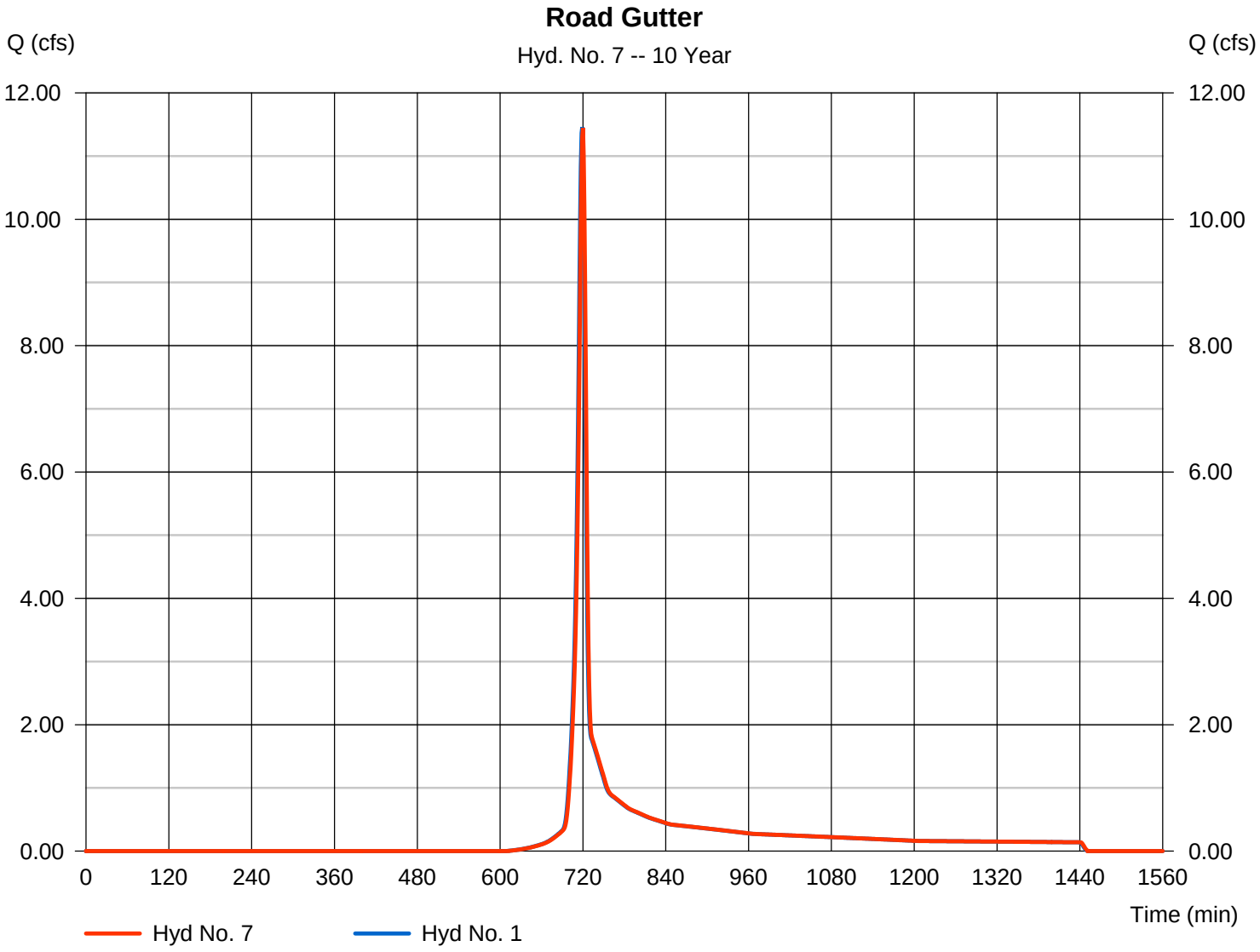
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	11.44 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	24,188 cuft
Inflow hyd. No.	=	1 - Bush Road - Pre Dev.	Section type	=	Triangular
Reach length	=	265.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.308	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.9074

Modified Att-Kin routing method used.



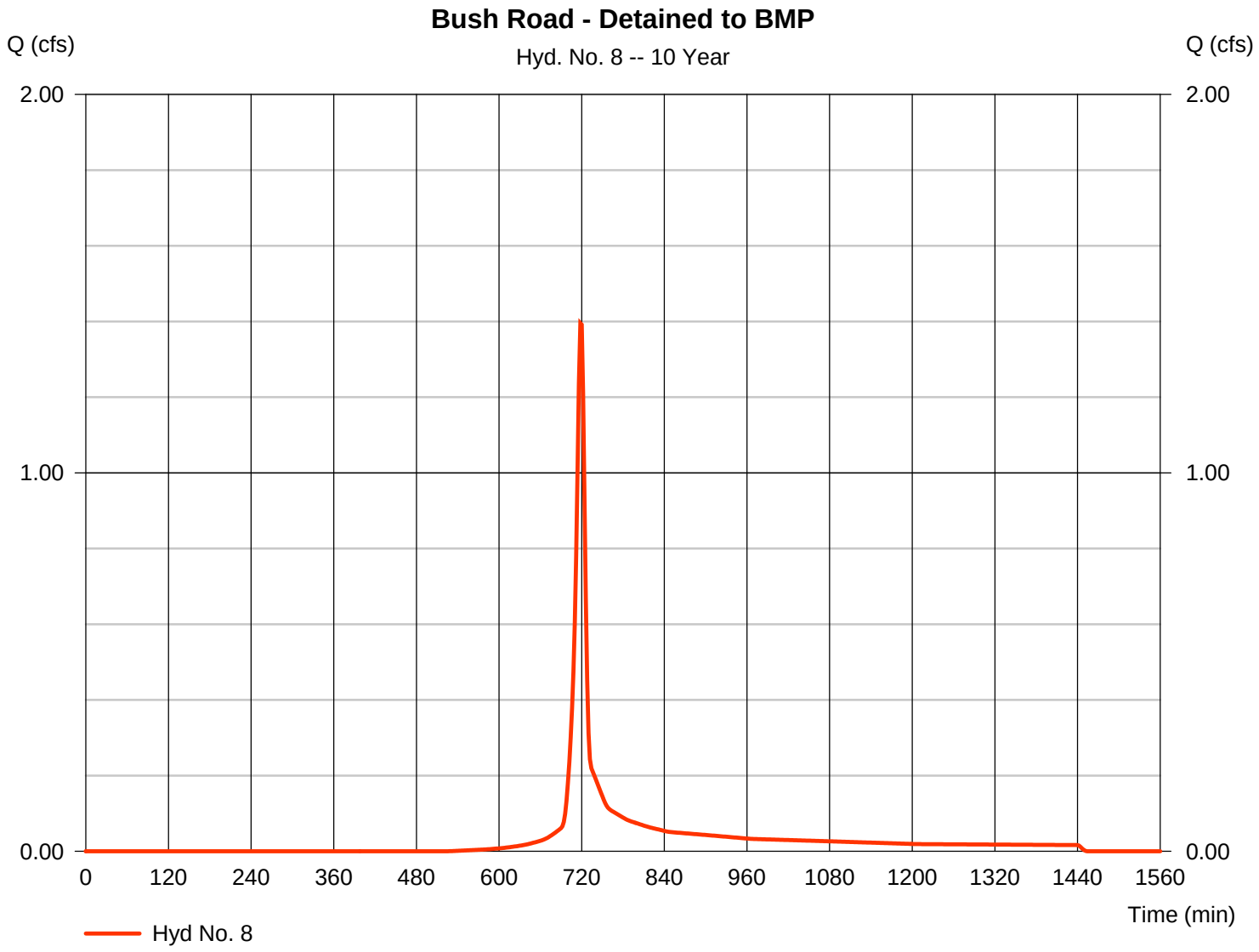
Hydrograph Report

Hyd. No. 8

Bush Road - Detained to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.396 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	3,194 cuft
Drainage area	=	0.530 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.010 x 77) + (0.360 x 78) + (0.130 x 91)] / 0.530



TR55 Tc Worksheet

Hyd. No. 8

Bush Road - Detained to BMP

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		535.00		70.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**1.84**	**+**	**0.26**	**=**	**2.45**
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 ..... 6.60 min

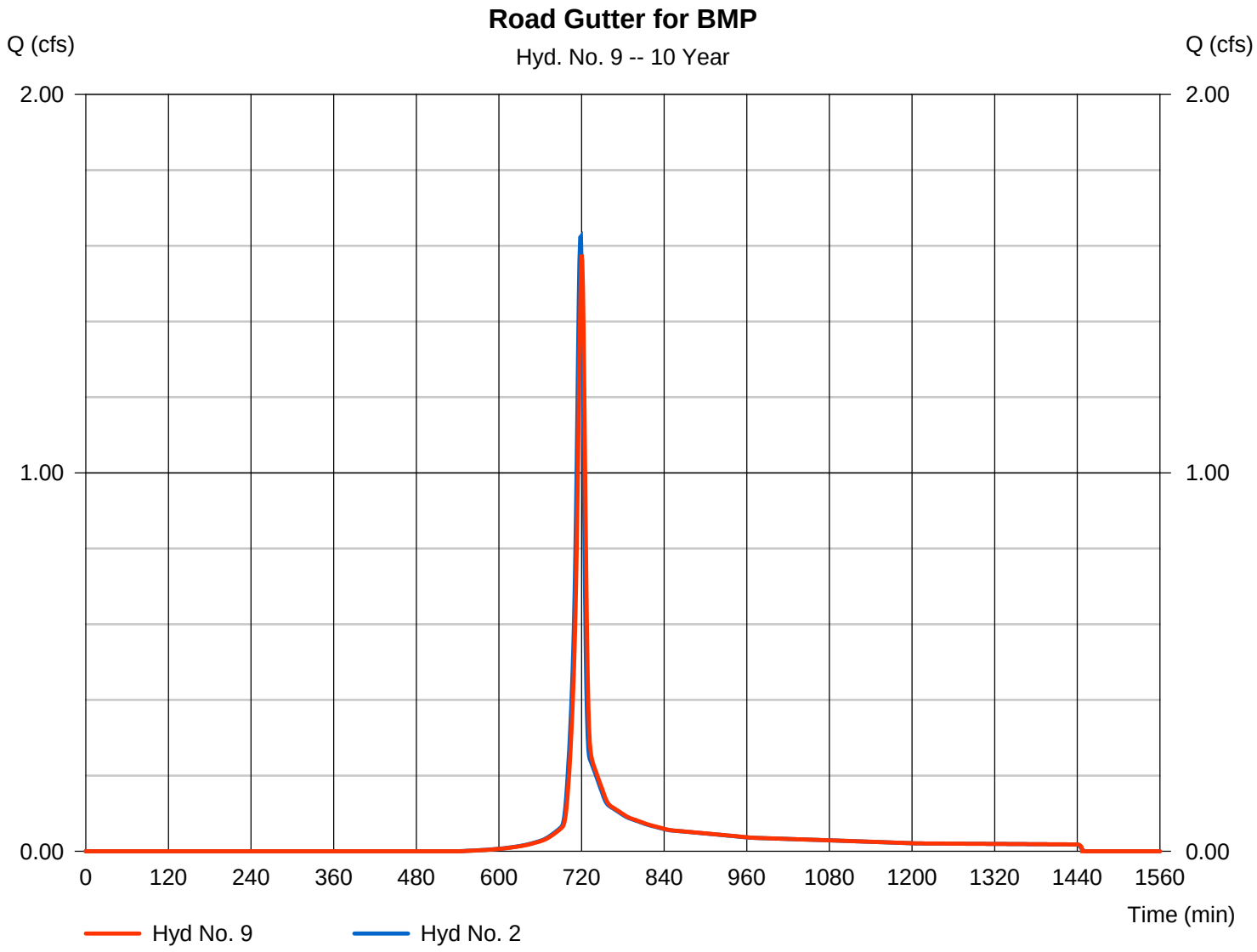
Hydrograph Report

Hyd. No. 9

Road Gutter for BMP

Hydrograph type	=	Reach	Peak discharge	=	1.576 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	3,428 cuft
Inflow hyd. No.	=	2 - Bush Road - Post w/o BMPs	Section type	=	Triangular
Reach length	=	450.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5011

Modified Att-Kin routing method used.

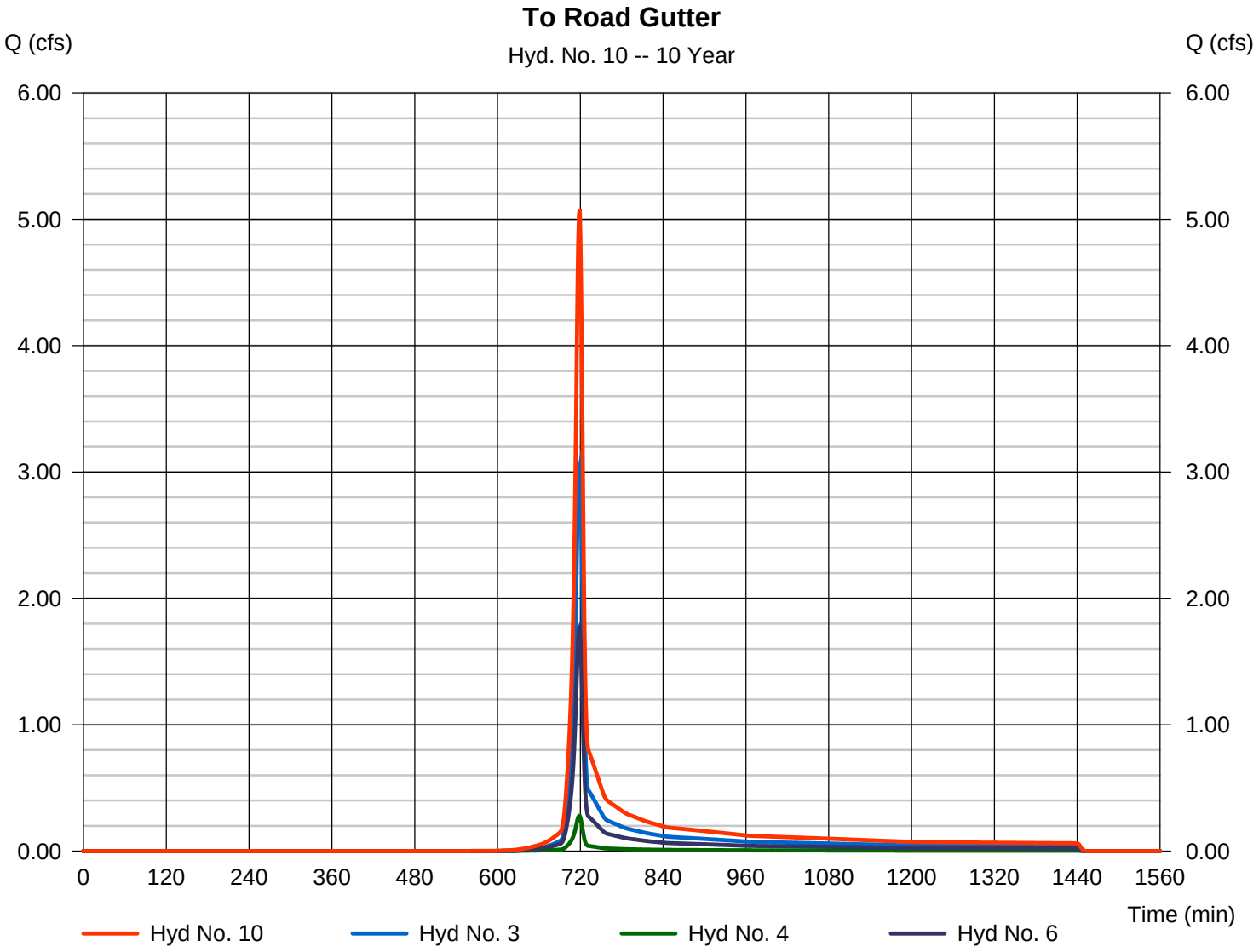


Hydrograph Report

Hyd. No. 10

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 5.081 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 10,735 cuft
Inflow hyds.	= 3, 4, 6	Contrib. drain. area	= 2.300 ac



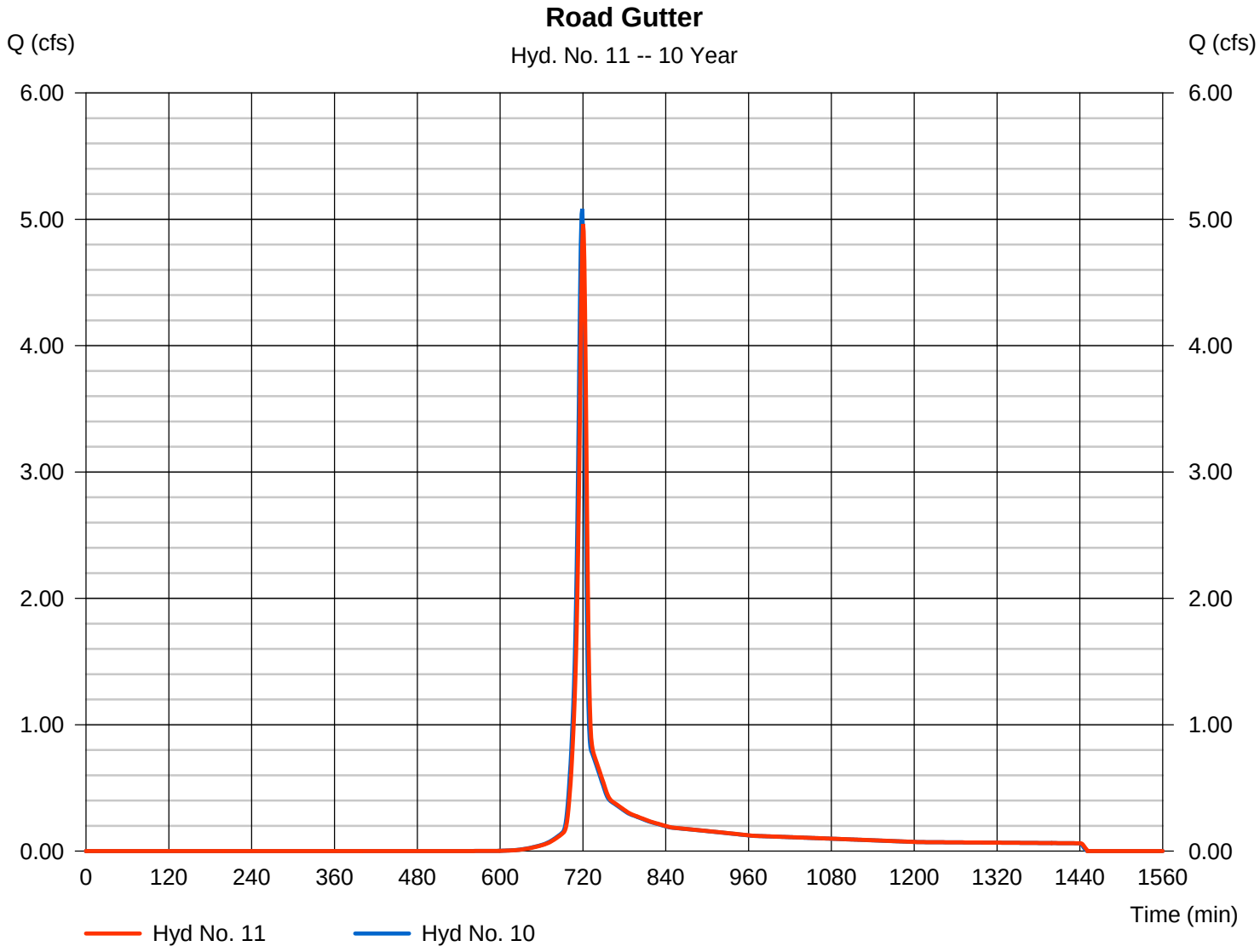
Hydrograph Report

Hyd. No. 11

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	4.962 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	10,734 cuft
Inflow hyd. No.	=	10 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5715

Modified Att-Kin routing method used.

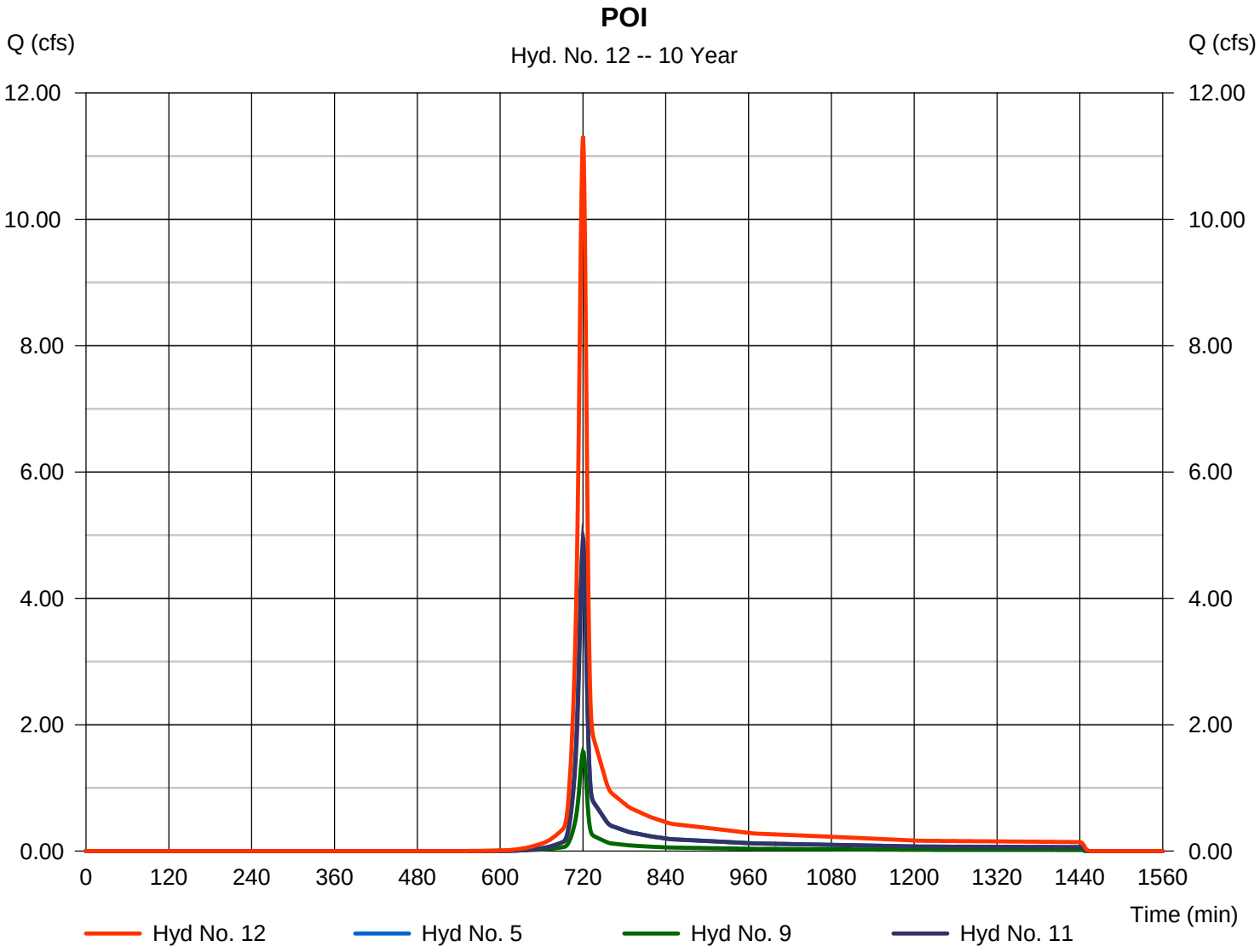


Hydrograph Report

Hyd. No. 12

POI

Hydrograph type	=	Combine	Peak discharge	=	11.32 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	25,008 cuft
Inflow hyds.	=	5, 9, 11	Contrib. drain. area	=	2.260 ac



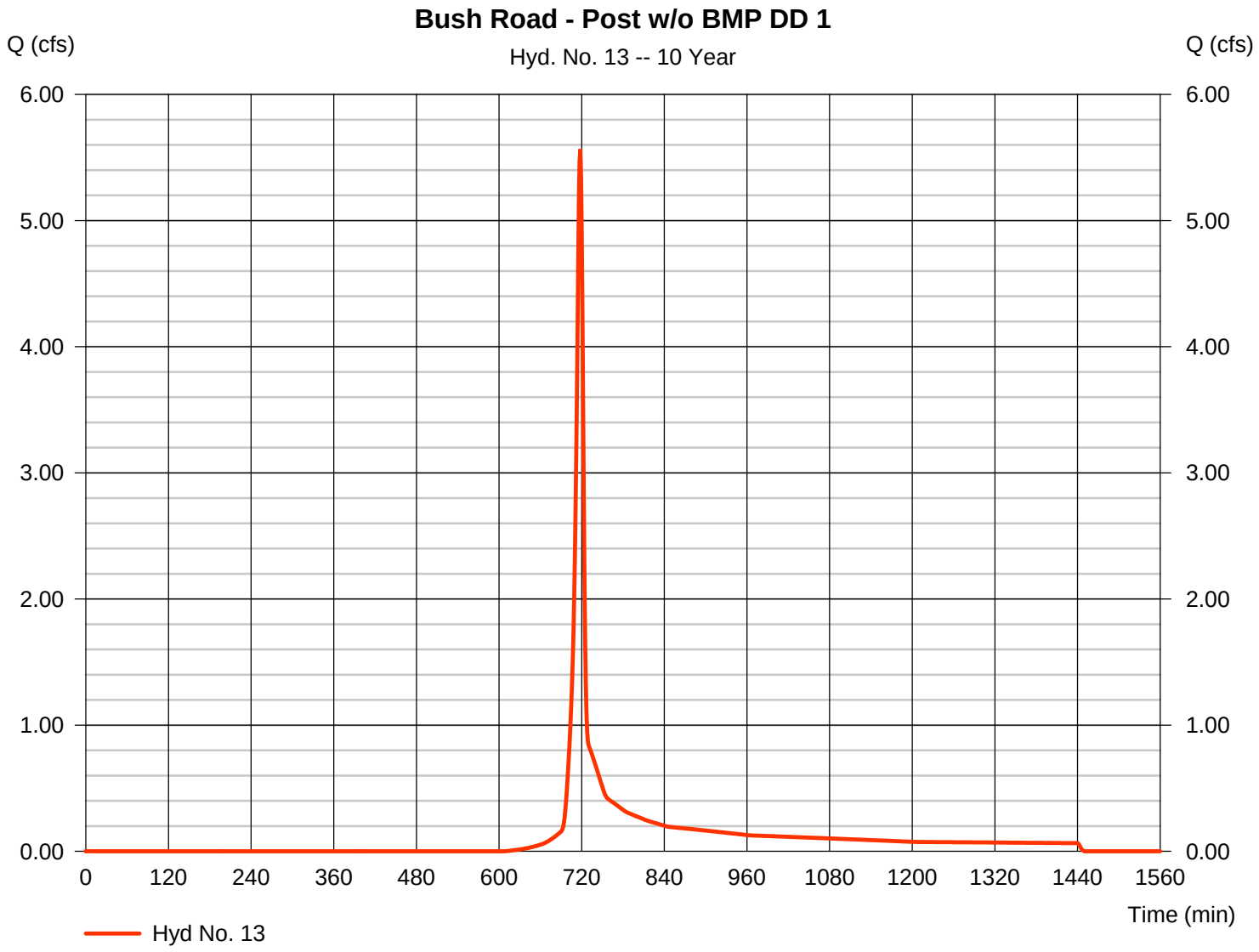
Hydrograph Report

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.566 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	11,184 cuft
Drainage area	=	2.260 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		0.00		
Watercourse slope (%)	= 23.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		0.00		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.00**	**=**	**1.86**
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	= 0.060		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 ..... 6.50 min

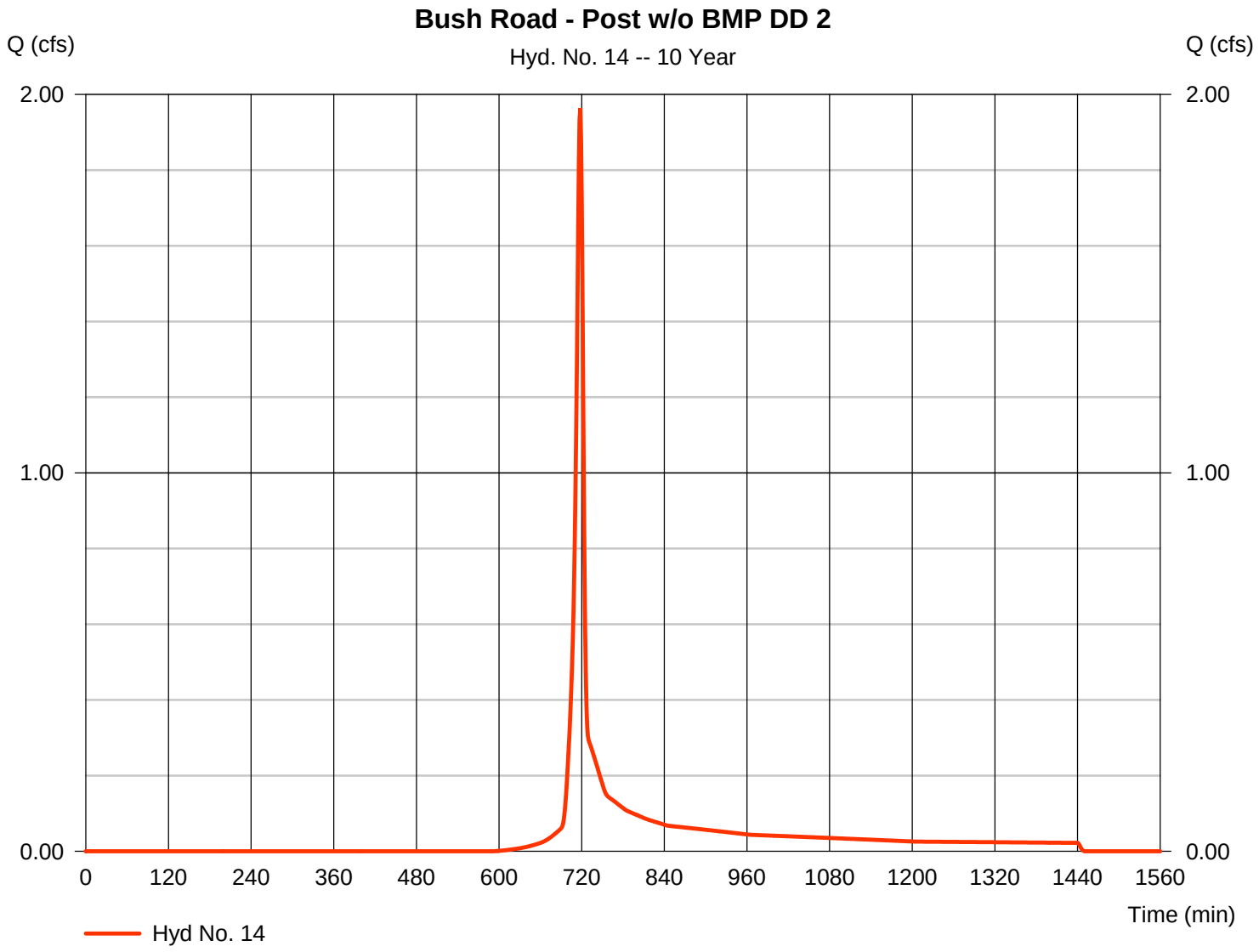
Hydrograph Report

Hyd. No. 14

Bush Road - Post w/o BMP DD 2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.964 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 3,943 cuft
Drainage area	= 0.760 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.50 min
Total precip.	= 3.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 14

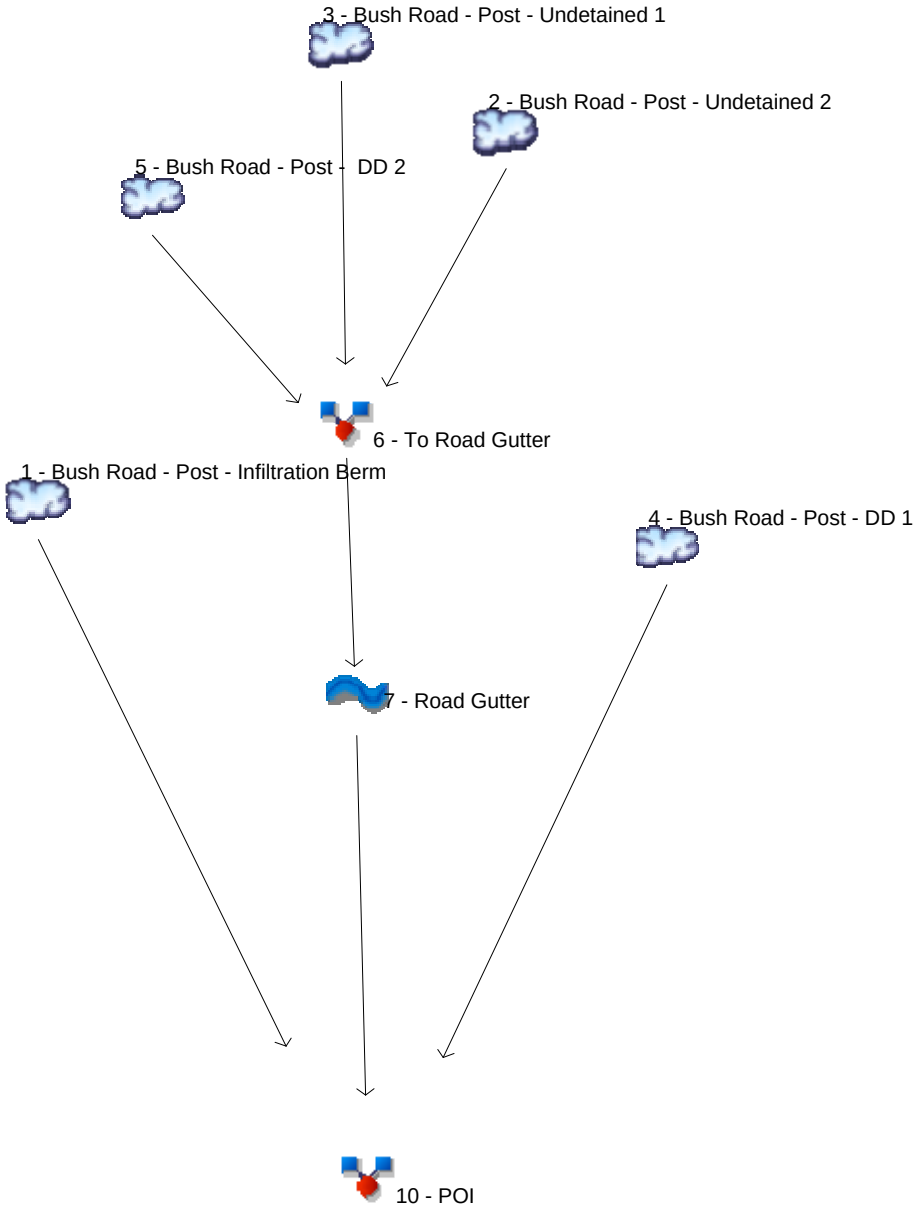
Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
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	= 0.060		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 ..... 6.50 min

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	0.697	1	739	3,536	------	------	------	Bush Road - Post - Infiltration Berm
2	SCS Runoff	3.036	1	719	6,419	------	------	------	Bush Road - Post - Undetained 2
3	SCS Runoff	0.278	1	718	588	------	------	------	Bush Road - Post - Undetained 1
4	SCS Runoff	4.778	1	720	10,845	------	------	------	Bush Road - Post - DD 1
5	SCS Runoff	1.768	1	719	3,728	------	------	------	Bush Road - Post - DD 2
6	Combine	5.081	1	719	10,735	2, 3, 5	------	------	To Road Gutter
7	Reach	4.962	1	720	10,734	6	------	------	Road Gutter
10	Combine	10.07	1	720	25,115	1, 4, 7,	------	------	POI

Hydrograph Report

Hyd. No. 1

Bush Road - Post - Infiltration Berm

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.697 cfs
Storm frequency	=	10 yrs	Time to peak	=	739 min
Time interval	=	1 min	Hyd. volume	=	3,536 cuft
Drainage area	=	0.610 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	41.90 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610

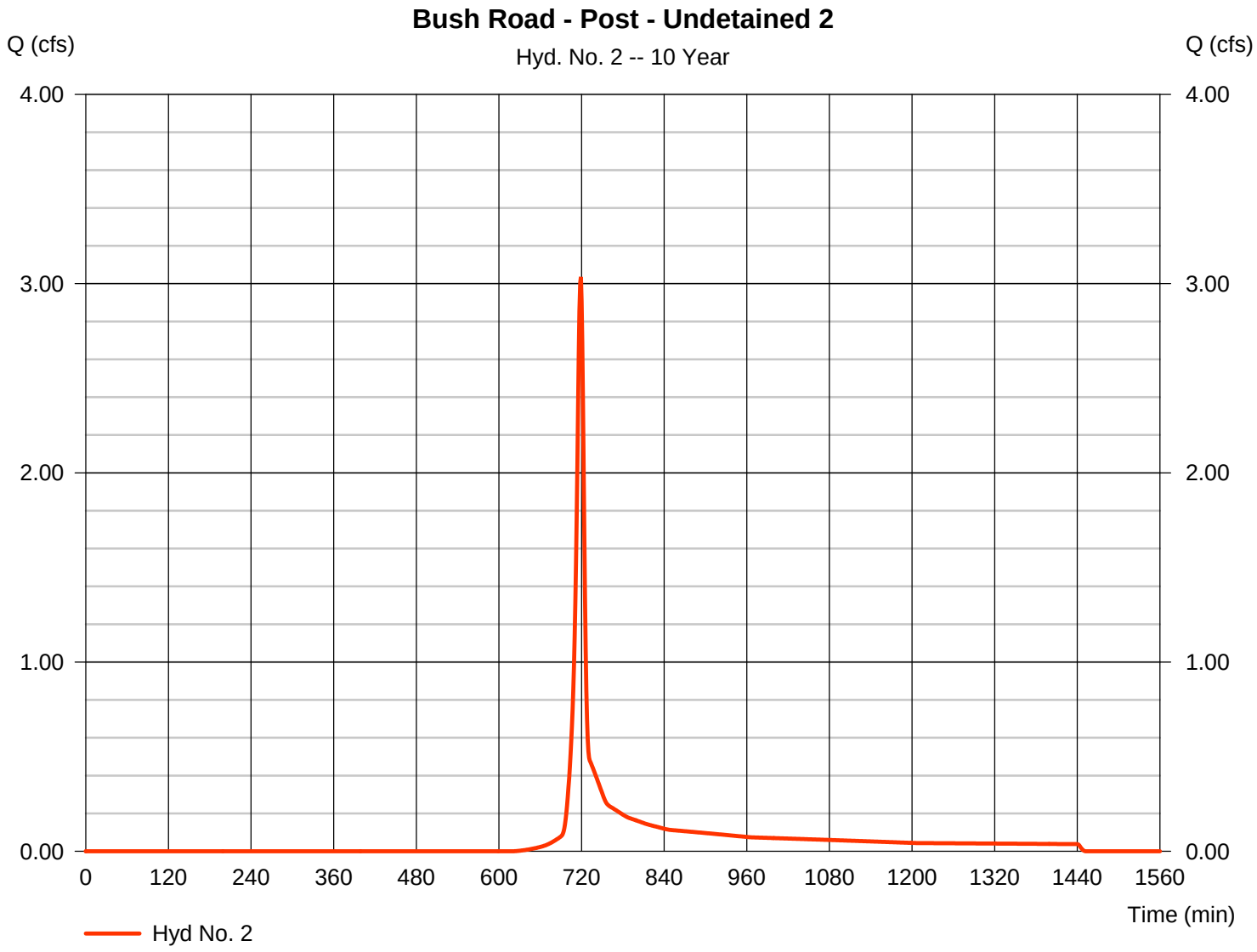
Hydrograph Report

Hyd. No. 2

Bush Road - Post - Undetained 2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.036 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 6,419 cuft
Drainage area	= 1.440 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 3.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post - Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

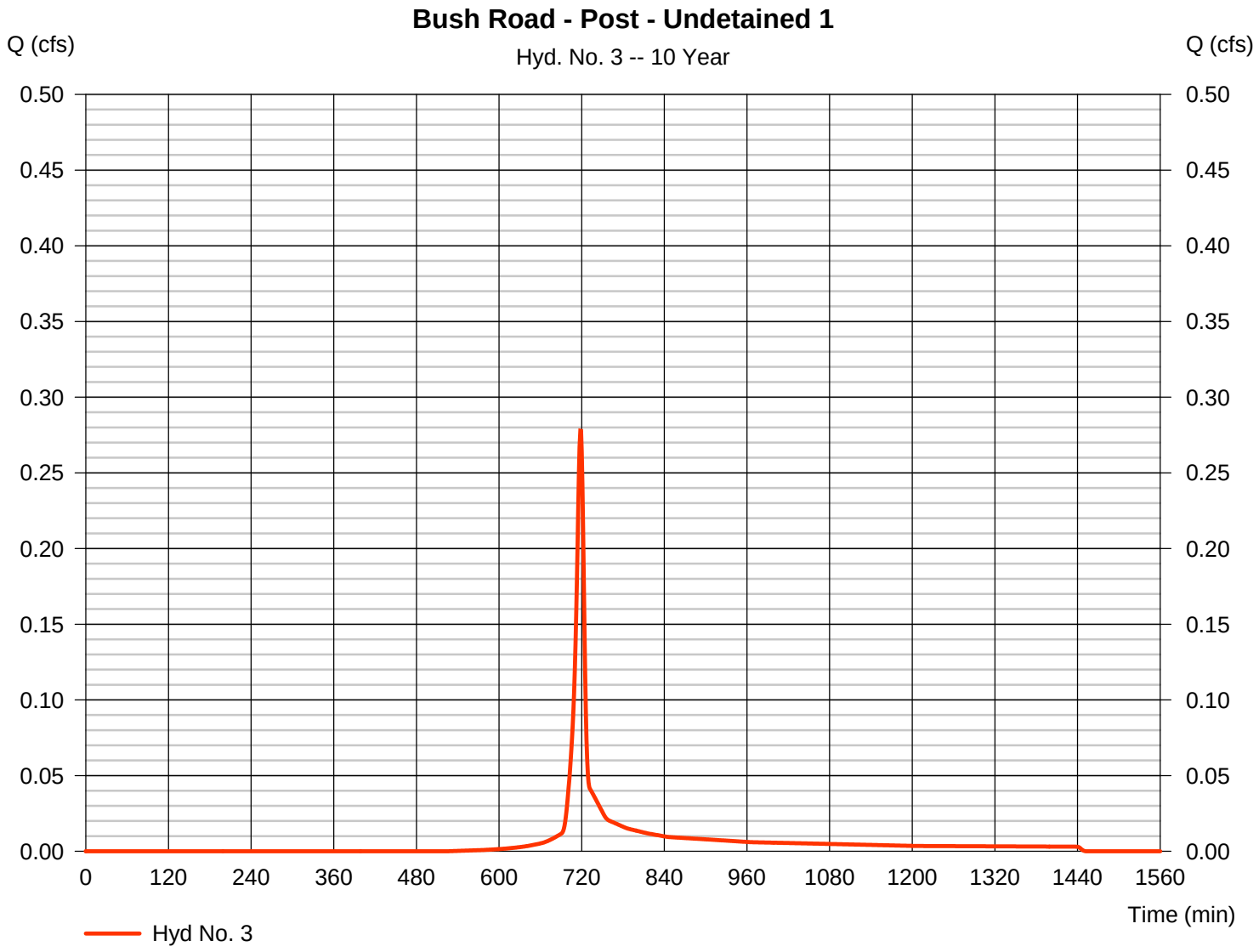
Hydrograph Report

Hyd. No. 3

Bush Road - Post - Undetained 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.278 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	588 cuft
Drainage area	=	0.100 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post - Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

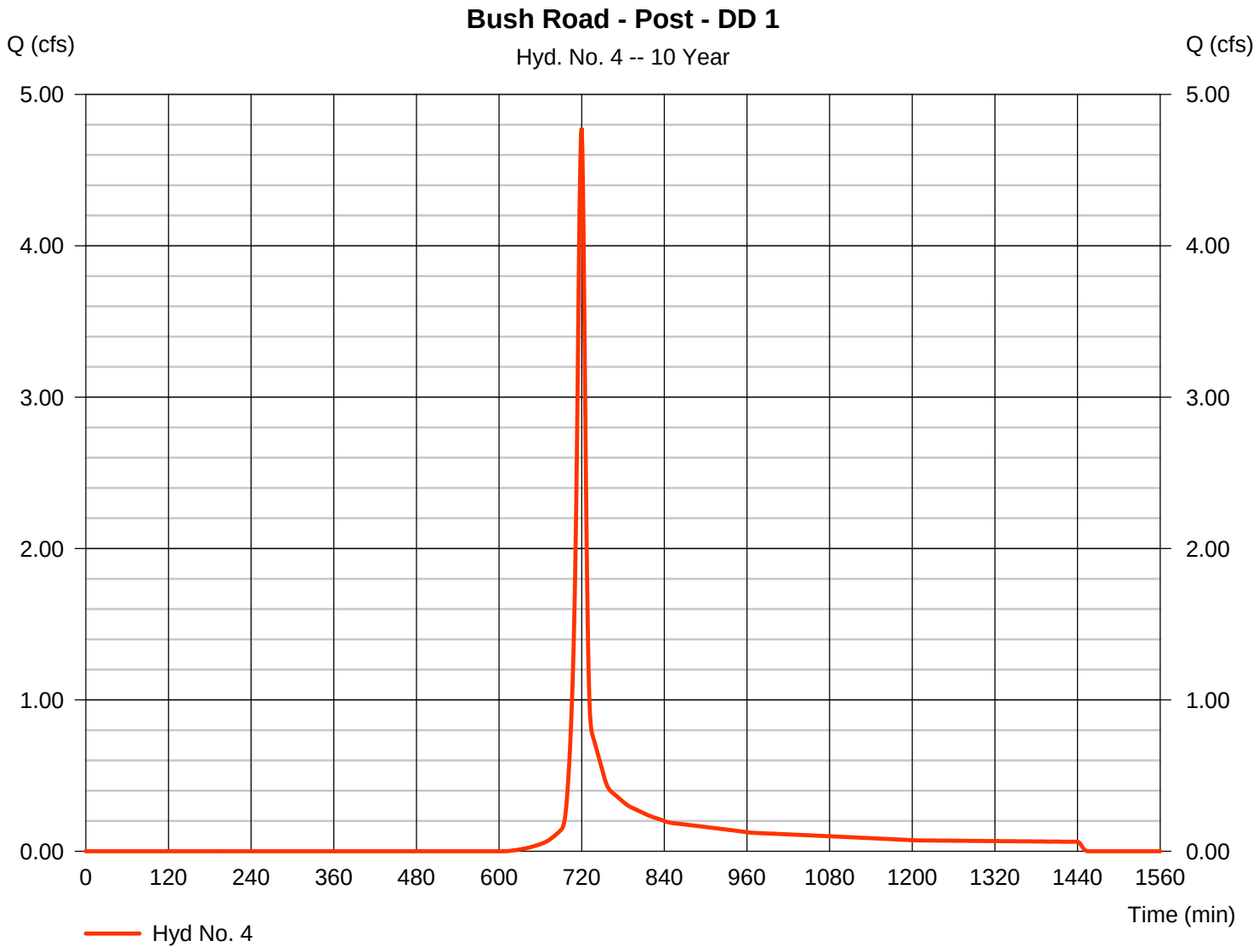
Hydrograph Report

Hyd. No. 4

Bush Road - Post - DD 1

Hydrograph type	= SCS Runoff	Peak discharge	= 4.778 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 10,845 cuft
Drainage area	= 2.260 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.50 min
Total precip.	= 3.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post - DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

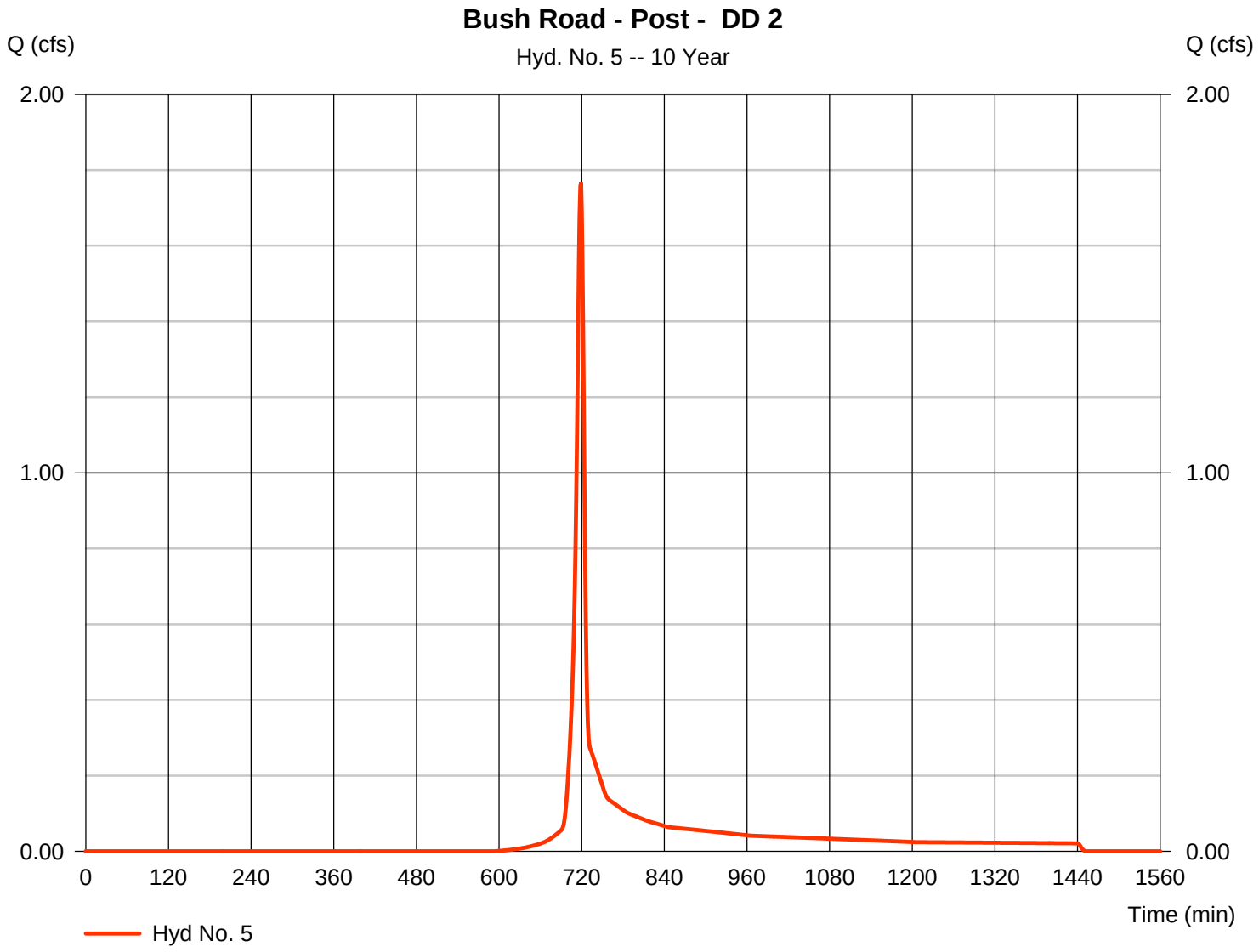
Hydrograph Report

Hyd. No. 5

Bush Road - Post - DD 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.768 cfs
Storm frequency	=	10 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	3,728 cuft
Drainage area	=	0.760 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	3.44 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post - DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

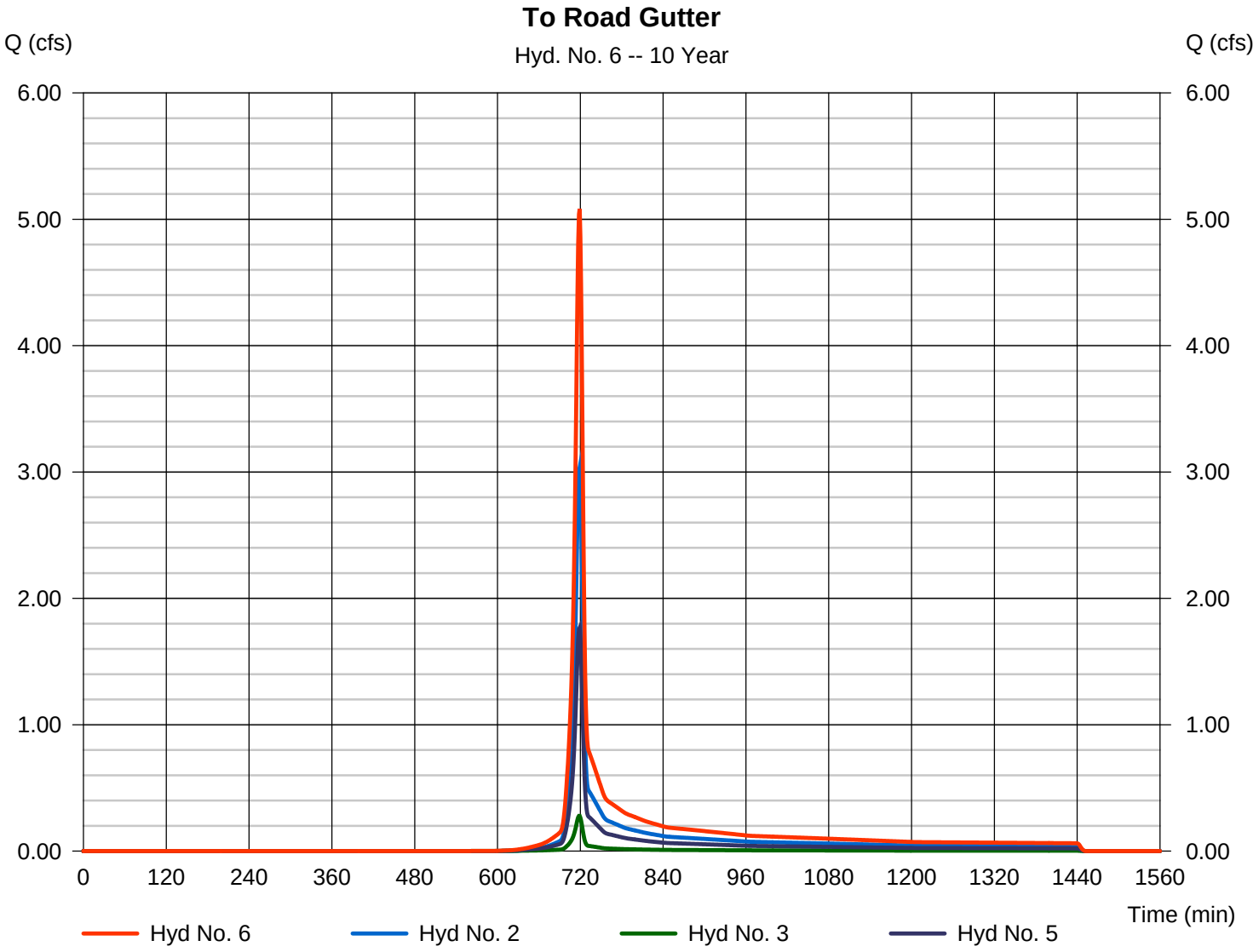
Total Travel Time, Tc ..... 6.70 min

Hydrograph Report

Hyd. No. 6

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 5.081 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 10,735 cuft
Inflow hyds.	= 2, 3, 5	Contrib. drain. area	= 2.300 ac



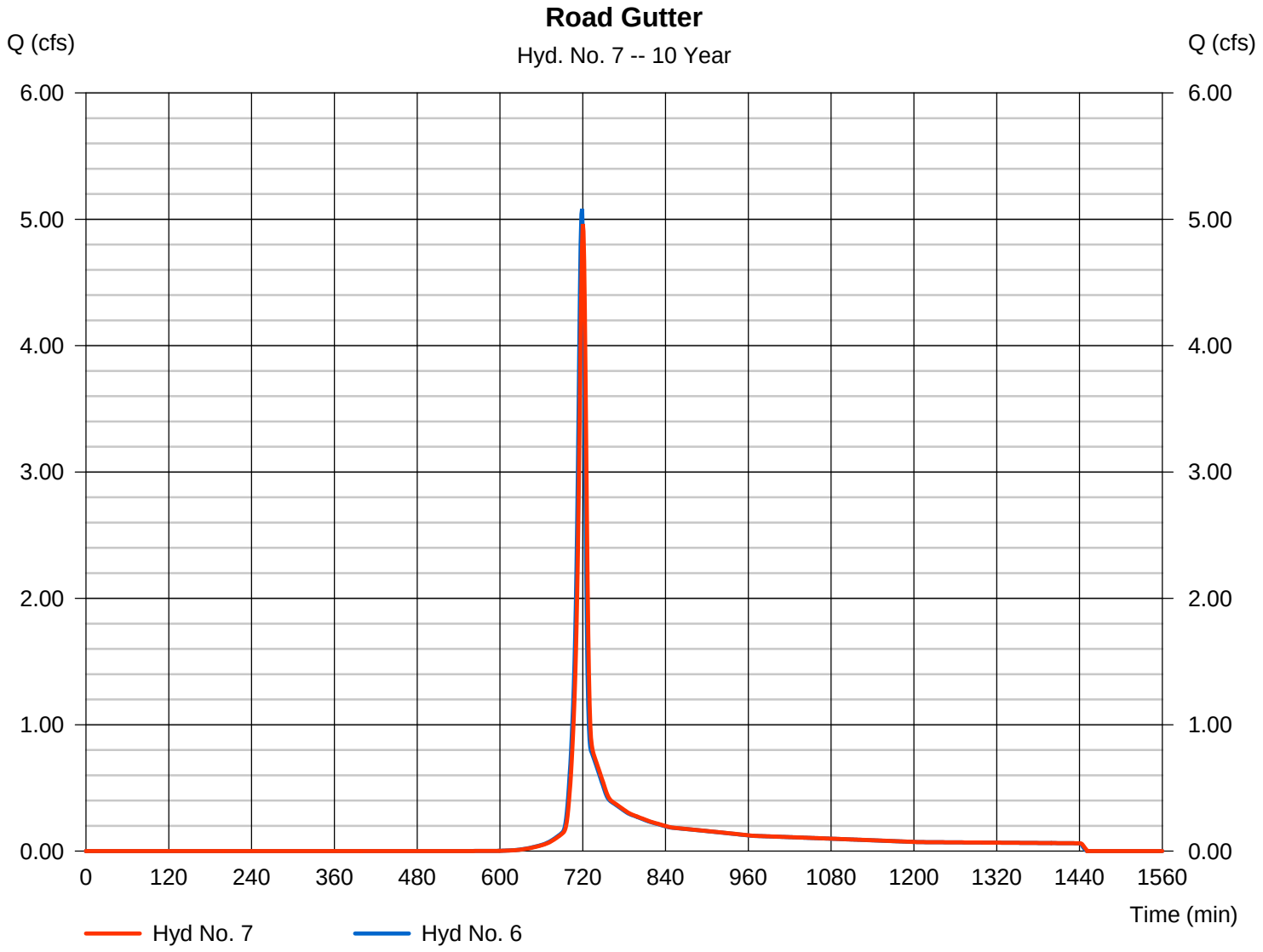
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	4.962 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	10,734 cuft
Inflow hyd. No.	=	6 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5715

Modified Att-Kin routing method used.

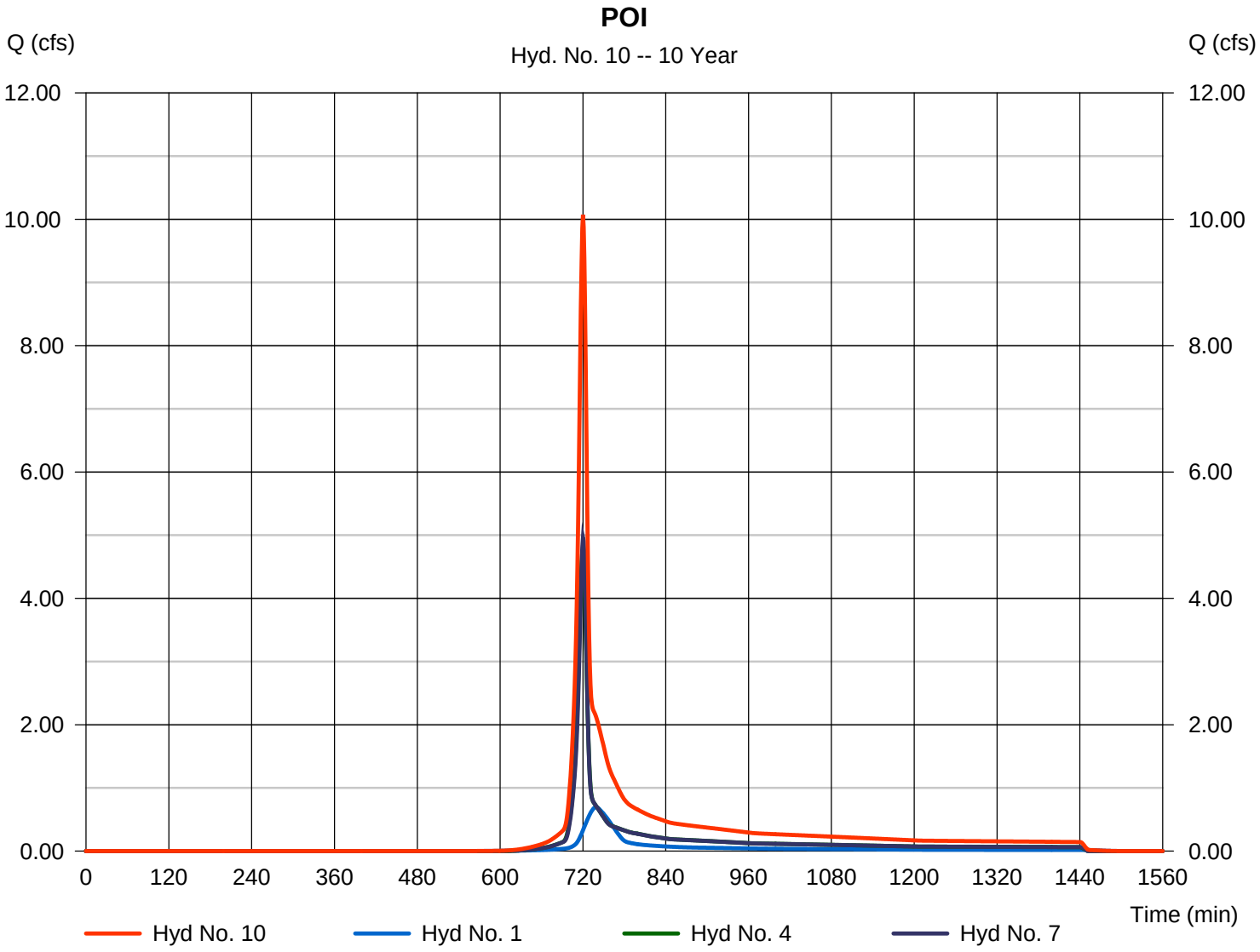


Hydrograph Report

Hyd. No. 10

POI

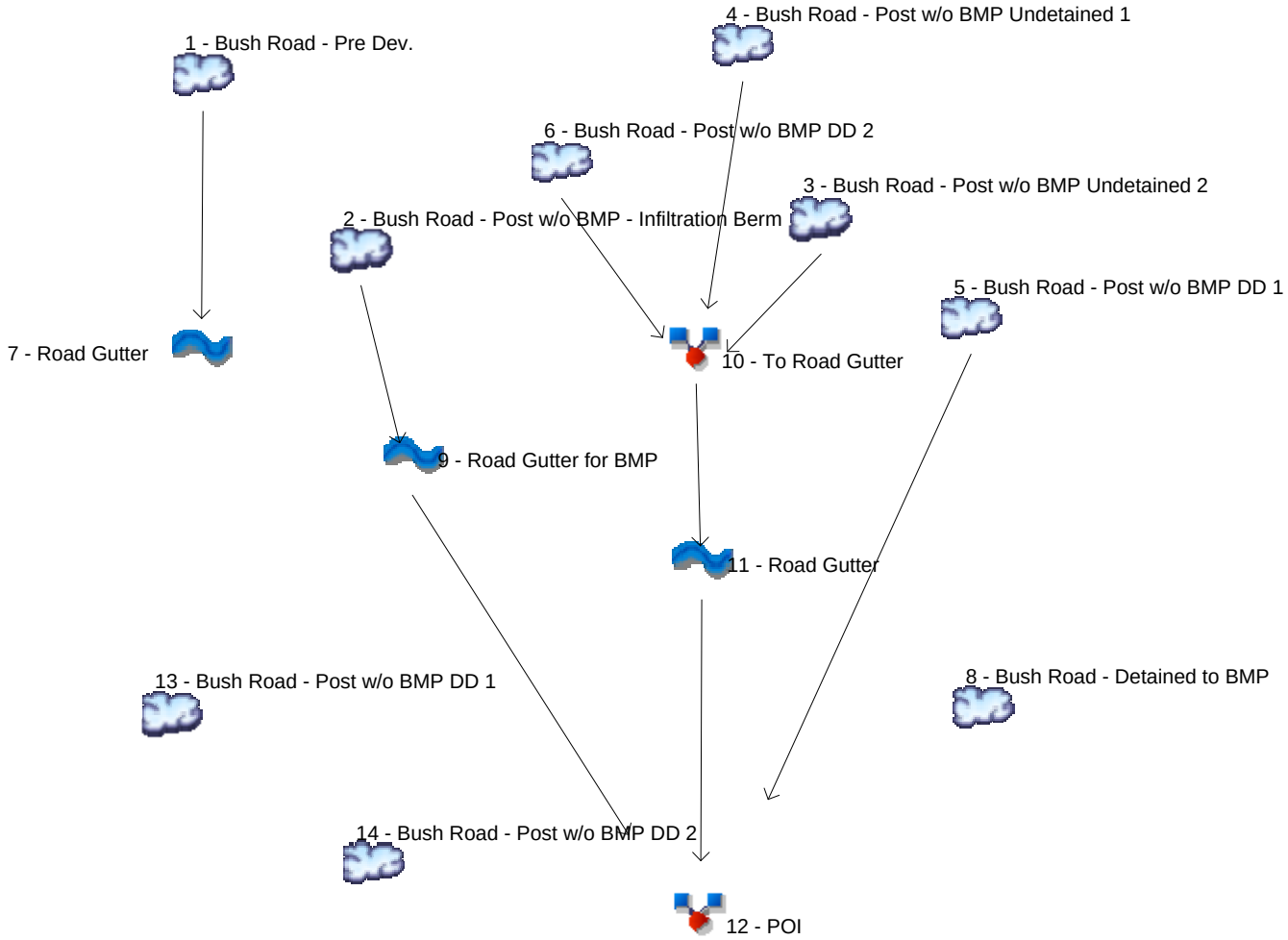
Hydrograph type	=	Combine	Peak discharge	=	10.07 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	25,115 cuft
Inflow hyds.	=	1, 4, 7	Contrib. drain. area	=	2.870 ac



ATTACHMENT C-3
BUSH RD
50 Year-24 Hour Storm

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	19.05	1	719	40,289	------	------	------	Bush Road - Pre Dev.
2	SCS Runoff	2.578	1	718	5,480	------	------	------	Bush Road - Post w/o BMP - Infiltratio
3	SCS Runoff	5.119	1	719	10,811	------	------	------	Bush Road - Post w/o BMP Undetain
4	SCS Runoff	0.436	1	718	929	------	------	------	Bush Road - Post w/o BMP Undetain
5	SCS Runoff	7.986	1	719	18,064	------	------	------	Bush Road - Post w/o BMP DD 1
6	SCS Runoff	2.903	1	718	6,143	------	------	------	Bush Road - Post w/o BMP DD 2
7	Reach	19.05	1	720	40,289	1	------	------	Road Gutter
8	SCS Runoff	2.202	2	718	5,052	------	------	------	Bush Road - Detained to BMP
9	Reach	2.522	1	720	5,479	2	------	------	Road Gutter for BMP
10	Combine	8.452	1	719	17,883	3, 4, 6,	------	------	To Road Gutter
11	Reach	8.354	1	720	17,882	10	------	------	Road Gutter
12	Combine	18.85	1	720	41,425	5, 9, 11	------	------	POI
13	SCS Runoff	9.243	1	718	18,628	------	------	------	Bush Road - Post w/o BMP DD 1
14	SCS Runoff	3.218	1	718	6,498	------	------	------	Bush Road - Post w/o BMP DD 2

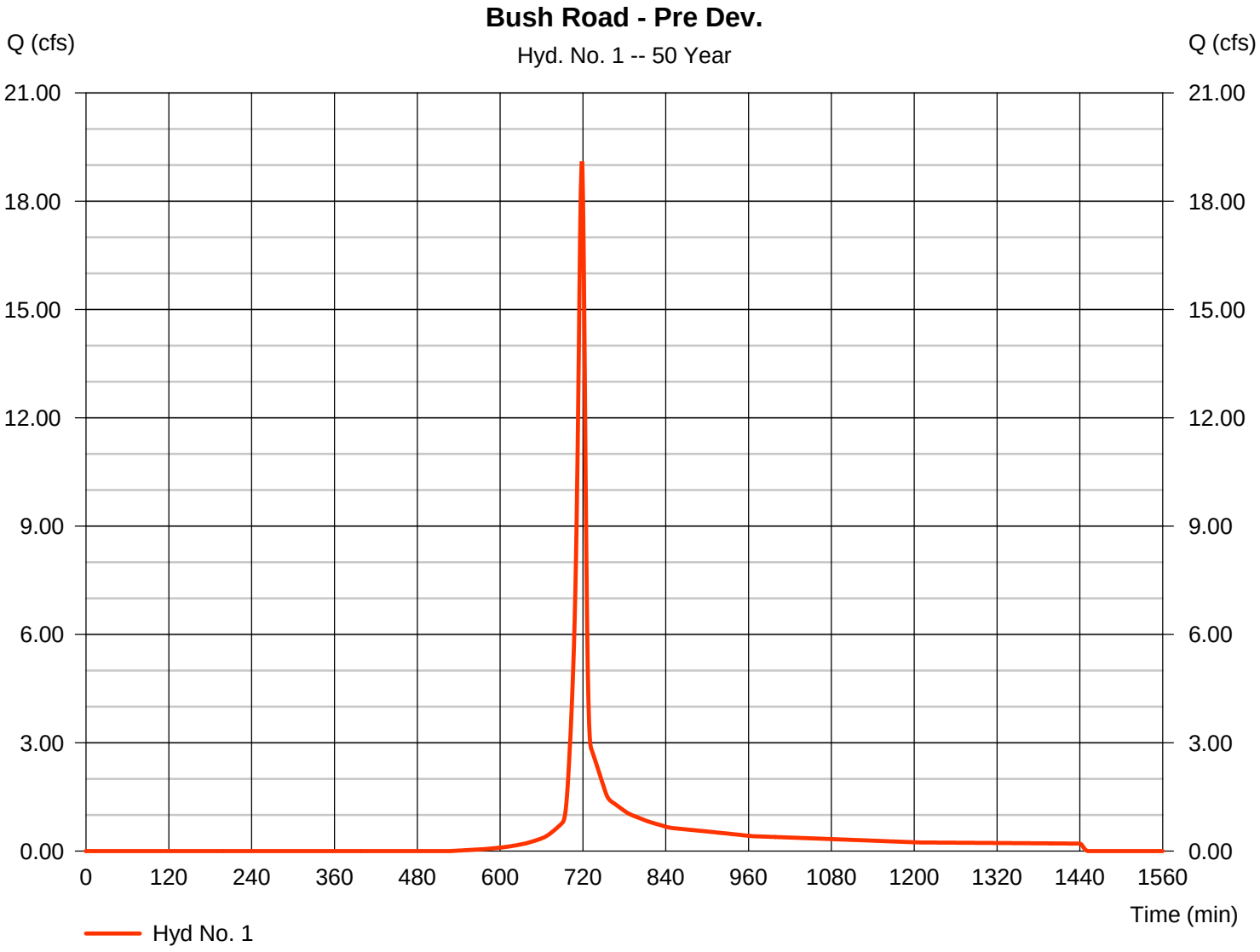
Hydrograph Report

Hyd. No. 1

Bush Road - Pre Dev.

Hydrograph type	= SCS Runoff	Peak discharge	= 19.05 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 40,289 cuft
Drainage area	= 5.170 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.80 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.370 x 78) + (1.350 x 70) + (0.060 x 91) + (0.390 x 77)] / 5.170



TR55 Tc Worksheet

Hyd. No. 1

Bush Road - Pre Dev.

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 243.00		800.00		0.00		
Watercourse slope (%)	= 24.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		5.10		0.00		
Travel Time (min)	**= 0.51**	**+**	**2.61**	**+**	**0.00**	**=**	**3.13**
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 ..... 7.80 min

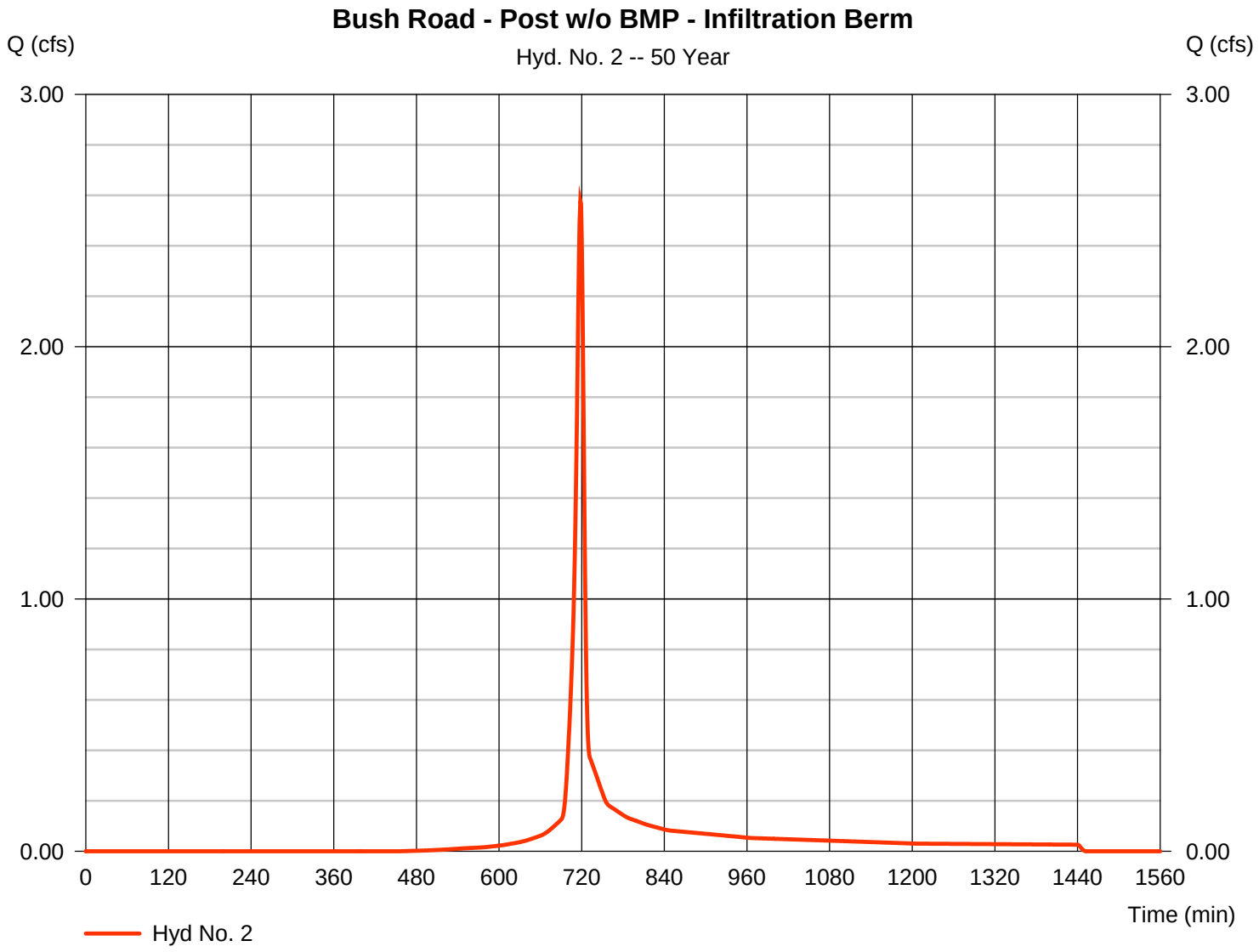
Hydrograph Report

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.578 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	5,480 cuft
Drainage area	=	0.610 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.90 min
Total precip.	=	4.59 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		629.00		75.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**2.17**	**+**	**0.27**	**=**	**2.79**
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 ..... 6.90 min

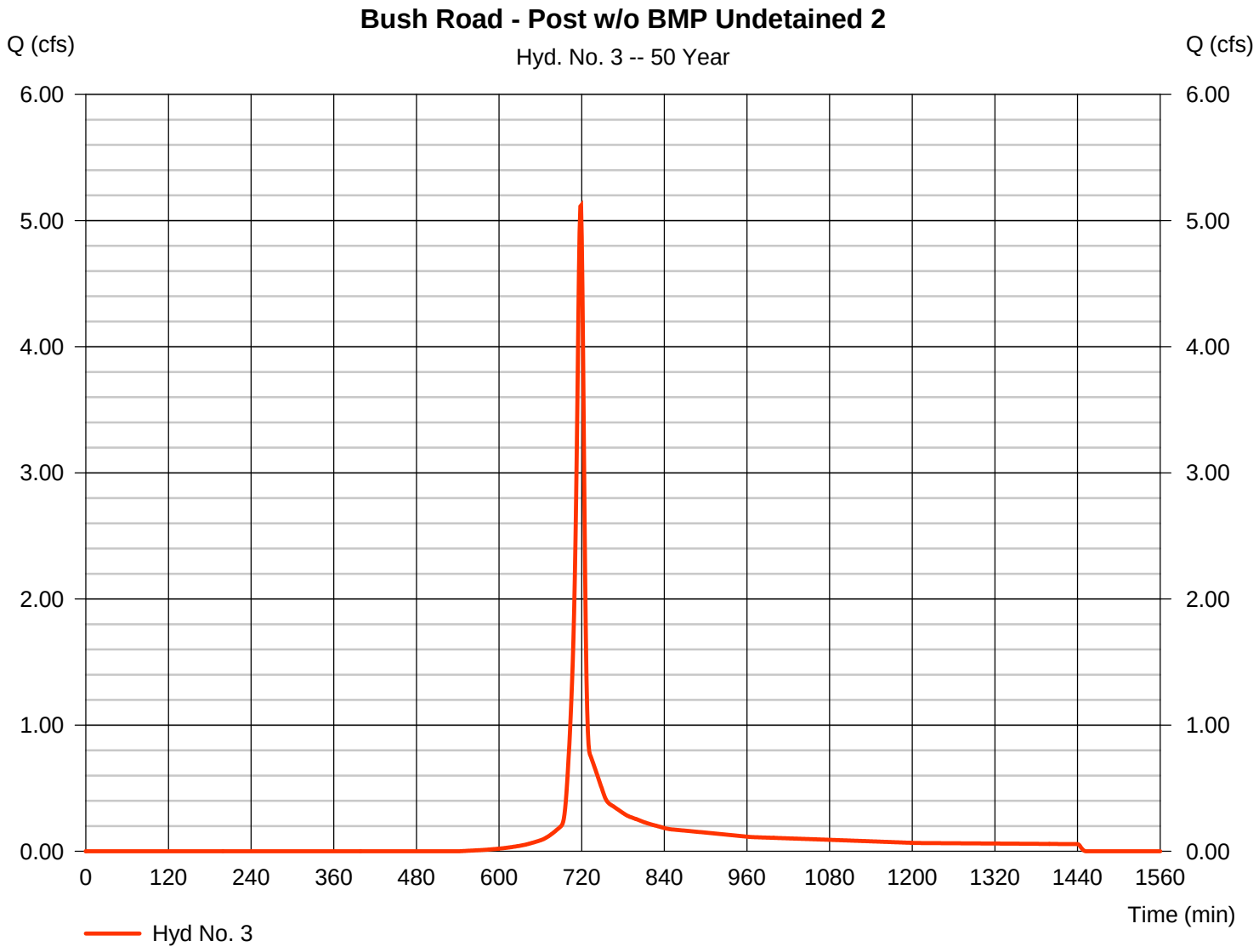
Hydrograph Report

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Hydrograph type	= SCS Runoff	Peak discharge	= 5.119 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 10,811 cuft
Drainage area	= 1.440 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

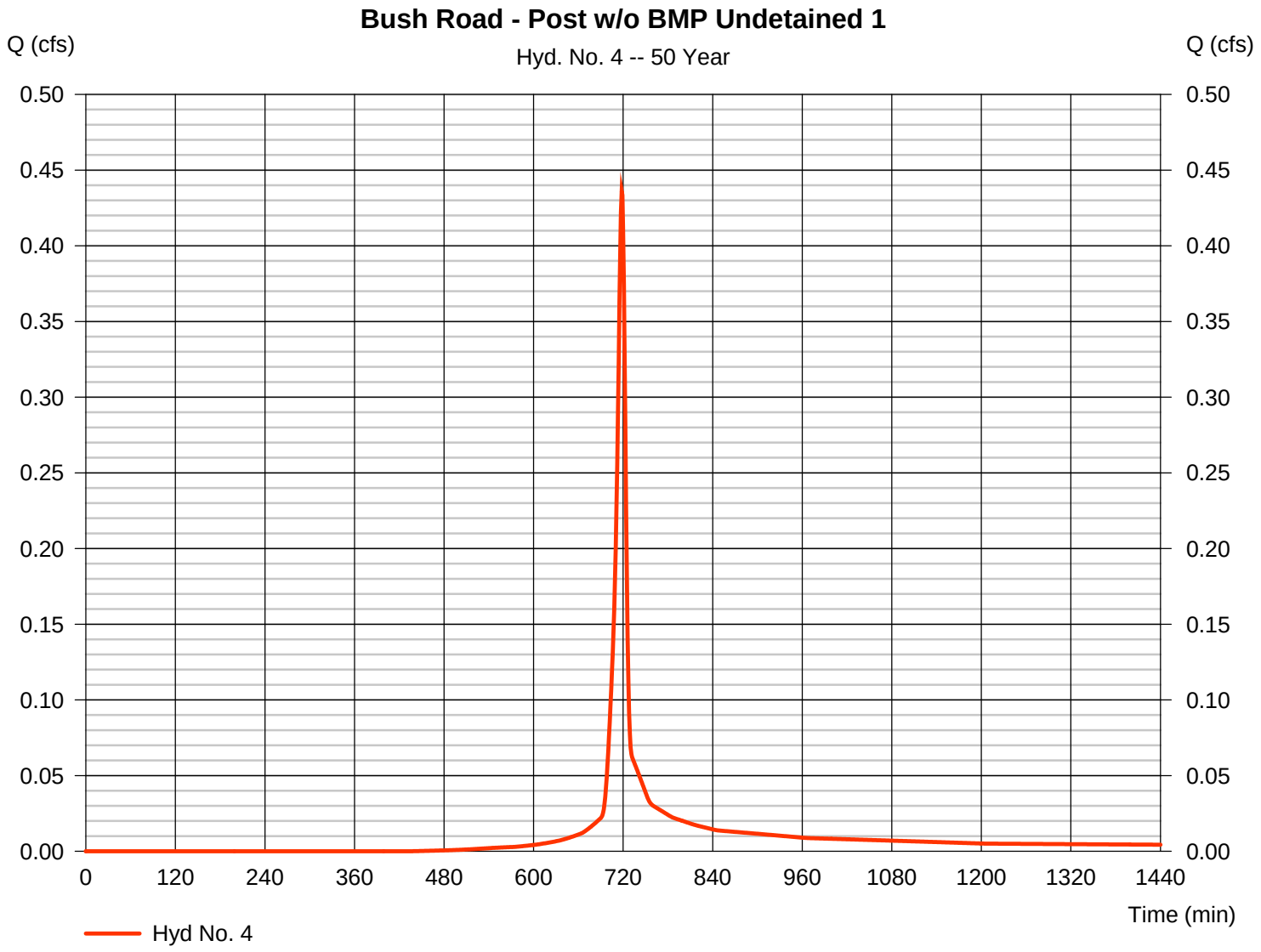
Hydrograph Report

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.436 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 929 cuft
Drainage area	= 0.100 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

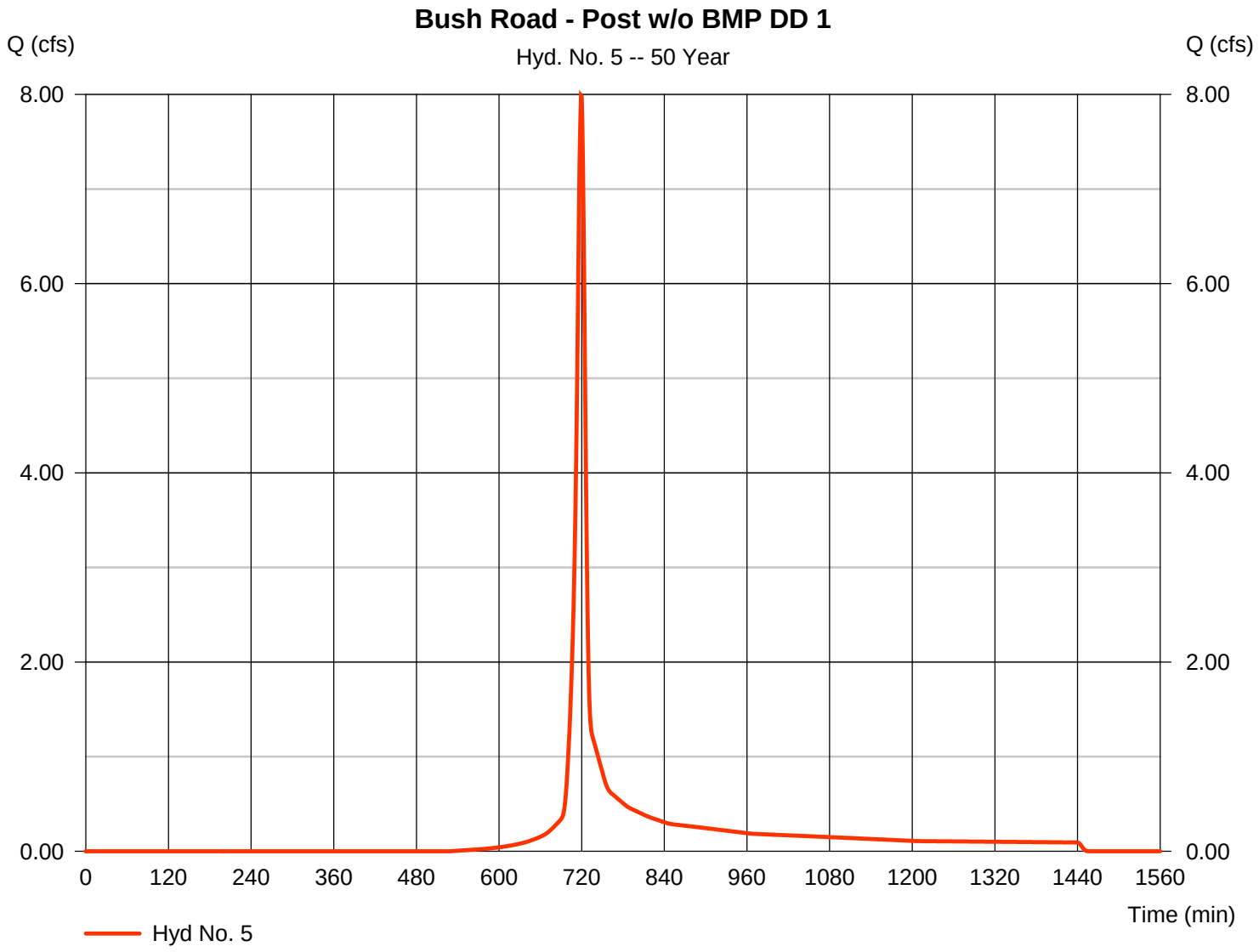
Hydrograph Report

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Hydrograph type	= SCS Runoff	Peak discharge	= 7.986 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 18,064 cuft
Drainage area	= 2.260 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.50 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

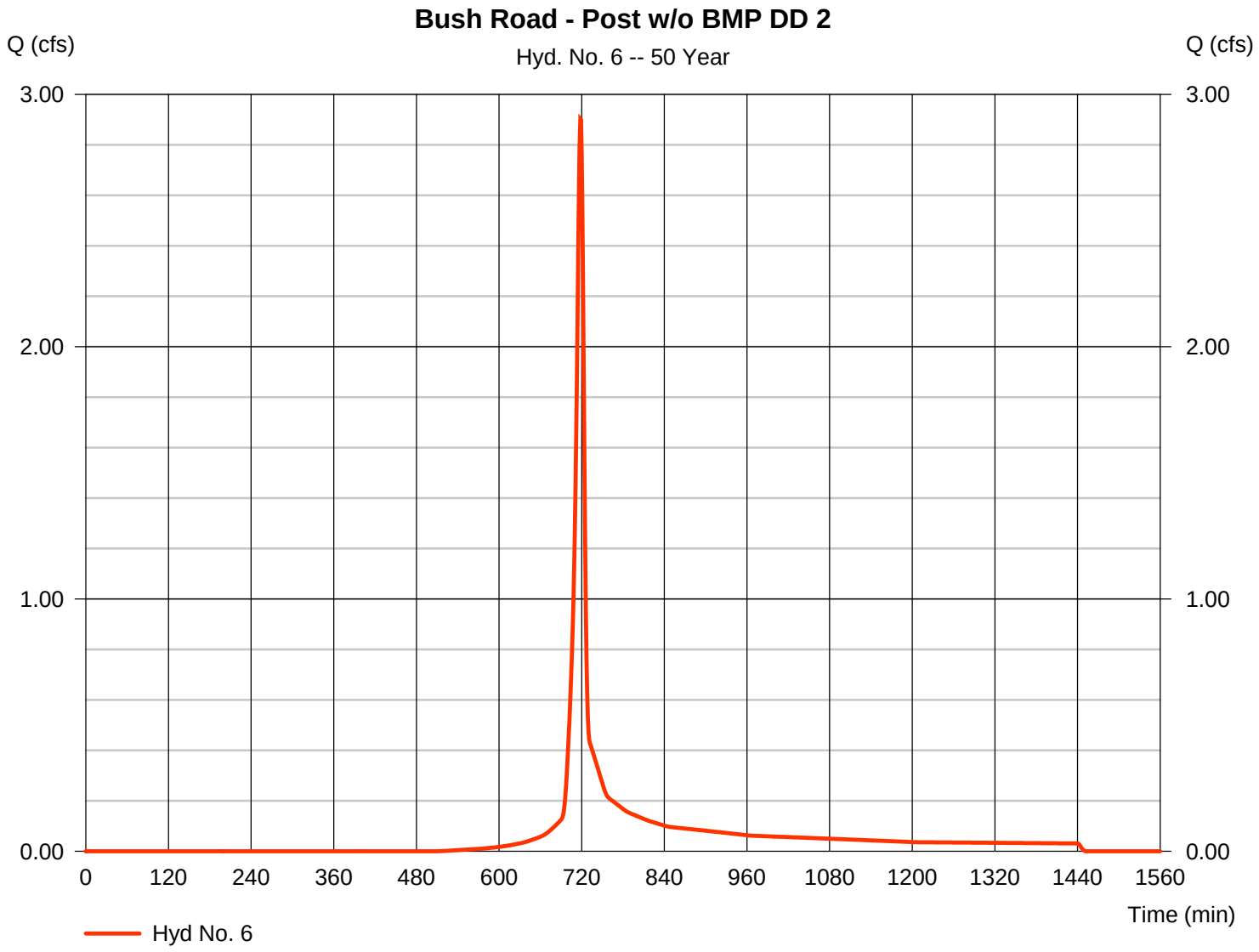
Hydrograph Report

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.903 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	6,143 cuft
Drainage area	=	0.760 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	4.59 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

Total Travel Time, Tc ..... 6.70 min

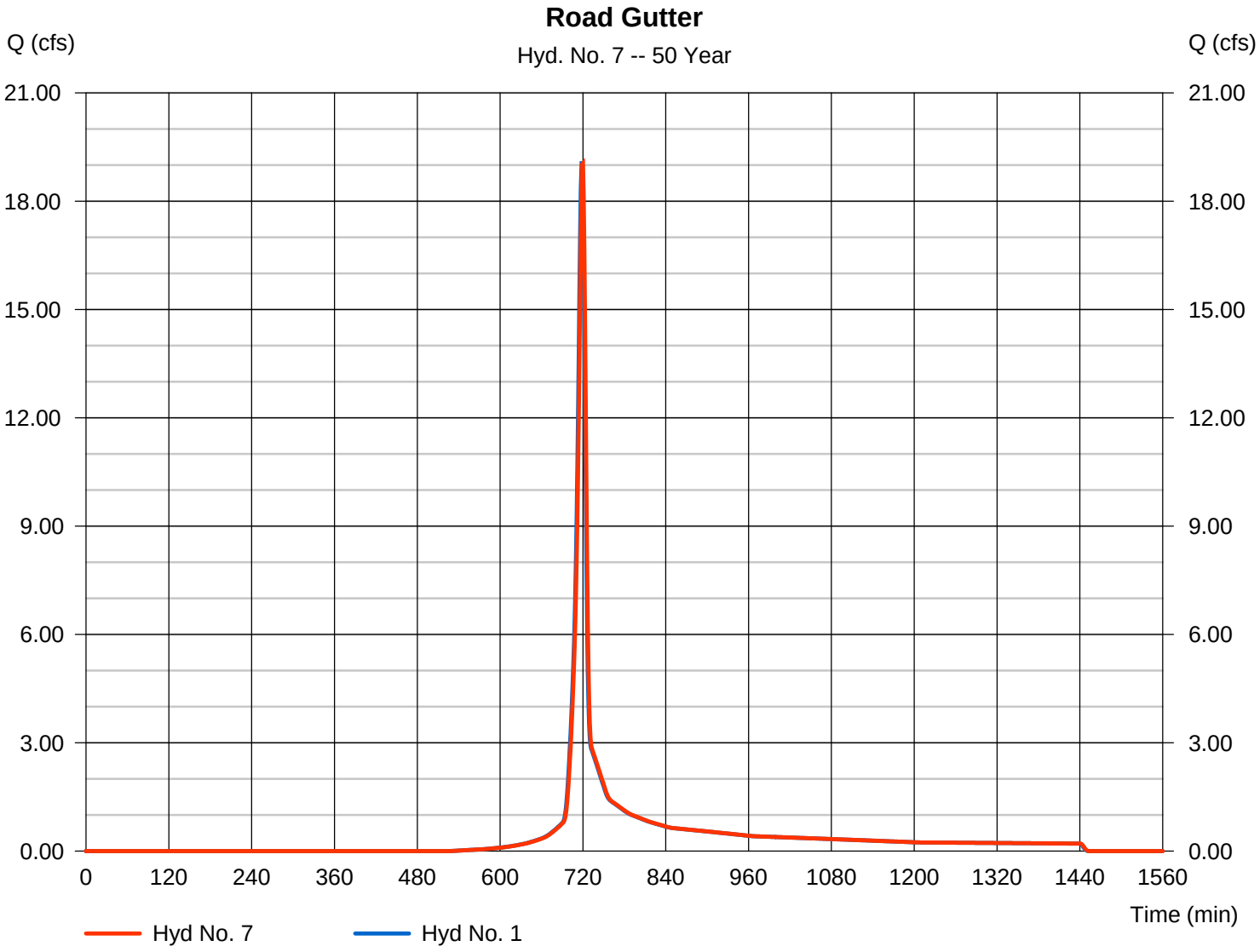
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	19.05 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	40,289 cuft
Inflow hyd. No.	=	1 - Bush Road - Pre Dev.	Section type	=	Triangular
Reach length	=	265.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.308	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.9707

Modified Att-Kin routing method used.



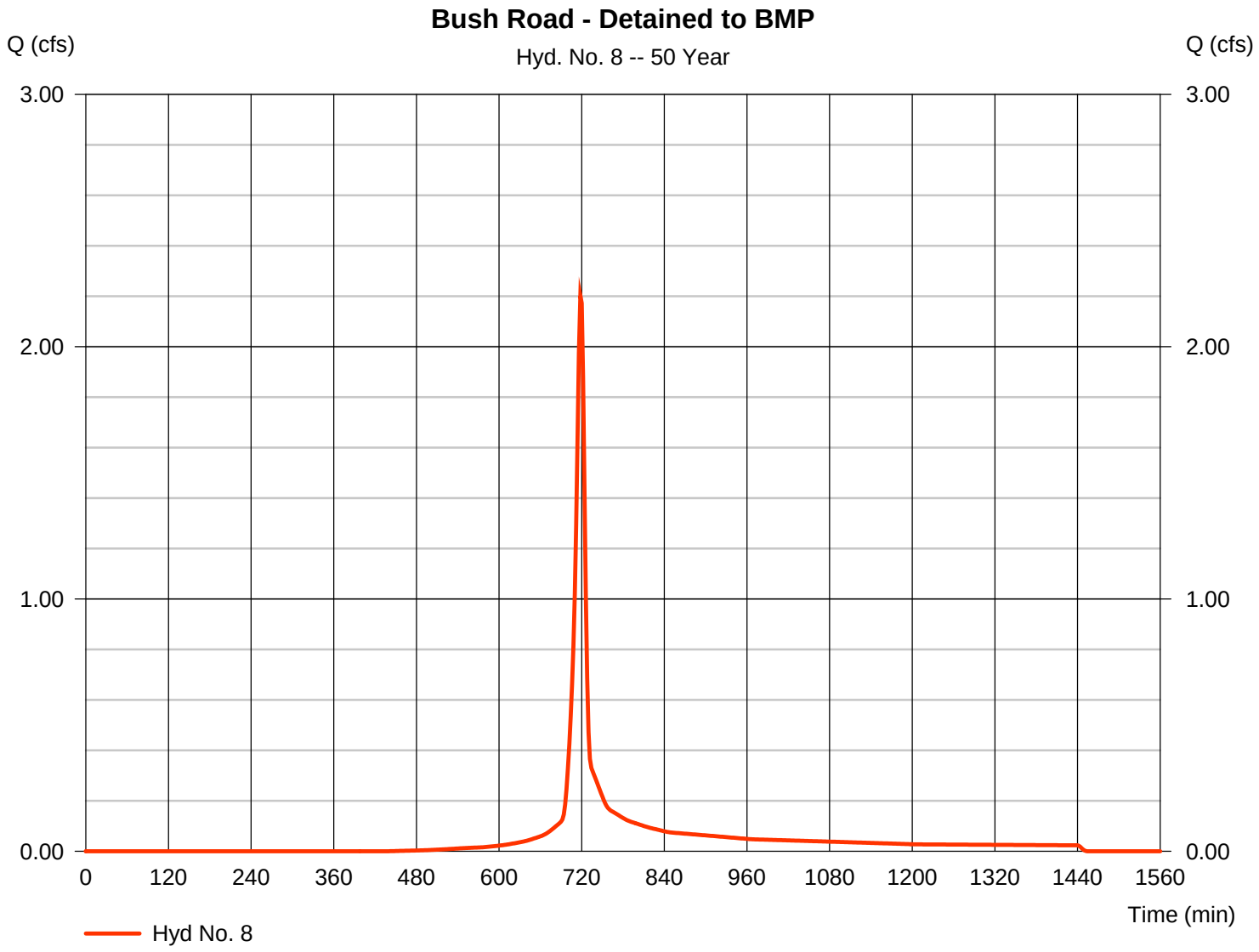
Hydrograph Report

Hyd. No. 8

Bush Road - Detained to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.202 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	5,052 cuft
Drainage area	=	0.530 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	4.59 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.010 x 77) + (0.360 x 78) + (0.130 x 91)] / 0.530



TR55 Tc Worksheet

Hyd. No. 8

Bush Road - Detained to BMP

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		535.00		70.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**1.84**	**+**	**0.26**	**=**	**2.45**
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 ..... 6.60 min

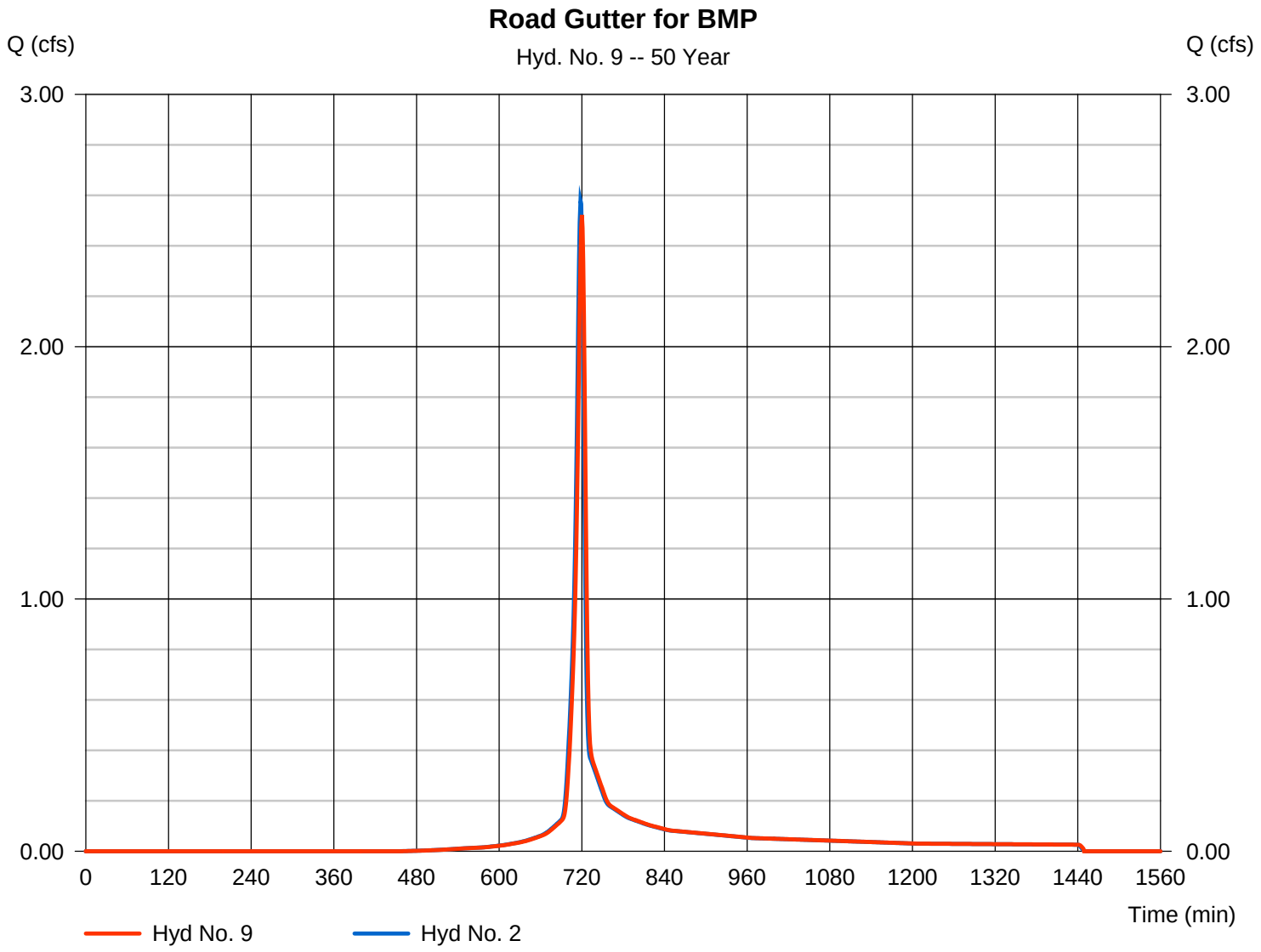
Hydrograph Report

Hyd. No. 9

Road Gutter for BMP

Hydrograph type	=	Reach	Peak discharge	=	2.522 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	5,479 cuft
Inflow hyd. No.	=	2 - Bush Road - Post w/o BMPs	Section type	=	Triangular
Reach length	=	450.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5457

Modified Att-Kin routing method used.

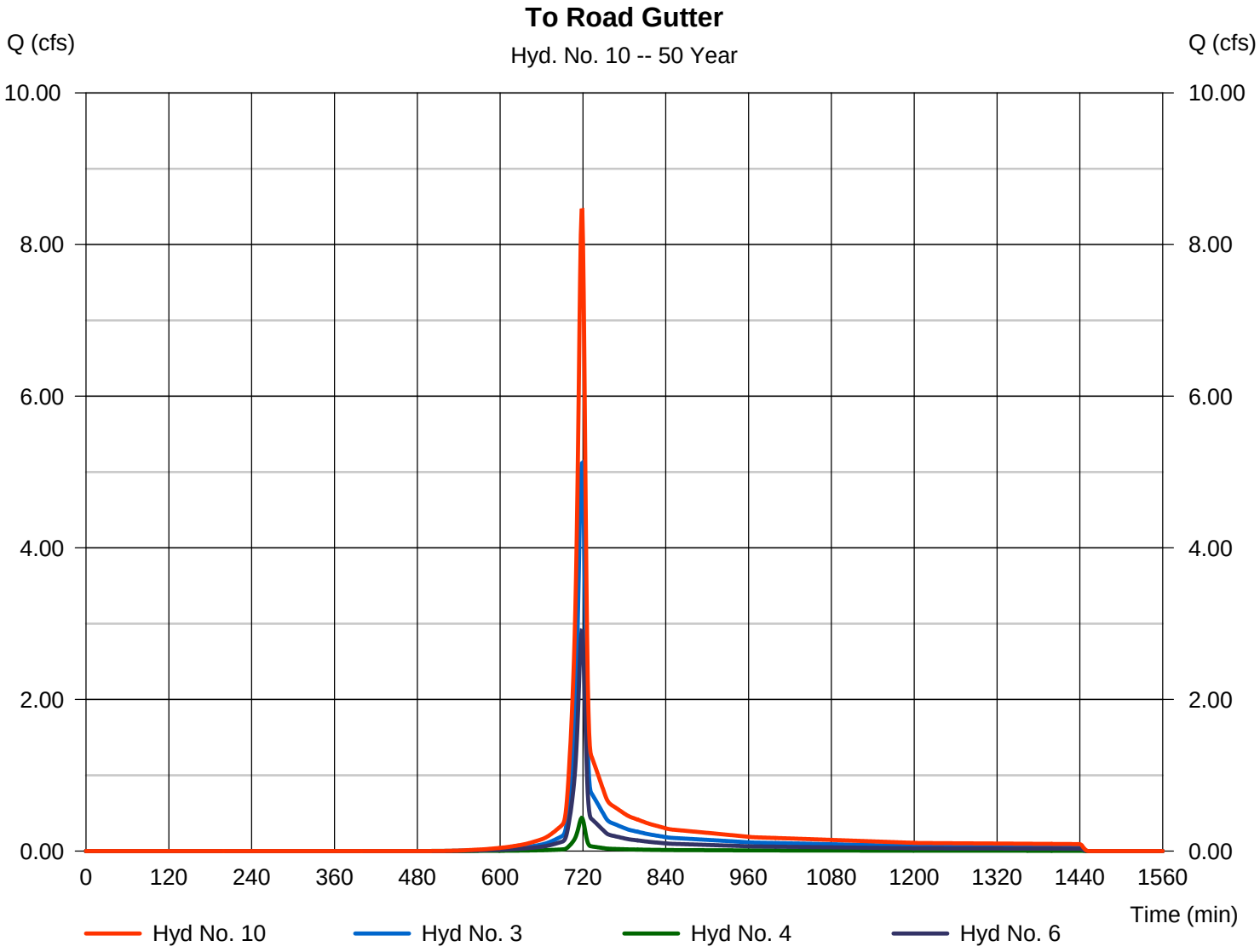


Hydrograph Report

Hyd. No. 10

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 8.452 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 17,883 cuft
Inflow hyds.	= 3, 4, 6	Contrib. drain. area	= 2.300 ac



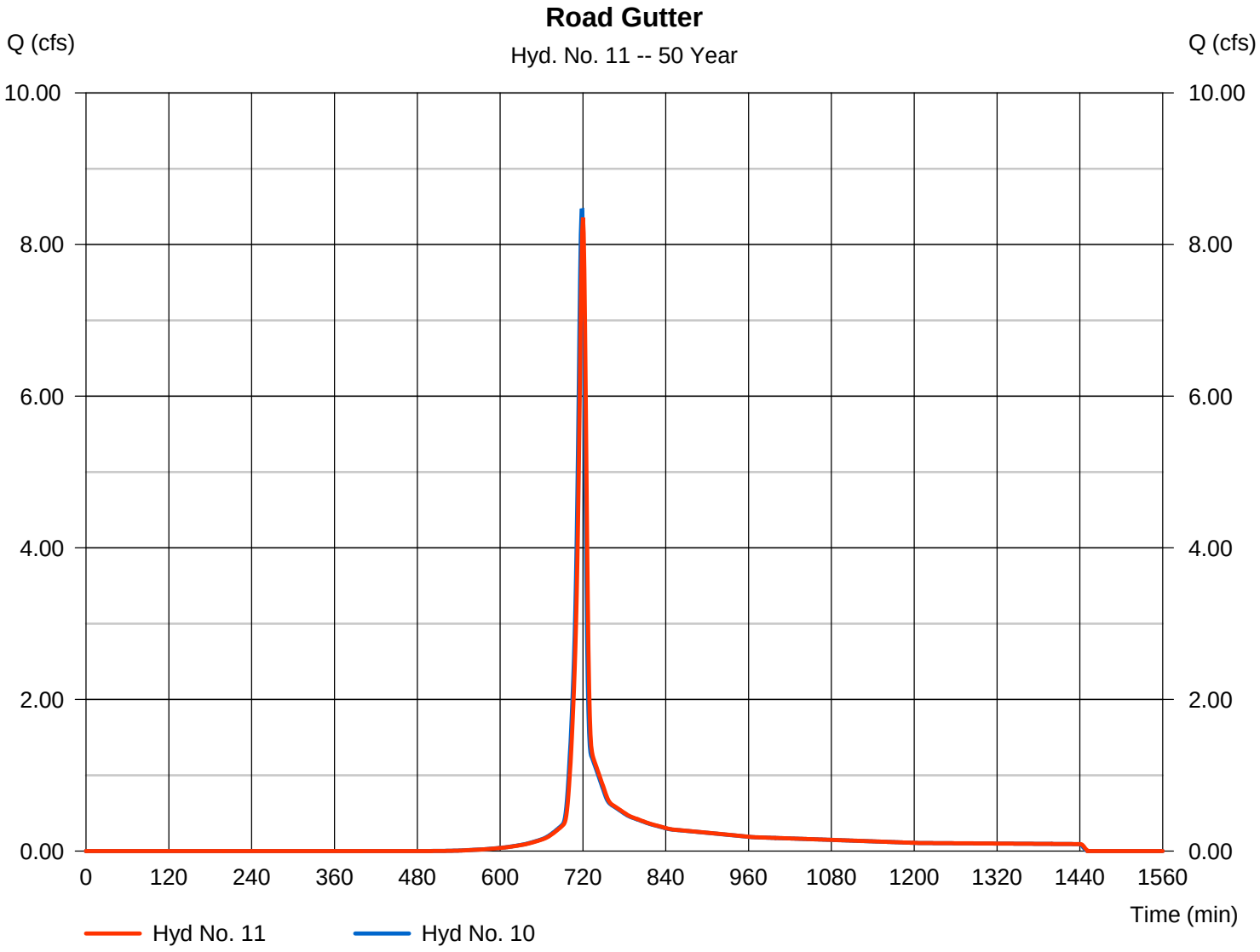
Hydrograph Report

Hyd. No. 11

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	8.354 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	17,882 cuft
Inflow hyd. No.	=	10 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.6249

Modified Att-Kin routing method used.

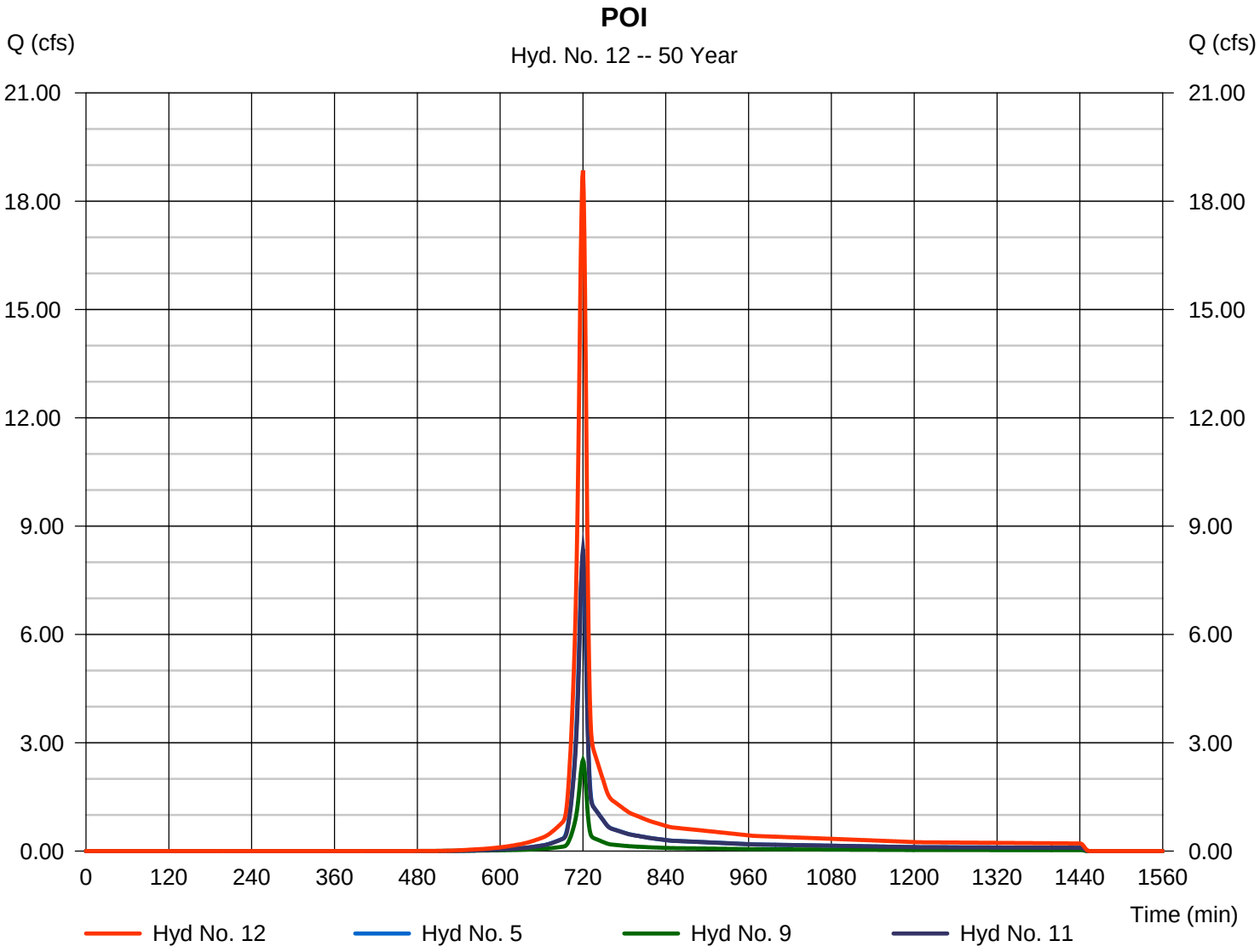


Hydrograph Report

Hyd. No. 12

POI

Hydrograph type	=	Combine	Peak discharge	=	18.85 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	41,425 cuft
Inflow hyds.	=	5, 9, 11	Contrib. drain. area	=	2.260 ac



Hydrograph Report

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Hydrograph type	= SCS Runoff	Peak discharge	= 9.243 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 18,628 cuft
Drainage area	= 2.260 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.50 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260

TR55 Tc Worksheet

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		0.00		
Watercourse slope (%)	= 23.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		0.00		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.00**	**=**	**1.86**
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	= 0.060		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 ..... 6.50 min

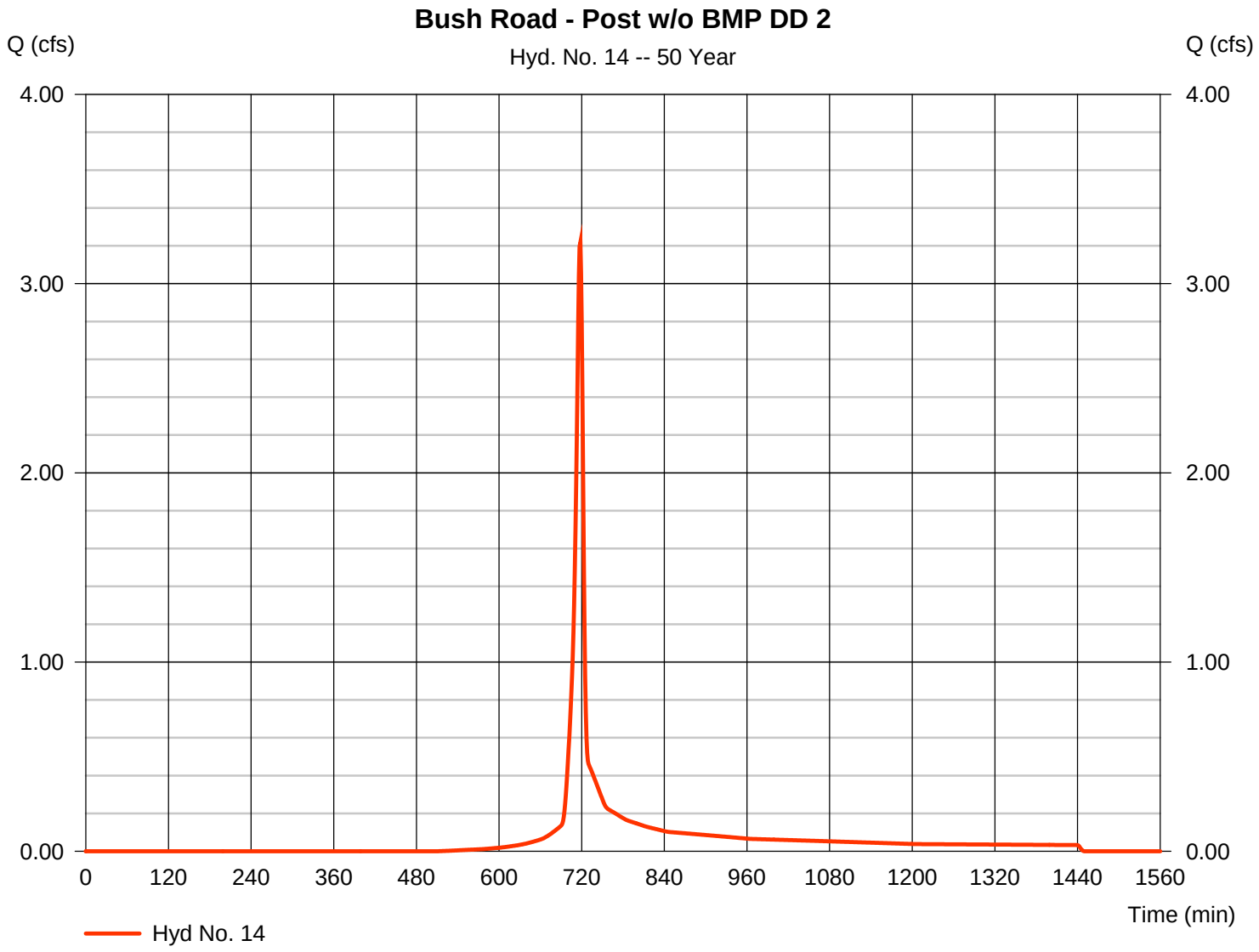
Hydrograph Report

Hyd. No. 14

Bush Road - Post w/o BMP DD 2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.218 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 6,498 cuft
Drainage area	= 0.760 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.50 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 14

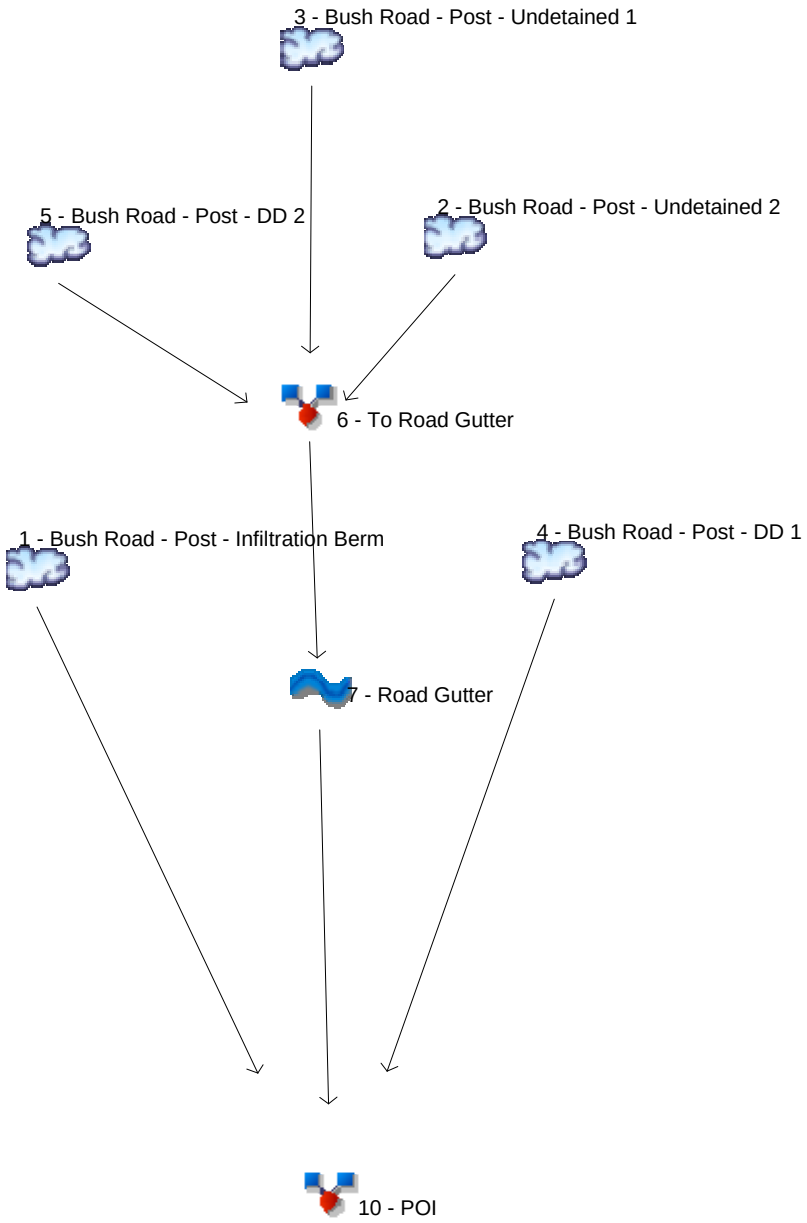
Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
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	= 0.060		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 ..... 6.50 min

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	1.407	1	731	5,621	------	------	------	Bush Road - Post - Infiltration Berm
2	SCS Runoff	5.119	1	719	10,811	------	------	------	Bush Road - Post - Undetained 2
3	SCS Runoff	0.436	1	718	929	------	------	------	Bush Road - Post - Undetained 1
4	SCS Runoff	7.986	1	719	18,064	------	------	------	Bush Road - Post - DD 1
5	SCS Runoff	2.903	1	718	6,143	------	------	------	Bush Road - Post - DD 2
6	Combine	8.452	1	719	17,883	2, 3, 5	------	------	To Road Gutter
7	Reach	8.354	1	720	17,882	6	------	------	Road Gutter
10	Combine	17.26	1	720	41,567	1, 4, 7,	------	------	POI

Hydrograph Report

Hyd. No. 1

Bush Road - Post - Infiltration Berm

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.407 cfs
Storm frequency	=	50 yrs	Time to peak	=	731 min
Time interval	=	1 min	Hyd. volume	=	5,621 cuft
Drainage area	=	0.610 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	29.10 min
Total precip.	=	4.59 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610

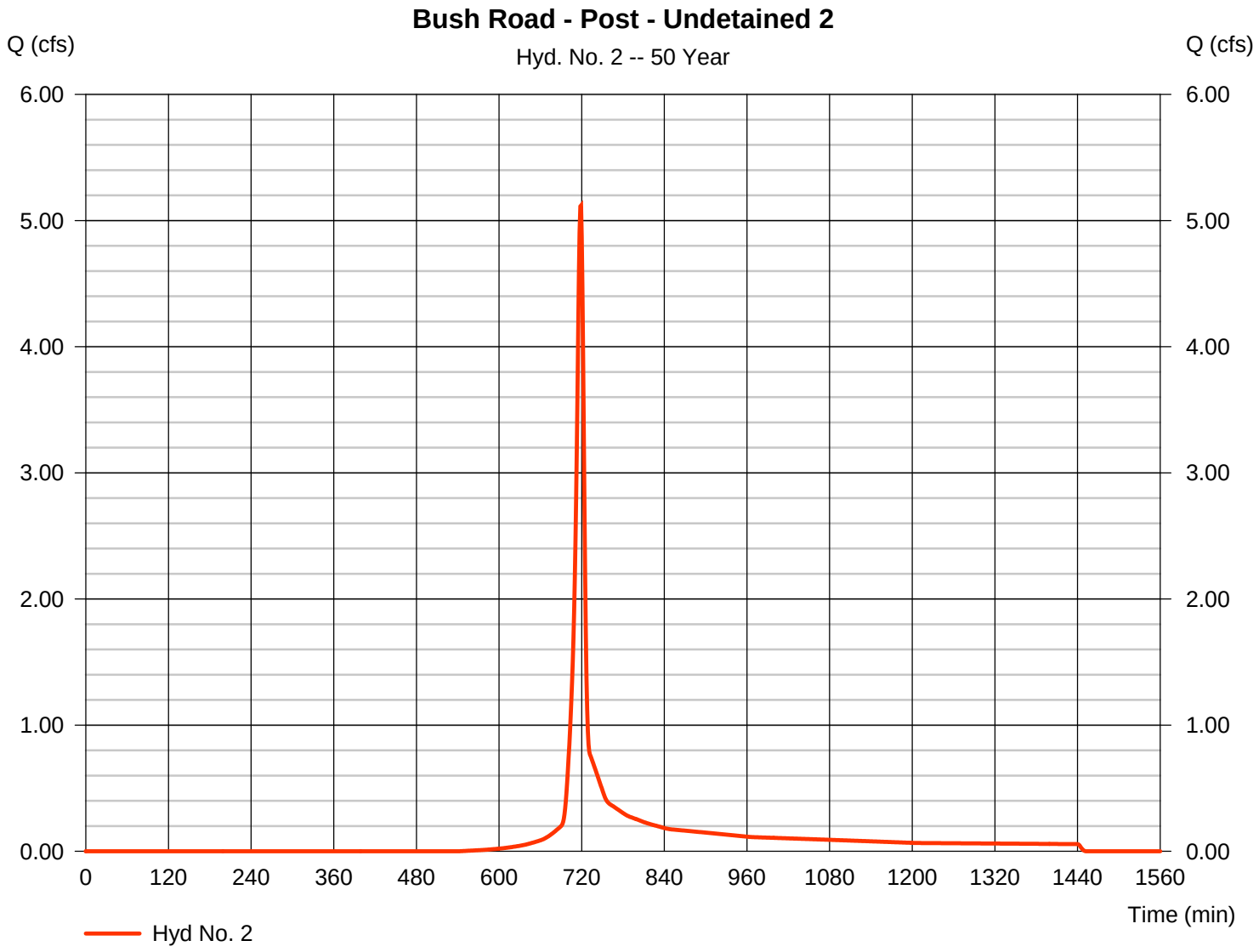
Hydrograph Report

Hyd. No. 2

Bush Road - Post - Undetained 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.119 cfs
Storm frequency	=	50 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	10,811 cuft
Drainage area	=	1.440 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	4.59 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post - Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

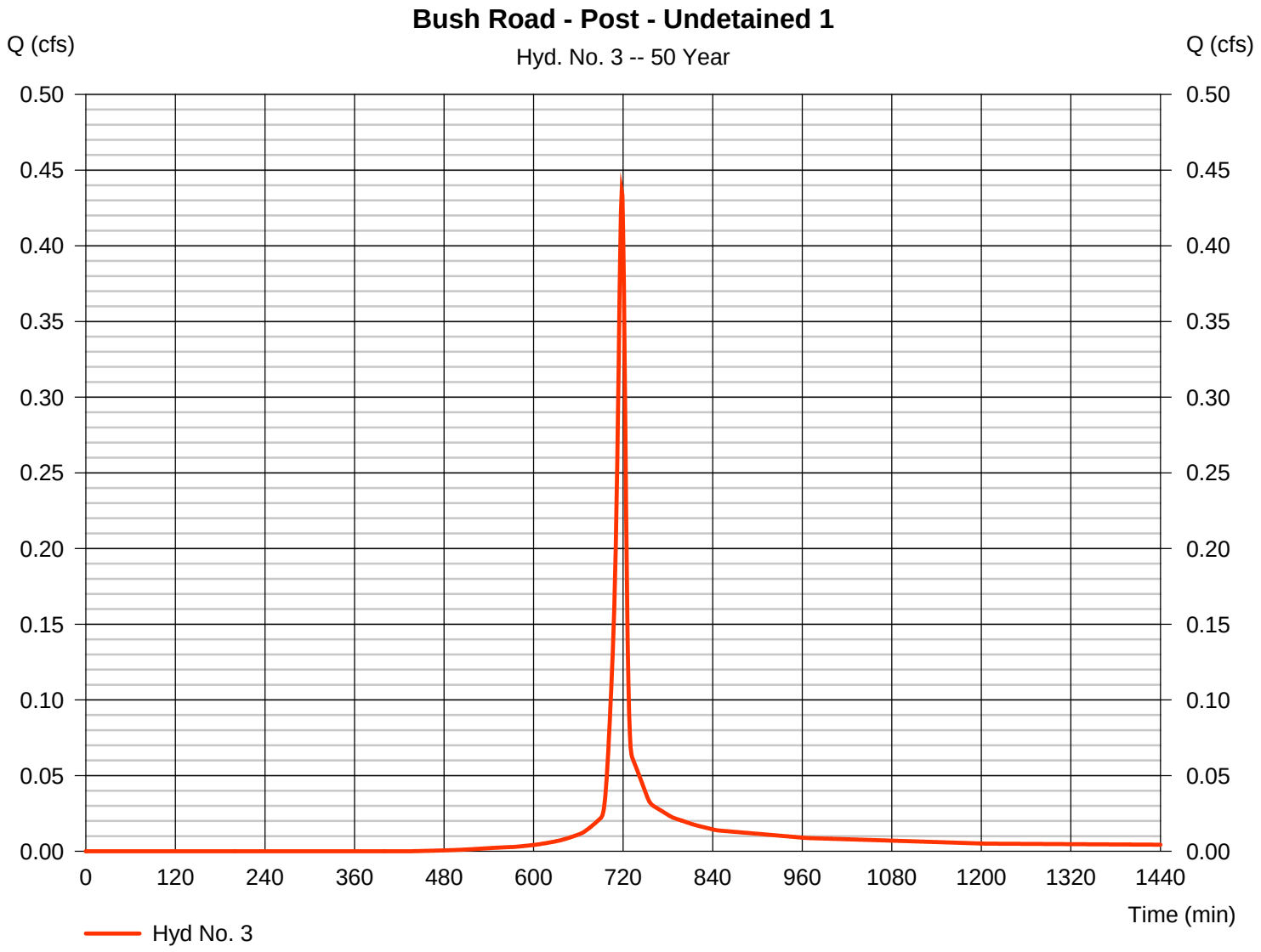
Hydrograph Report

Hyd. No. 3

Bush Road - Post - Undetained 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.436 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 929 cuft
Drainage area	= 0.100 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post - Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

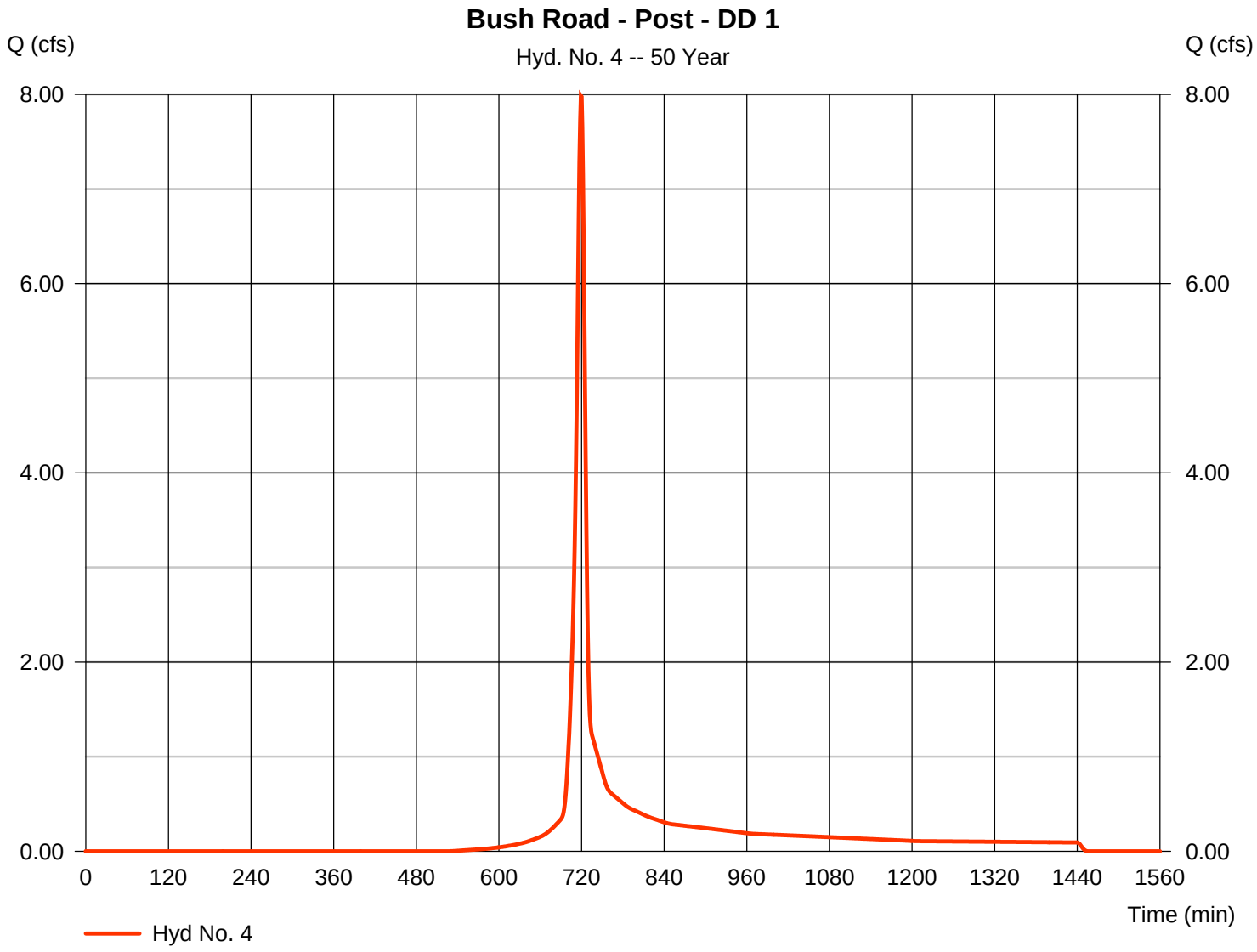
Hydrograph Report

Hyd. No. 4

Bush Road - Post - DD 1

Hydrograph type	= SCS Runoff	Peak discharge	= 7.986 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 18,064 cuft
Drainage area	= 2.260 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.50 min
Total precip.	= 4.59 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post - DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

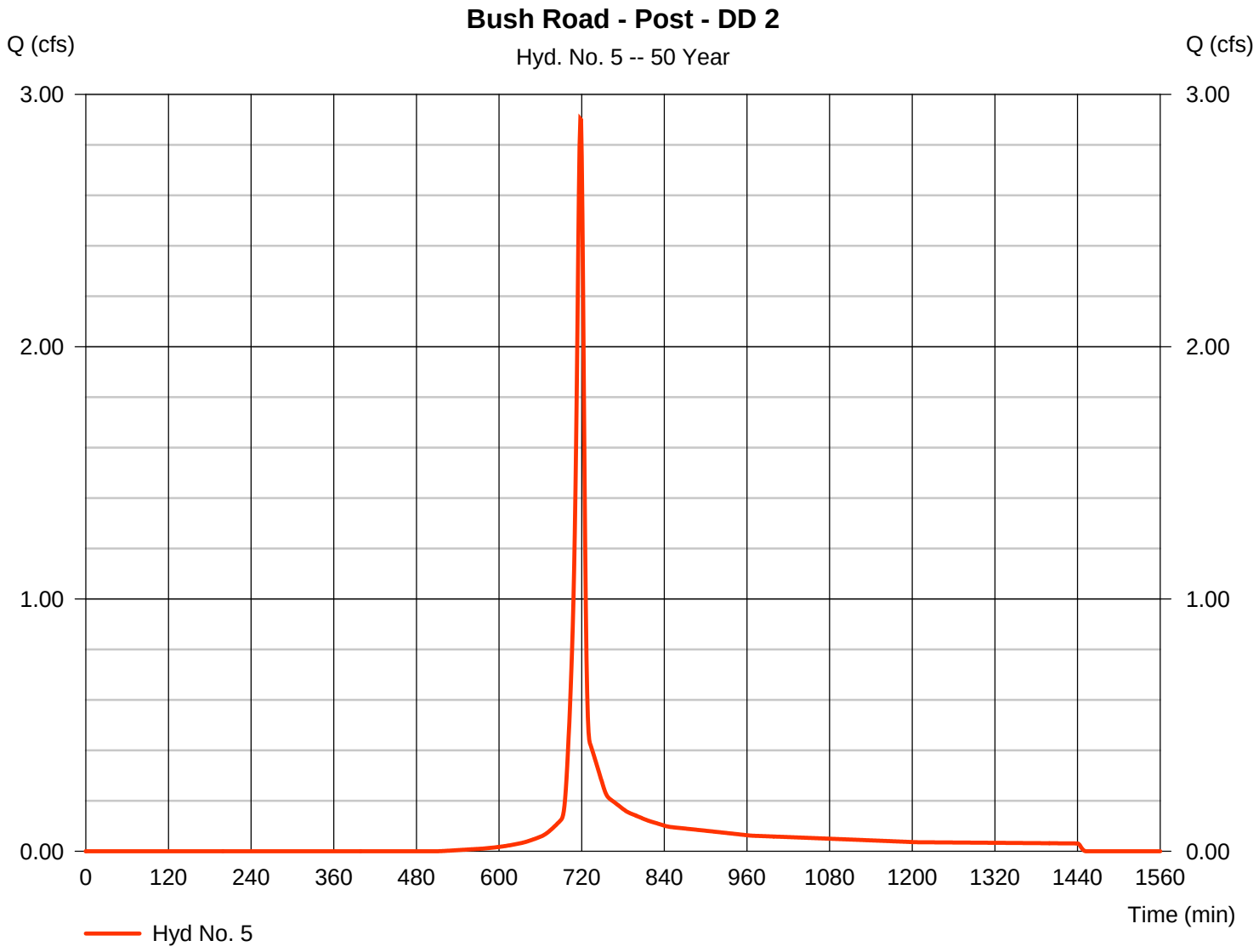
Hydrograph Report

Hyd. No. 5

Bush Road - Post - DD 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.903 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	6,143 cuft
Drainage area	=	0.760 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	4.59 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post - DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

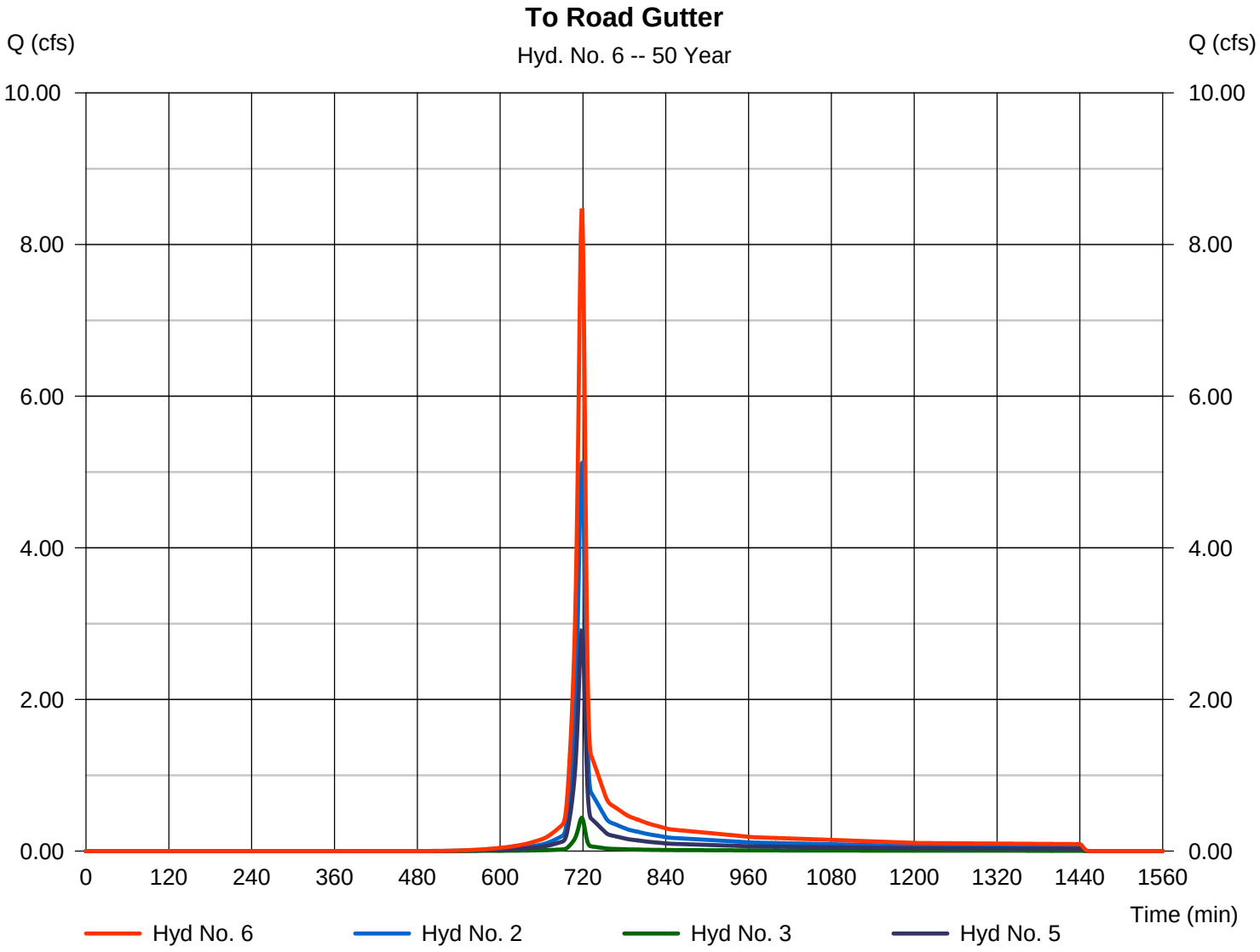
Total Travel Time, Tc ..... 6.70 min

Hydrograph Report

Hyd. No. 6

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 8.452 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 17,883 cuft
Inflow hyds.	= 2, 3, 5	Contrib. drain. area	= 2.300 ac



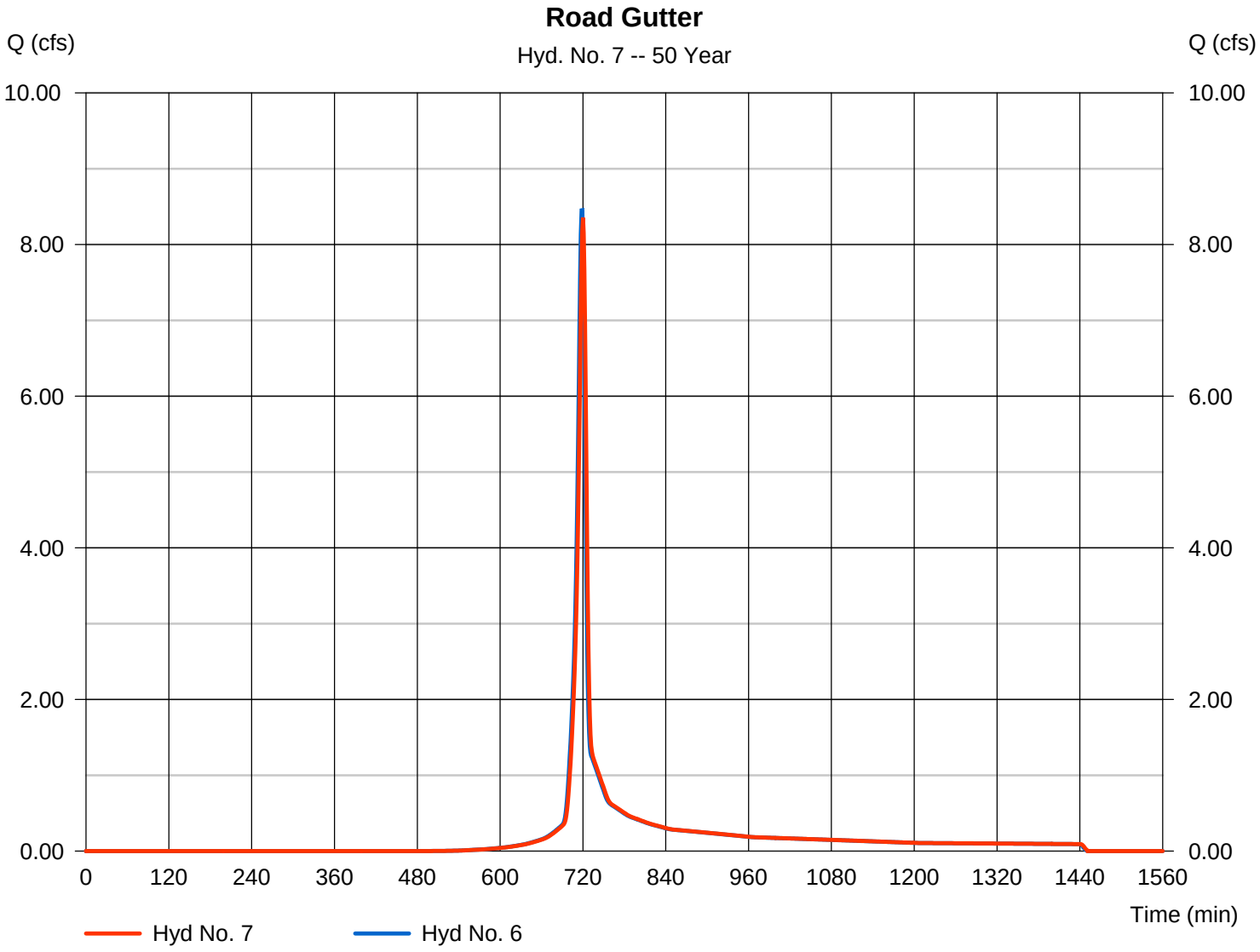
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	8.354 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	17,882 cuft
Inflow hyd. No.	=	6 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.6249

Modified Att-Kin routing method used.

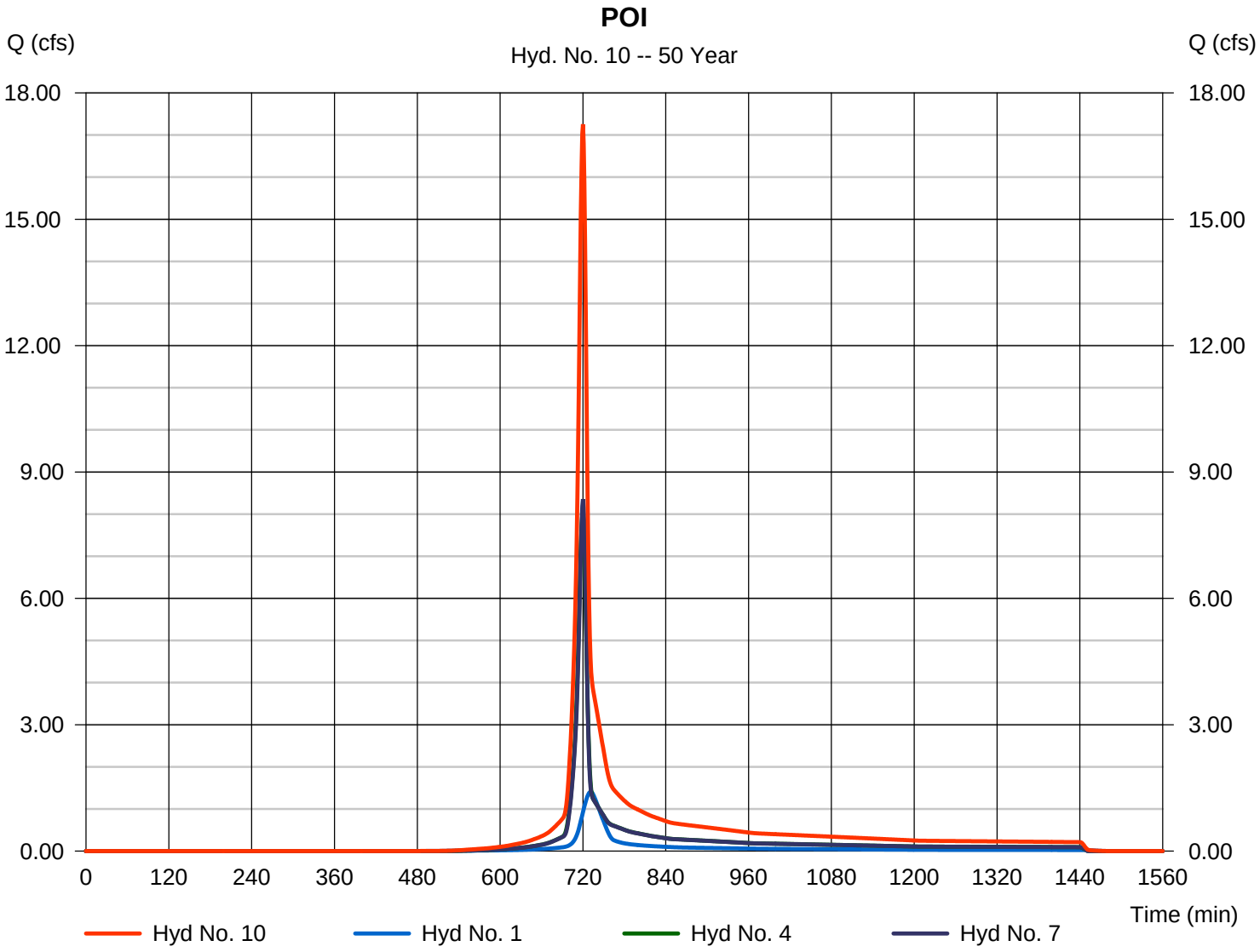


Hydrograph Report

Hyd. No. 10

POI

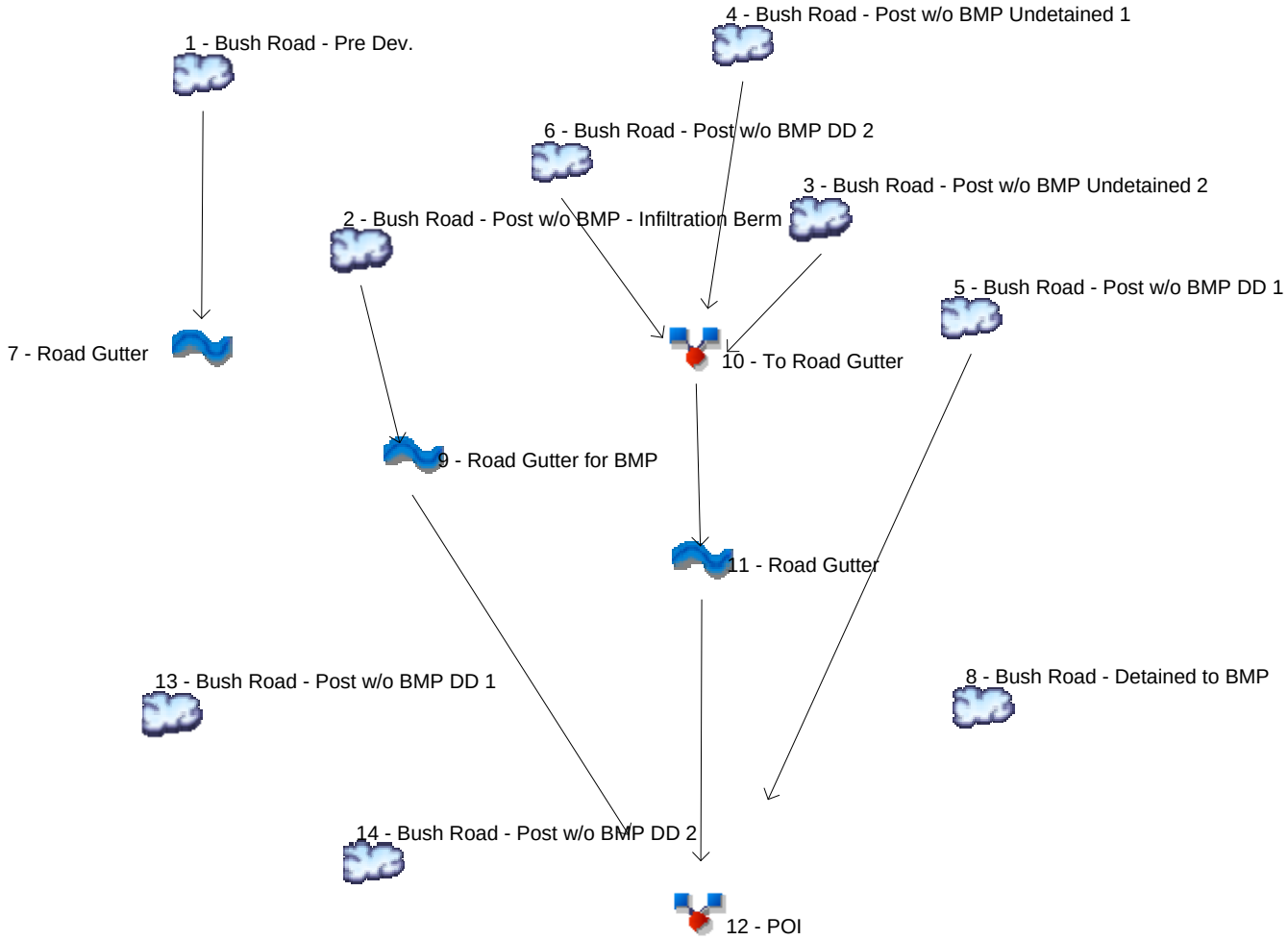
Hydrograph type	=	Combine	Peak discharge	=	17.26 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	41,567 cuft
Inflow hyds.	=	1, 4, 7	Contrib. drain. area	=	2.870 ac



ATTACHMENT C-4
BUSH RD
100 Year-24 Hour Storm

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	22.83	1	718	48,362	------	------	------	Bush Road - Pre Dev.
2	SCS Runoff	3.039	1	718	6,491	------	------	------	Bush Road - Post w/o BMP - Infiltratio
3	SCS Runoff	6.154	1	718	13,022	------	------	------	Bush Road - Post w/o BMP Undetain
4	SCS Runoff	0.512	1	718	1,097	------	------	------	Bush Road - Post w/o BMP Undetain
5	SCS Runoff	9.579	1	719	21,683	------	------	------	Bush Road - Post w/o BMP DD 1
6	SCS Runoff	3.464	1	718	7,349	------	------	------	Bush Road - Post w/o BMP DD 2
7	Reach	22.83	1	719	48,362	1	------	------	Road Gutter
8	SCS Runoff	2.590	2	718	5,965	------	------	------	Bush Road - Detained to BMP
9	Reach	2.978	1	720	6,490	2	------	------	Road Gutter for BMP
10	Combine	10.13	1	718	21,468	3, 4, 6,	------	------	To Road Gutter
11	Reach	10.02	1	720	21,468	10	------	------	Road Gutter
12	Combine	22.54	1	720	49,641	5, 9, 11	------	------	POI
13	SCS Runoff	11.05	1	718	22,360	------	------	------	Bush Road - Post w/o BMP DD 1
14	SCS Runoff	3.829	1	718	7,773	------	------	------	Bush Road - Post w/o BMP DD 2

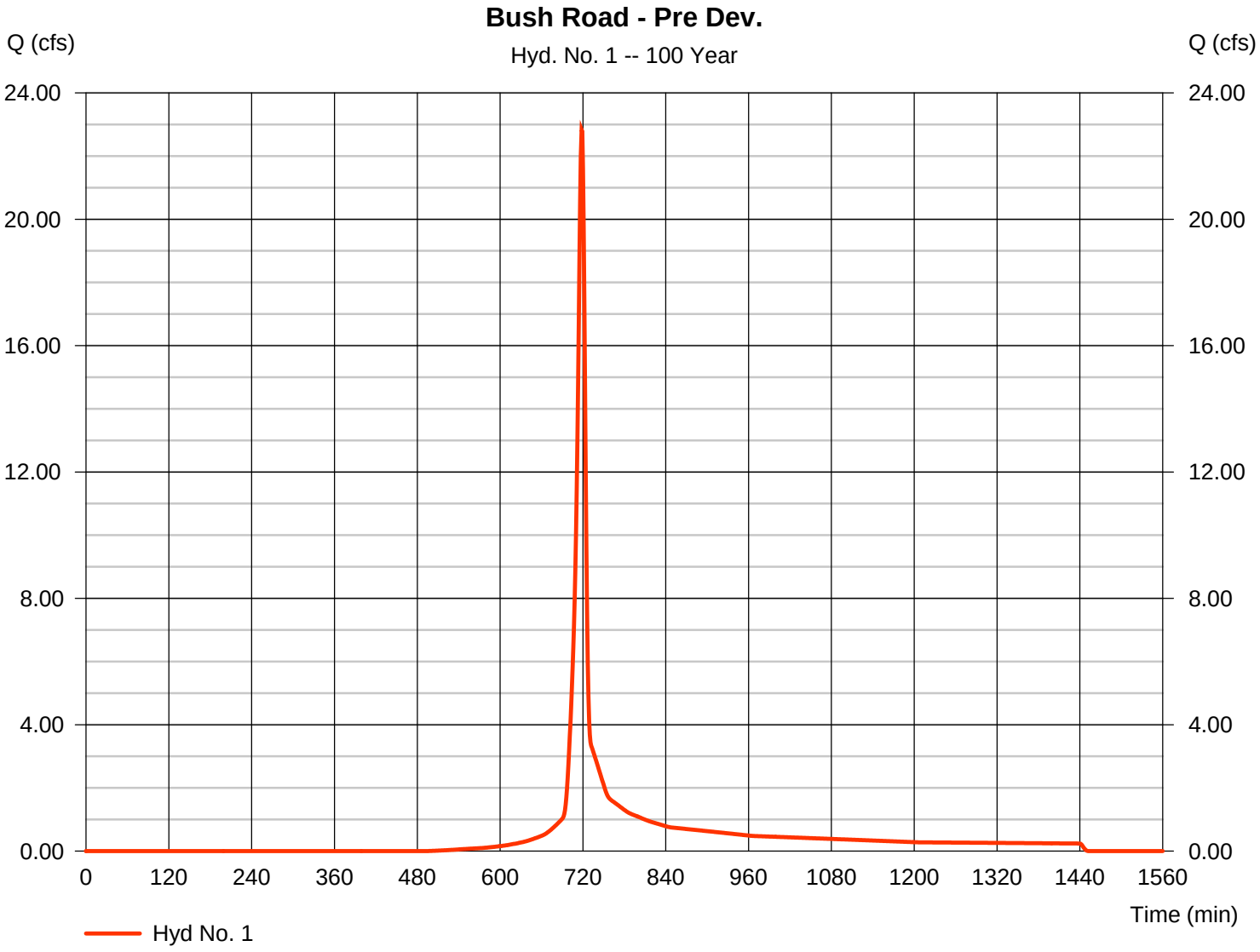
Hydrograph Report

Hyd. No. 1

Bush Road - Pre Dev.

Hydrograph type	= SCS Runoff	Peak discharge	= 22.83 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 48,362 cuft
Drainage area	= 5.170 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.80 min
Total precip.	= 5.13 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.370 x 78) + (1.350 x 70) + (0.060 x 91) + (0.390 x 77)] / 5.170



TR55 Tc Worksheet

Hyd. No. 1

Bush Road - Pre Dev.

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 243.00		800.00		0.00		
Watercourse slope (%)	= 24.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		5.10		0.00		
Travel Time (min)	**= 0.51**	**+**	**2.61**	**+**	**0.00**	**=**	**3.13**
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 ..... 7.80 min

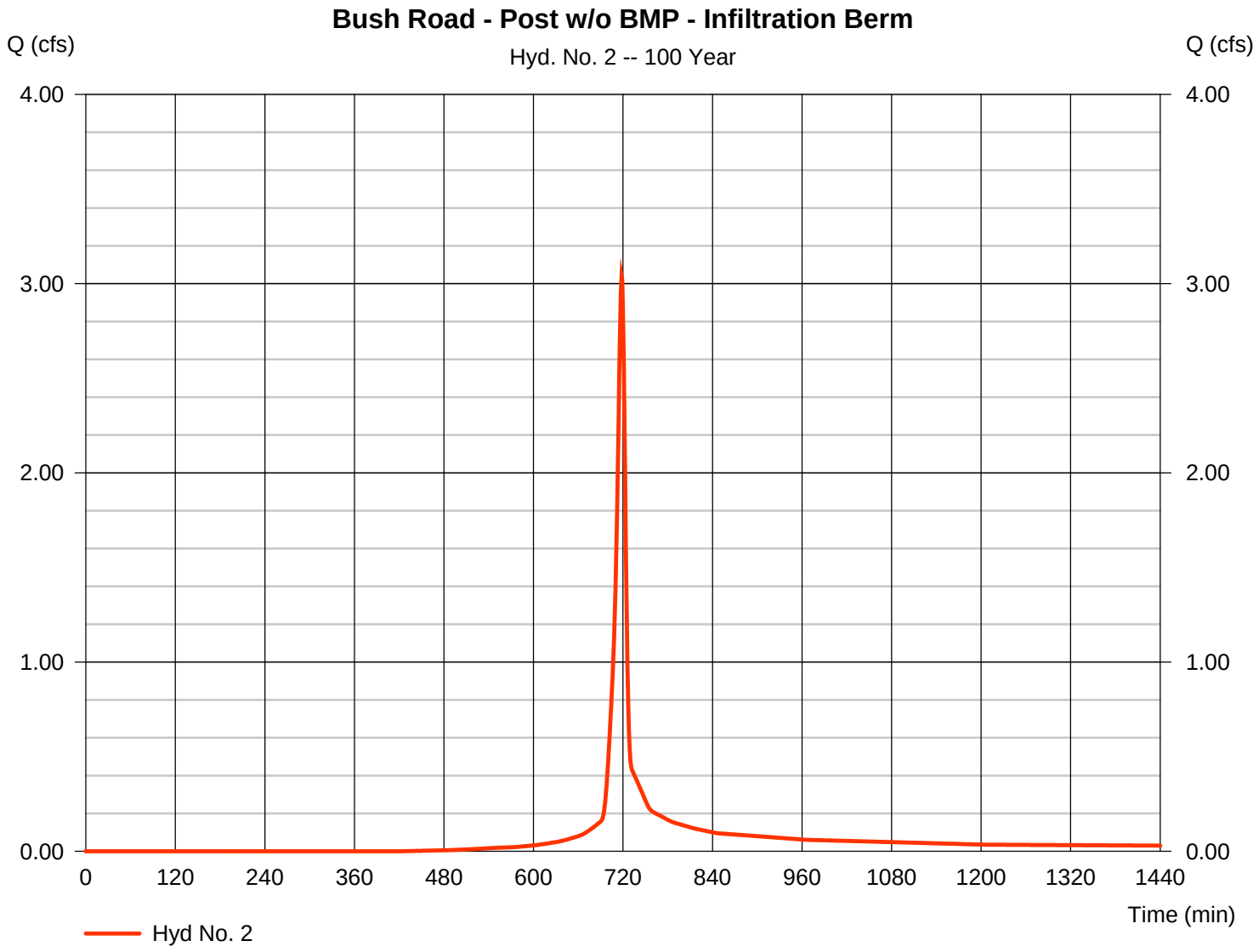
Hydrograph Report

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.039 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	6,491 cuft
Drainage area	=	0.610 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.90 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post w/o BMP - Infiltration Berm

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		629.00		75.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**2.17**	**+**	**0.27**	**=**	**2.79**
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 ..... 6.90 min

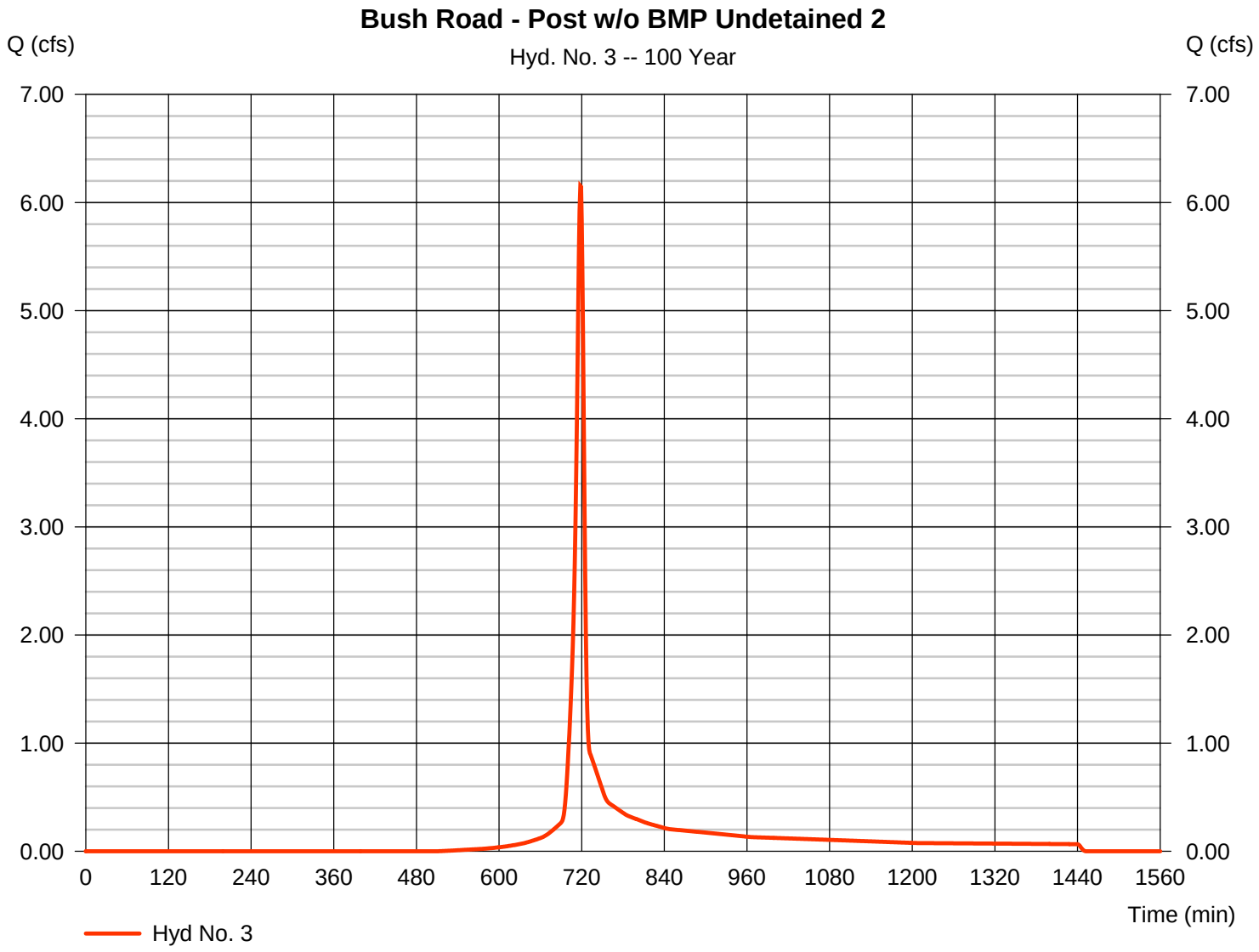
Hydrograph Report

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Hydrograph type	= SCS Runoff	Peak discharge	= 6.154 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 13,022 cuft
Drainage area	= 1.440 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 5.13 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post w/o BMP Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

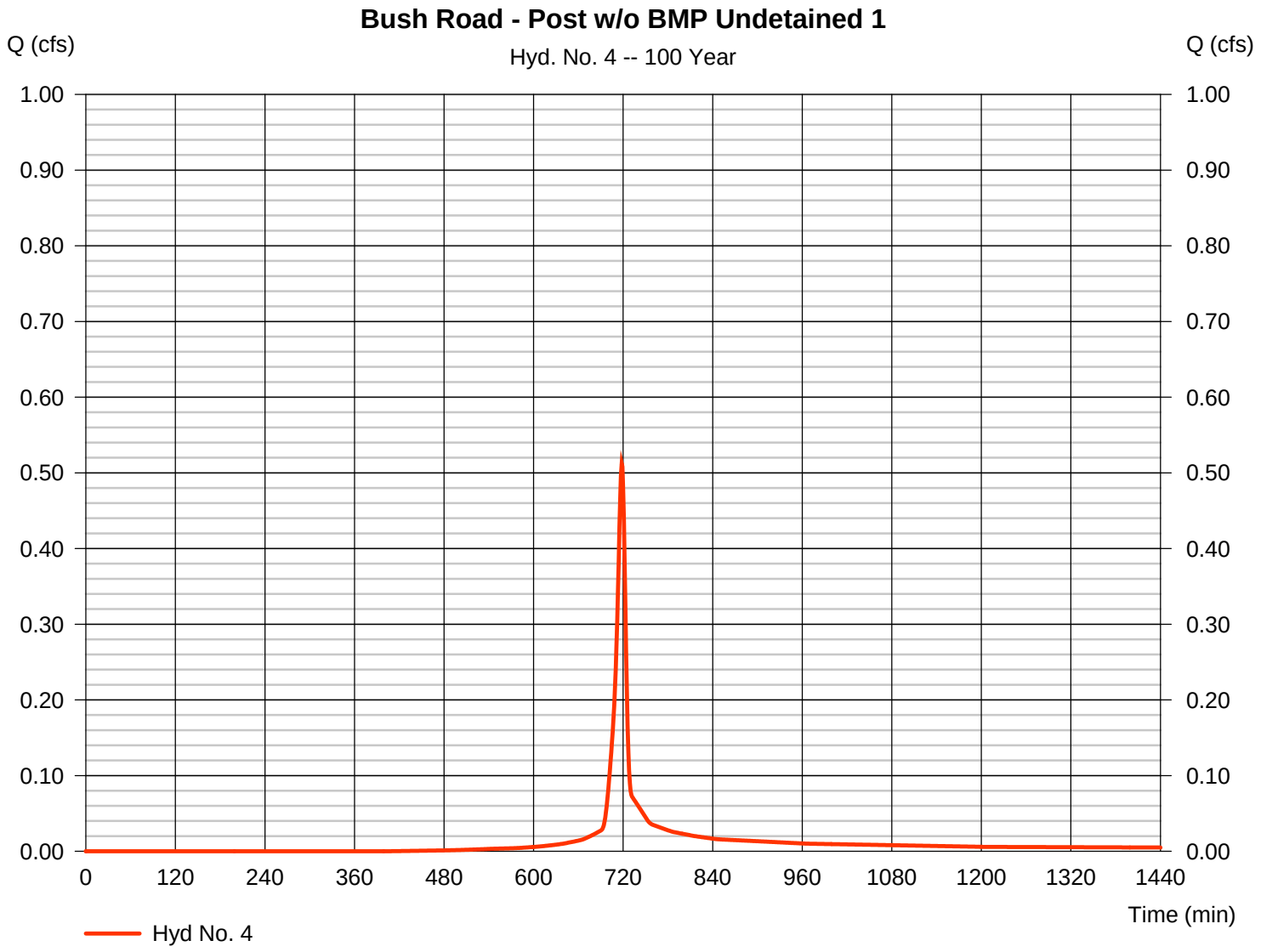
Hydrograph Report

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.512 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,097 cuft
Drainage area	= 0.100 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 5.13 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post w/o BMP Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

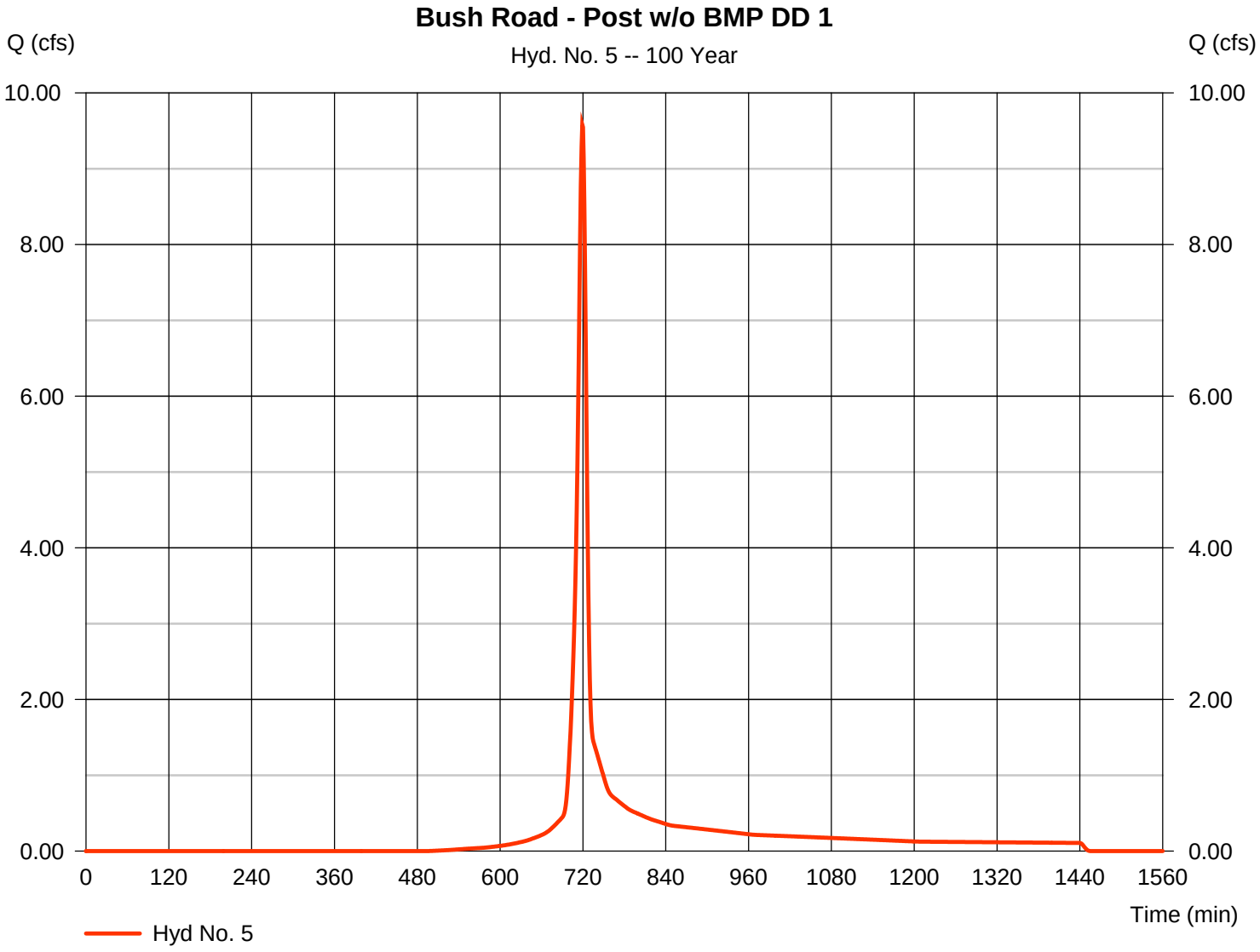
Hydrograph Report

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.579 cfs
Storm frequency	=	100 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	21,683 cuft
Drainage area	=	2.260 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.50 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

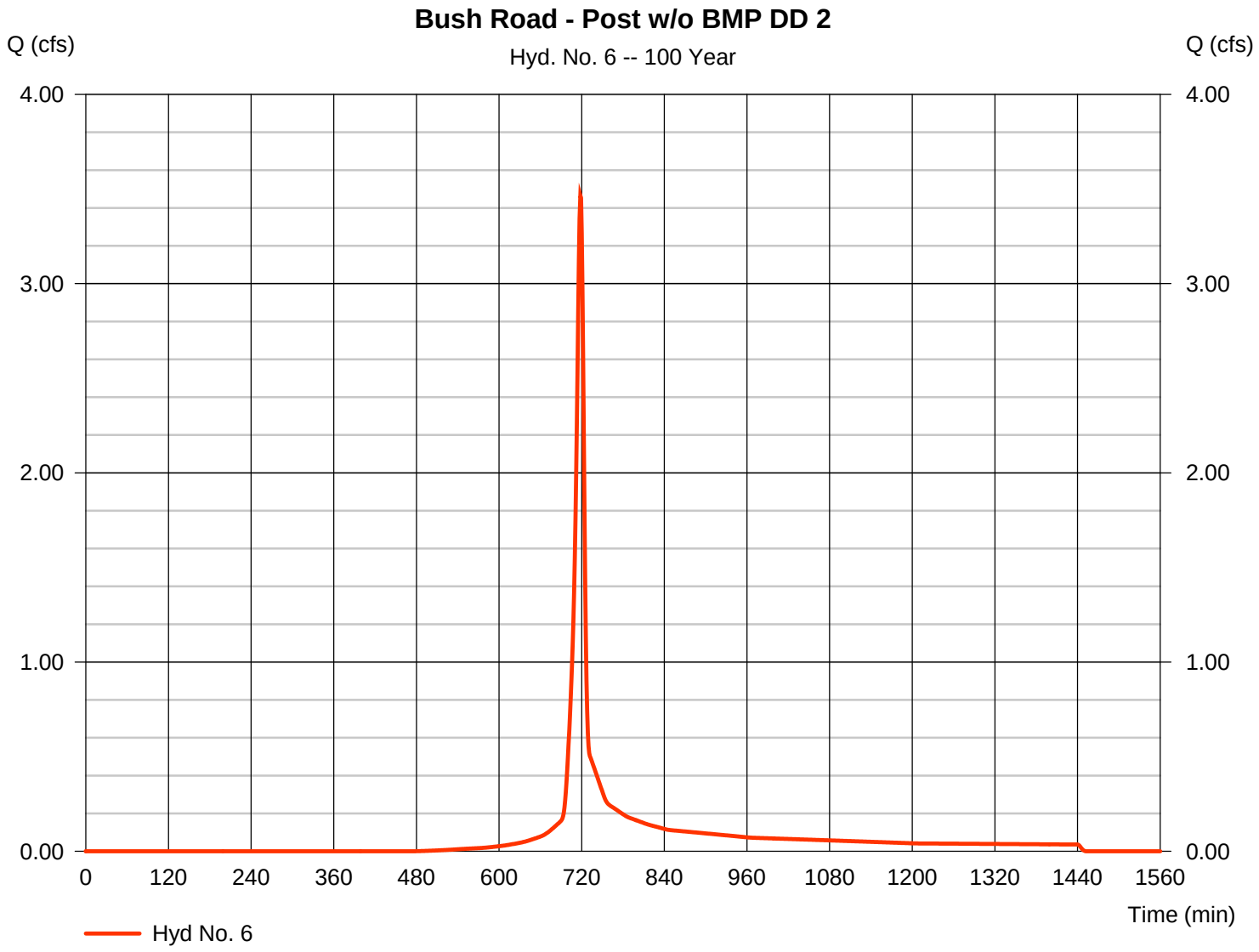
Hydrograph Report

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.464 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	7,349 cuft
Drainage area	=	0.760 ac	Curve number	=	77*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 6

Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

Total Travel Time, Tc ..... 6.70 min

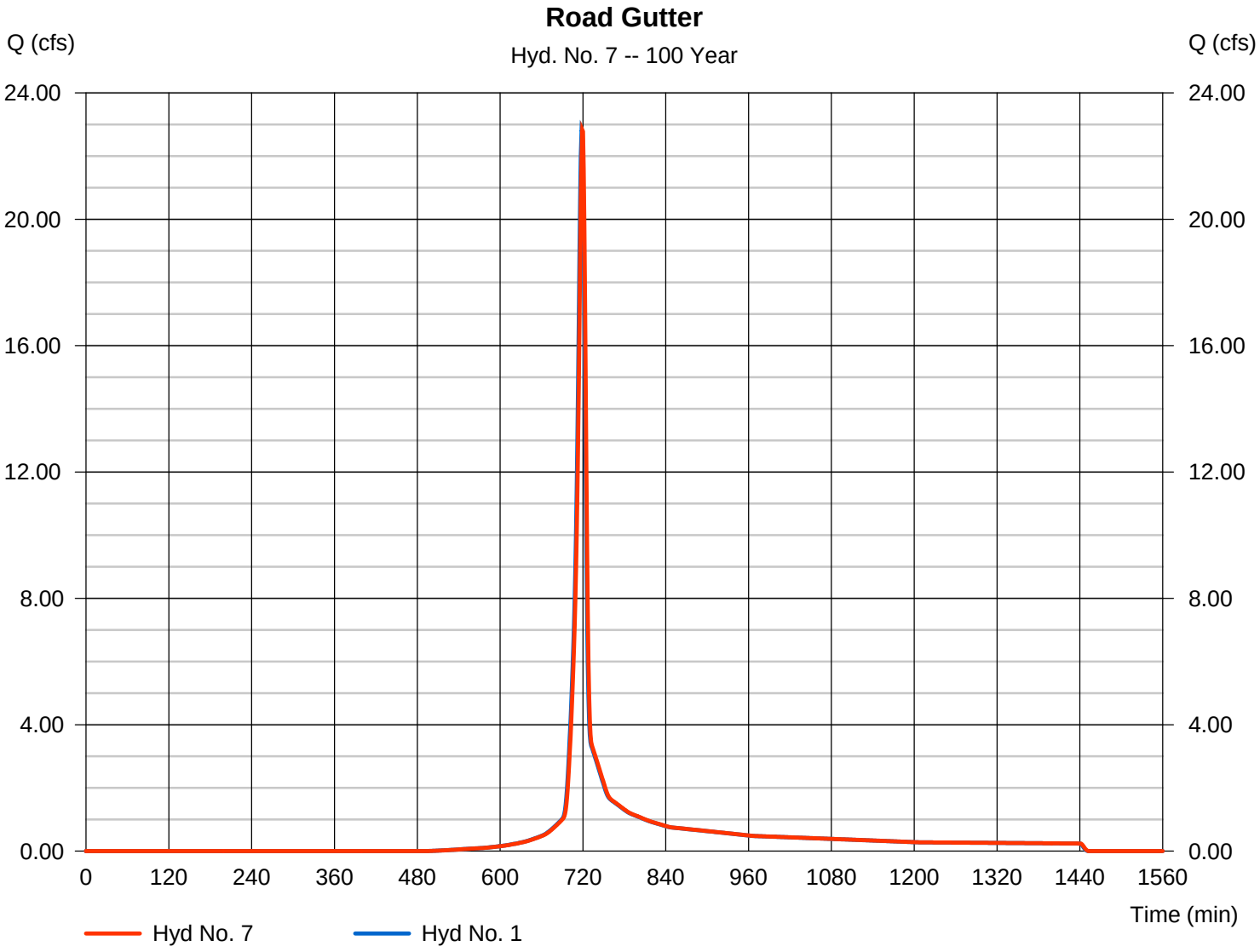
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	22.83 cfs
Storm frequency	=	100 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	48,362 cuft
Inflow hyd. No.	=	1 - Bush Road - Pre Dev.	Section type	=	Triangular
Reach length	=	265.0 ft	Channel slope	=	3.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.308	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.9933

Modified Att-Kin routing method used.



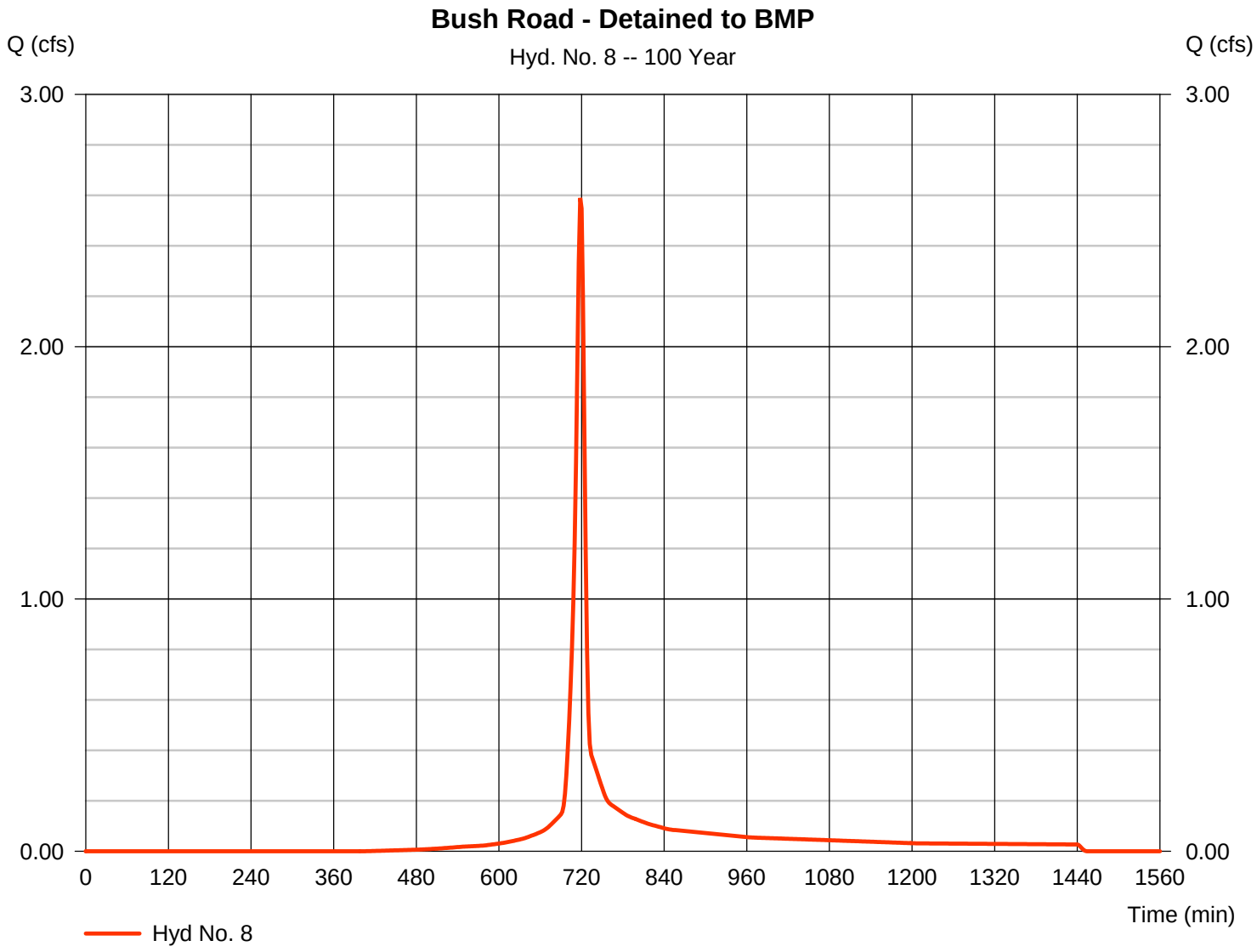
Hydrograph Report

Hyd. No. 8

Bush Road - Detained to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.590 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	5,965 cuft
Drainage area	=	0.530 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.010 x 77) + (0.360 x 78) + (0.130 x 91)] / 0.530



TR55 Tc Worksheet

Hyd. No. 8

Bush Road - Detained to BMP

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 24.00		0.00		0.00		
Travel Time (min)	**= 4.14**	**+**	**0.00**	**+**	**0.00**	**=**	**4.14**
Shallow Concentrated Flow							
Flow length (ft)	= 165.00		535.00		70.00		
Watercourse slope (%)	= 24.00		9.00		5.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=7.90		4.84		4.55		
Travel Time (min)	**= 0.35**	**+**	**1.84**	**+**	**0.26**	**=**	**2.45**
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 ..... 6.60 min

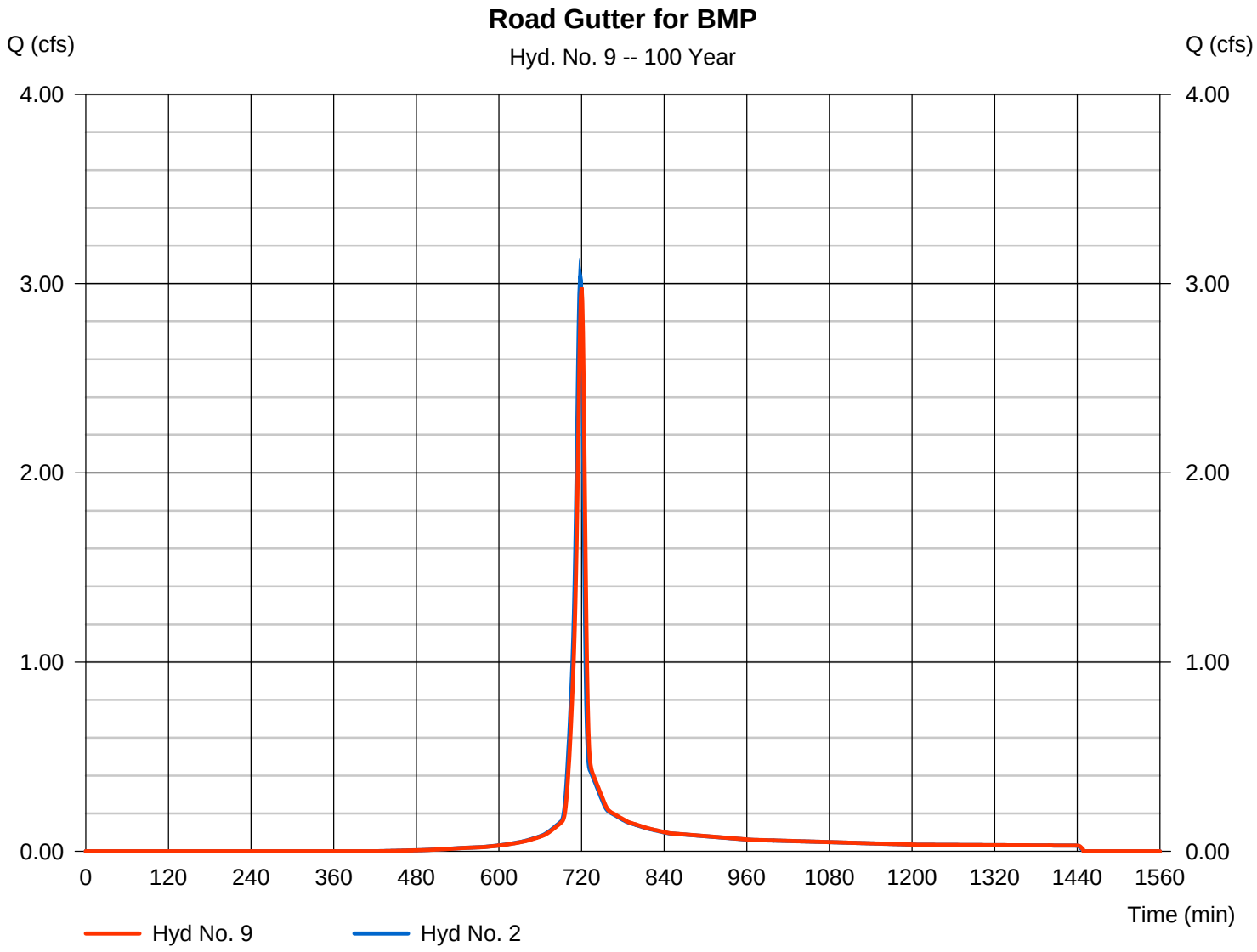
Hydrograph Report

Hyd. No. 9

Road Gutter for BMP

Hydrograph type	=	Reach	Peak discharge	=	2.978 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	6,490 cuft
Inflow hyd. No.	=	2 - Bush Road - Post w/o BMPs	Section type	=	Triangular
Reach length	=	450.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.5621

Modified Att-Kin routing method used.

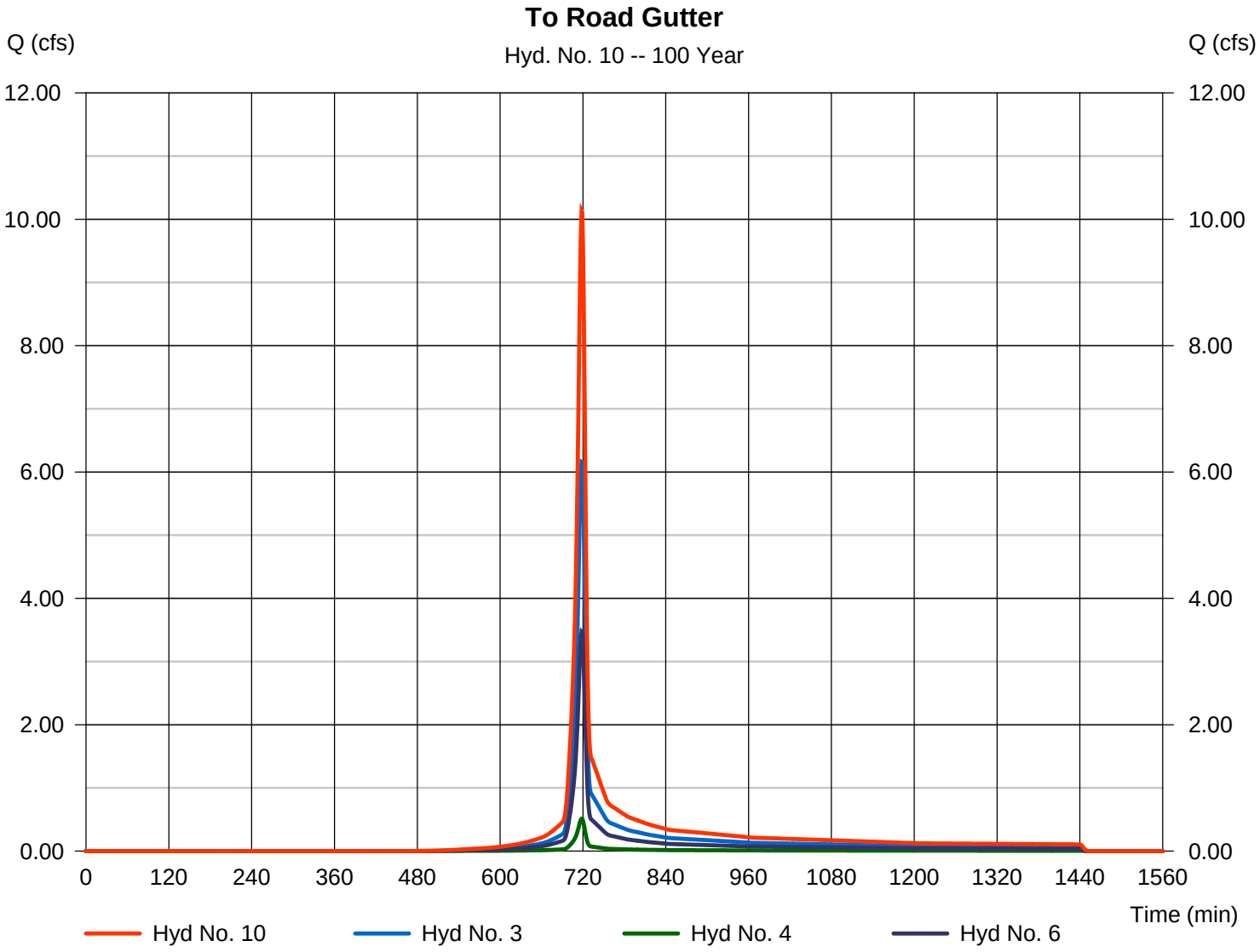


Hydrograph Report

Hyd. No. 10

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 10.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 21,468 cuft
Inflow hyds.	= 3, 4, 6	Contrib. drain. area	= 2.300 ac



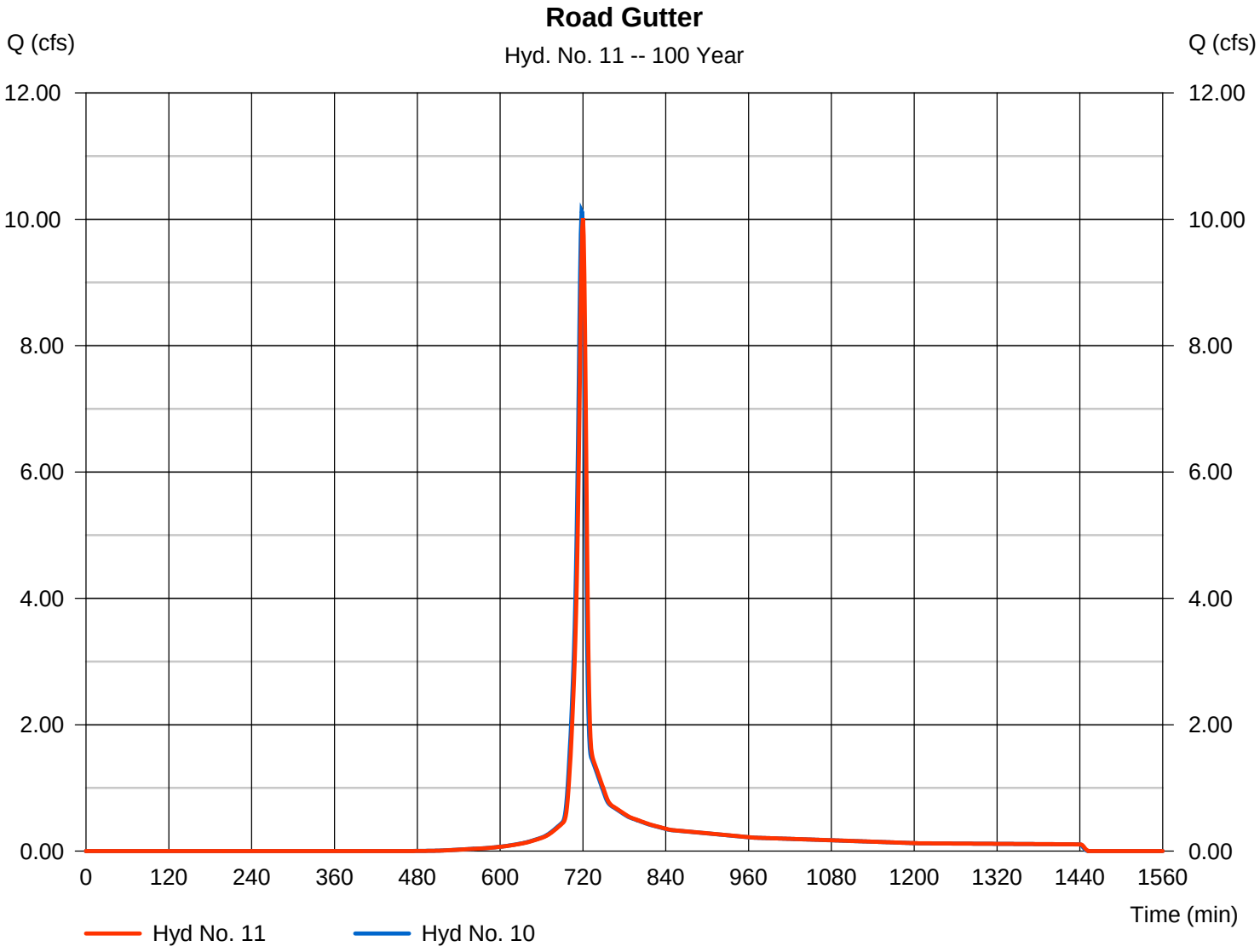
Hydrograph Report

Hyd. No. 11

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	10.02 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	21,468 cuft
Inflow hyd. No.	=	10 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.6445

Modified Att-Kin routing method used.

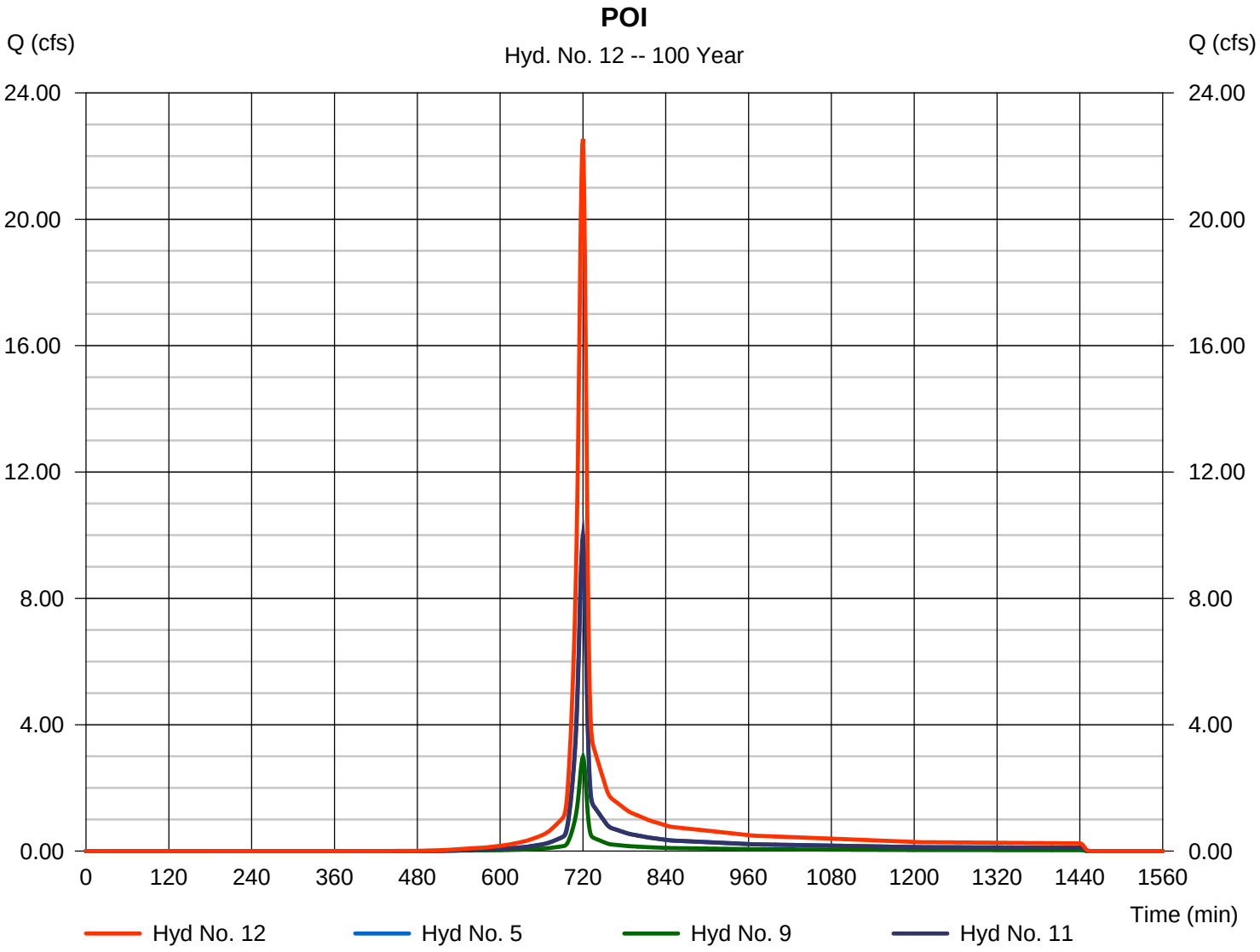


Hydrograph Report

Hyd. No. 12

POI

Hydrograph type	=	Combine	Peak discharge	=	22.54 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	49,641 cuft
Inflow hyds.	=	5, 9, 11	Contrib. drain. area	=	2.260 ac



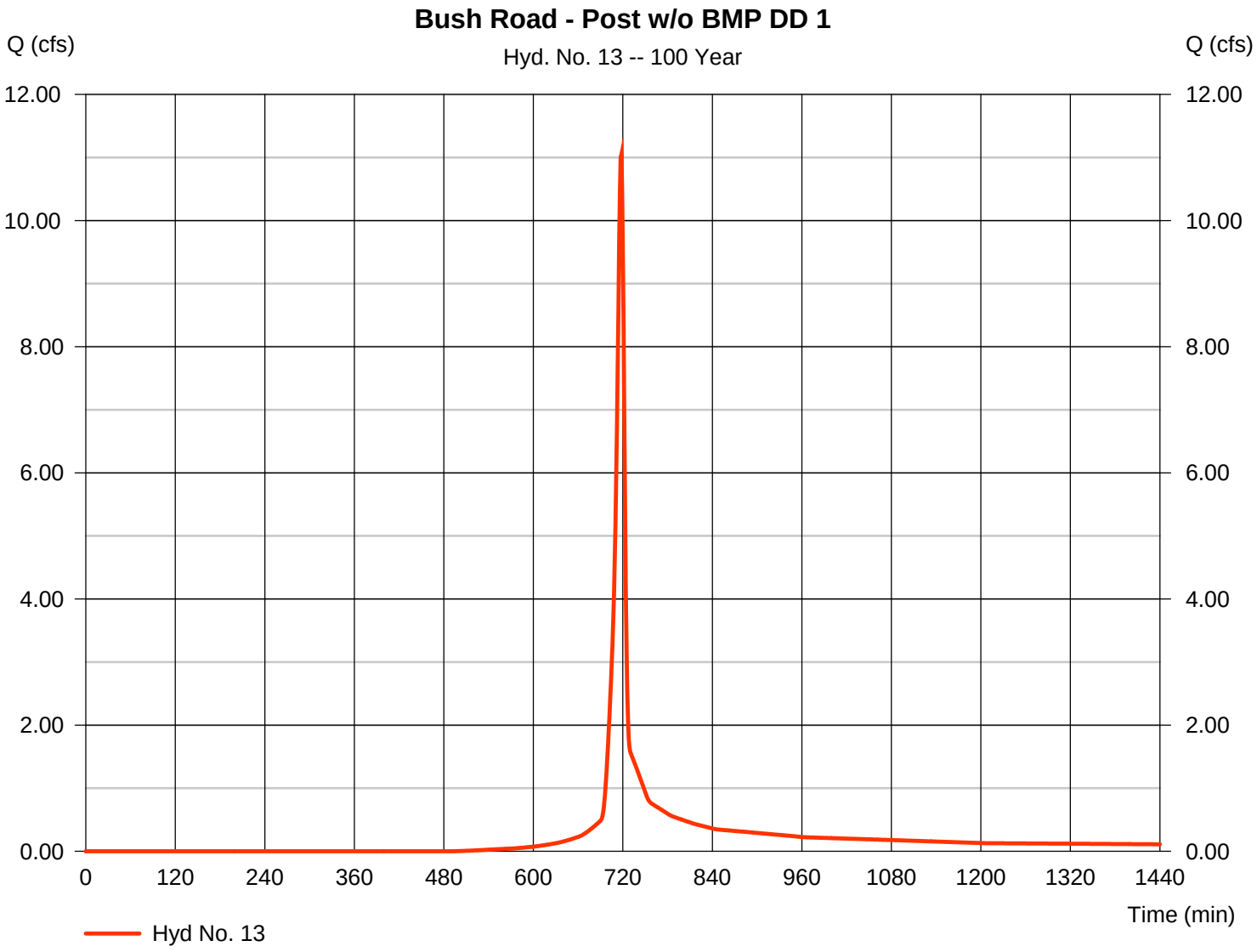
Hydrograph Report

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.05 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	22,360 cuft
Drainage area	=	2.260 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 13

Bush Road - Post w/o BMP DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		0.00		
Watercourse slope (%)	= 23.00		10.00		0.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		0.00		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.00**	**=**	**1.86**
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	= 0.060		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 ..... 6.50 min

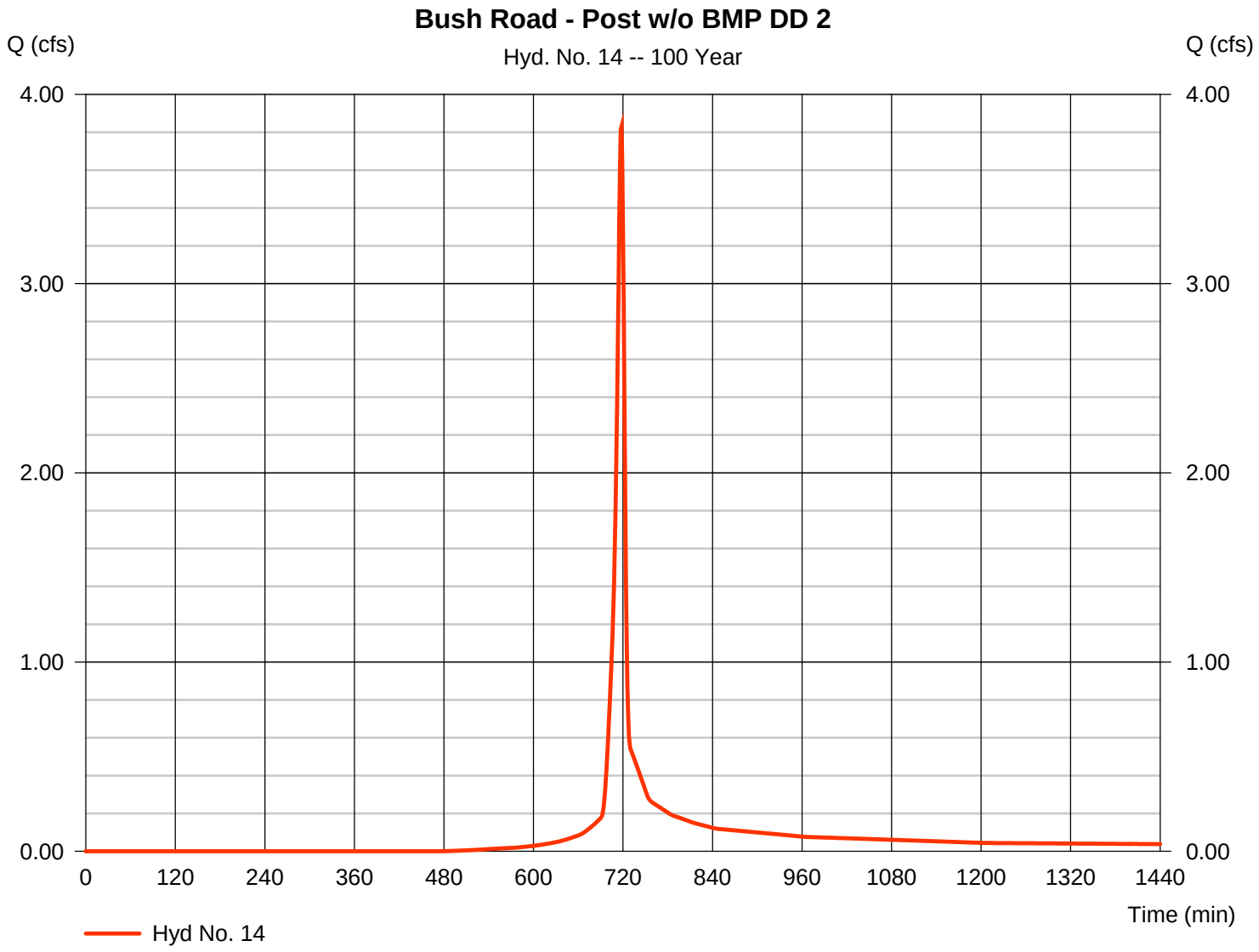
Hydrograph Report

Hyd. No. 14

Bush Road - Post w/o BMP DD 2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.829 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 7,773 cuft
Drainage area	= 0.760 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.50 min
Total precip.	= 5.13 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 14

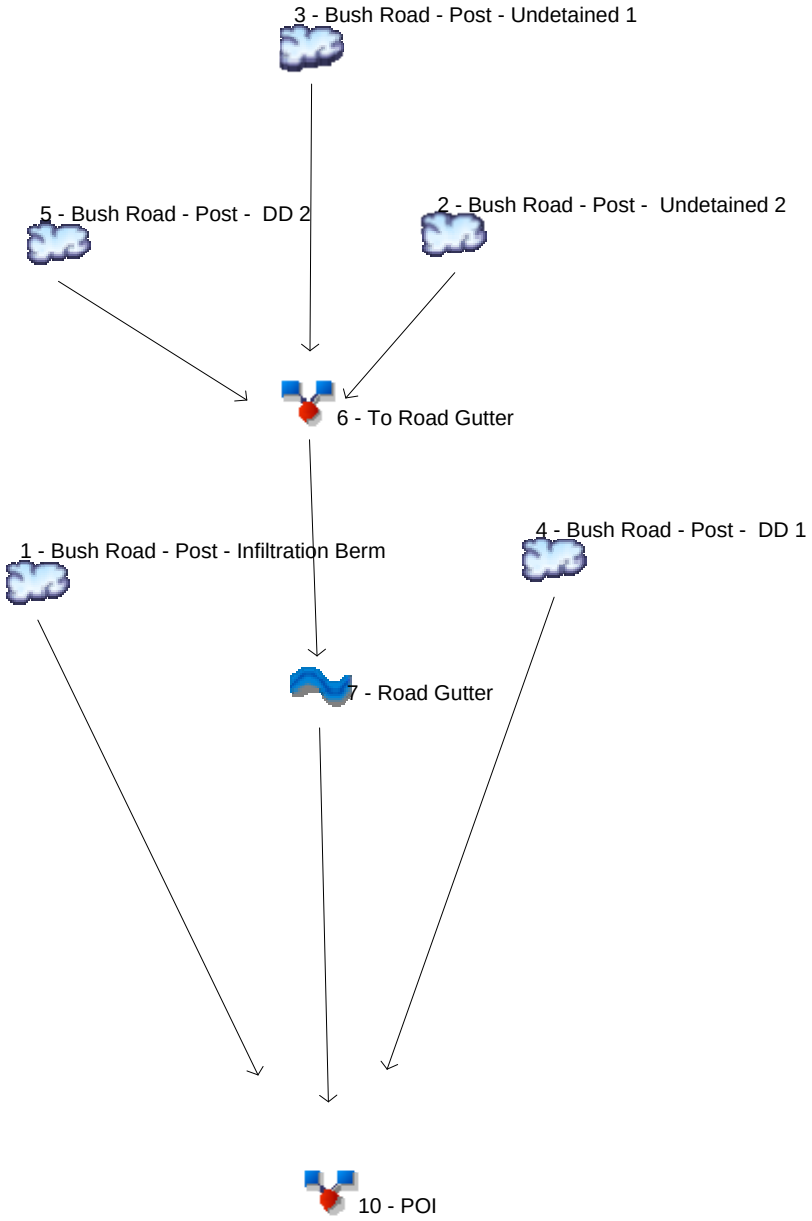
Bush Road - Post w/o BMP DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
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	= 0.060		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 ..... 6.50 min

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

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	1.804	1	729	6,709	------	------	------	Bush Road - Post - Infiltration Berm
2	SCS Runoff	6.154	1	718	13,022	------	------	------	Bush Road - Post - Undetained 2
3	SCS Runoff	0.512	1	718	1,097	------	------	------	Bush Road - Post - Undetained 1
4	SCS Runoff	9.579	1	719	21,683	------	------	------	Bush Road - Post - DD 1
5	SCS Runoff	3.464	1	718	7,349	------	------	------	Bush Road - Post - DD 2
6	Combine	10.13	1	718	21,468	2, 3, 5	------	------	To Road Gutter
7	Reach	10.02	1	720	21,468	6	------	------	Road Gutter
10	Combine	20.87	1	720	49,860	1, 4, 7,	------	------	POI

Hydrograph Report

Hyd. No. 1

Bush Road - Post - Infiltration Berm

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.804 cfs
Storm frequency	=	100 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	6,709 cuft
Drainage area	=	0.610 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	25.80 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 70) + (0.050 x 77) + (0.400 x 78) + (0.130 x 91)] / 0.610

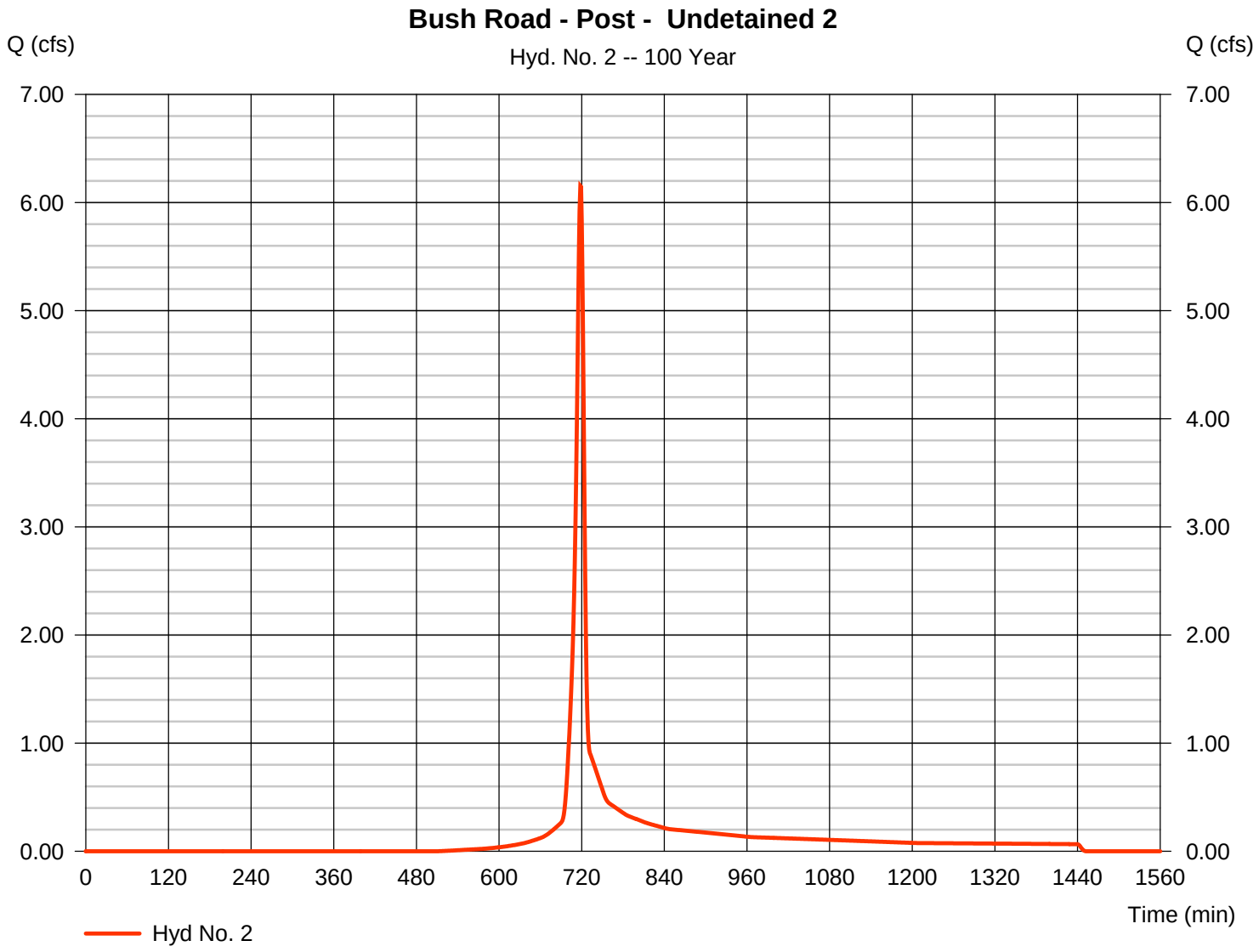
Hydrograph Report

Hyd. No. 2

Bush Road - Post - Undetained 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.154 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	13,022 cuft
Drainage area	=	1.440 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.70 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.730 x 78) + (0.180 x 77) + (0.530 x 70)] / 1.440



TR55 Tc Worksheet

Hyd. No. 2

Bush Road - Post - Undetained 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 65.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 4.00		0.00		0.00		
Travel Time (min)	**= 6.01**	**+**	**0.00**	**+**	**0.00**	**=**	**6.01**
Shallow Concentrated Flow							
Flow length (ft)	= 20.00		140.00		0.00		
Watercourse slope (%)	= 2.00		7.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		4.27		0.00		
Travel Time (min)	**= 0.12**	**+**	**0.55**	**+**	**0.00**	**=**	**0.66**
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 ..... 6.70 min

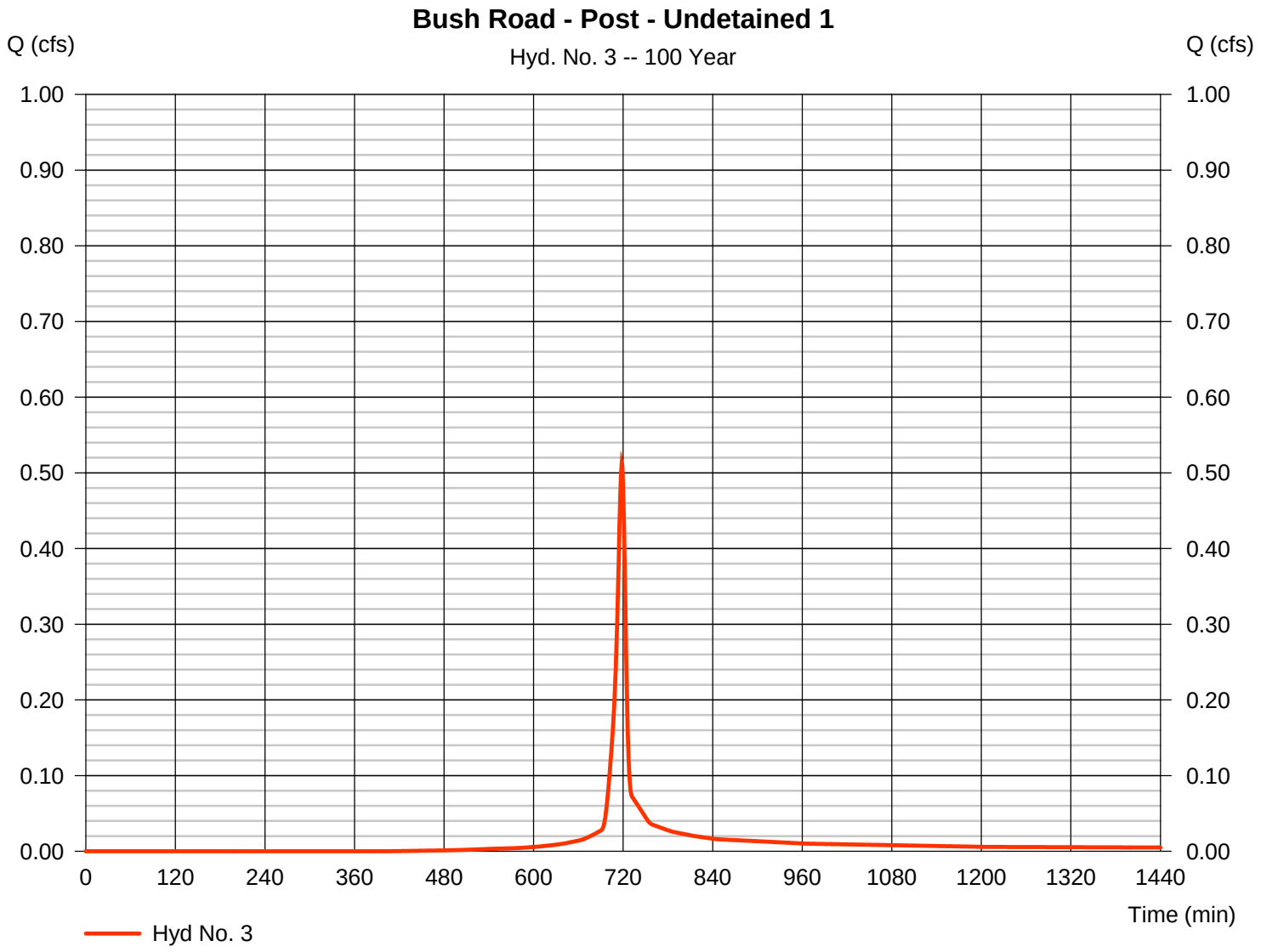
Hydrograph Report

Hyd. No. 3

Bush Road - Post - Undetained 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.512 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	1,097 cuft
Drainage area	=	0.100 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.20 min
Total precip.	=	5.13 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.080 x 78) + (0.020 x 91)] / 0.100



TR55 Tc Worksheet

Hyd. No. 3

Bush Road - Post - Undetained 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 7.22**	**+**	**0.00**	**+**	**0.00**	**=**	**7.22**
Shallow Concentrated Flow							
Flow length (ft)	= 172.00		111.00		0.00		
Watercourse slope (%)	= 6.00		18.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.95		6.85		0.00		
Travel Time (min)	**= 0.73**	**+**	**0.27**	**+**	**0.00**	**=**	**1.00**
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 ..... 8.20 min

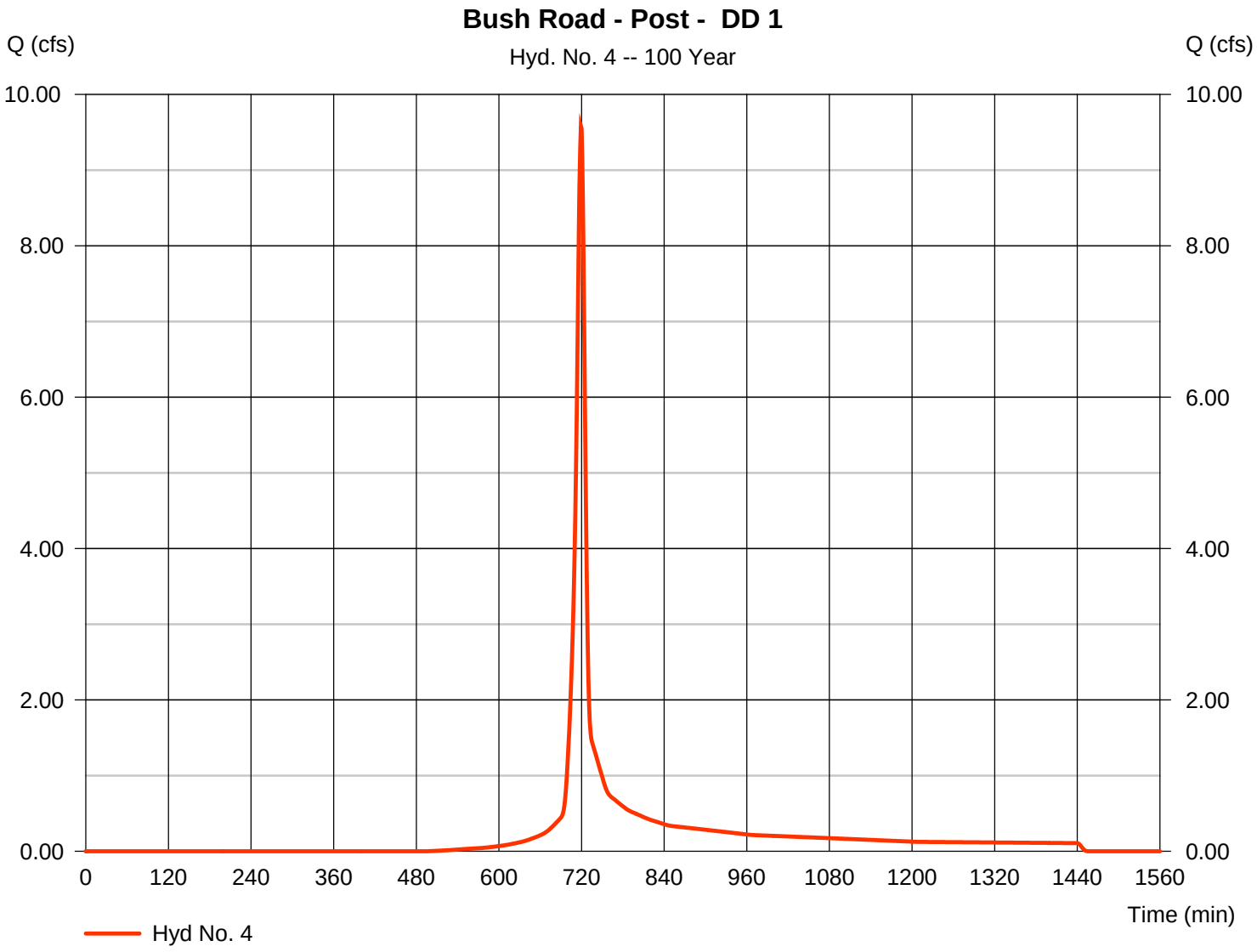
Hydrograph Report

Hyd. No. 4

Bush Road - Post - DD 1

Hydrograph type	= SCS Runoff	Peak discharge	= 9.579 cfs
Storm frequency	= 100 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 21,683 cuft
Drainage area	= 2.260 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.50 min
Total precip.	= 5.13 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.670 x 70) + (0.050 x 77) + (1.540 x 78)] / 2.260



TR55 Tc Worksheet

Hyd. No. 4

Bush Road - Post - DD 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 18.00		0.00		0.00		
Travel Time (min)	**= 4.65**	**+**	**0.00**	**+**	**0.00**	**=**	**4.65**
Shallow Concentrated Flow							
Flow length (ft)	= 280.00		385.00		270.00		
Watercourse slope (%)	= 23.00		10.00		15.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=7.74		5.10		6.25		
Travel Time (min)	**= 0.60**	**+**	**1.26**	**+**	**0.72**	**=**	**2.58**
Channel Flow							
X sectional flow area (sqft)	= 2.52		0.00		0.00		
Wetted perimeter (ft)	= 5.02		0.00		0.00		
Channel slope (%)	= 2.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=2.21						
			0.00				
					0.00		
Flow length (ft)	({0})175.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc ..... 8.50 min

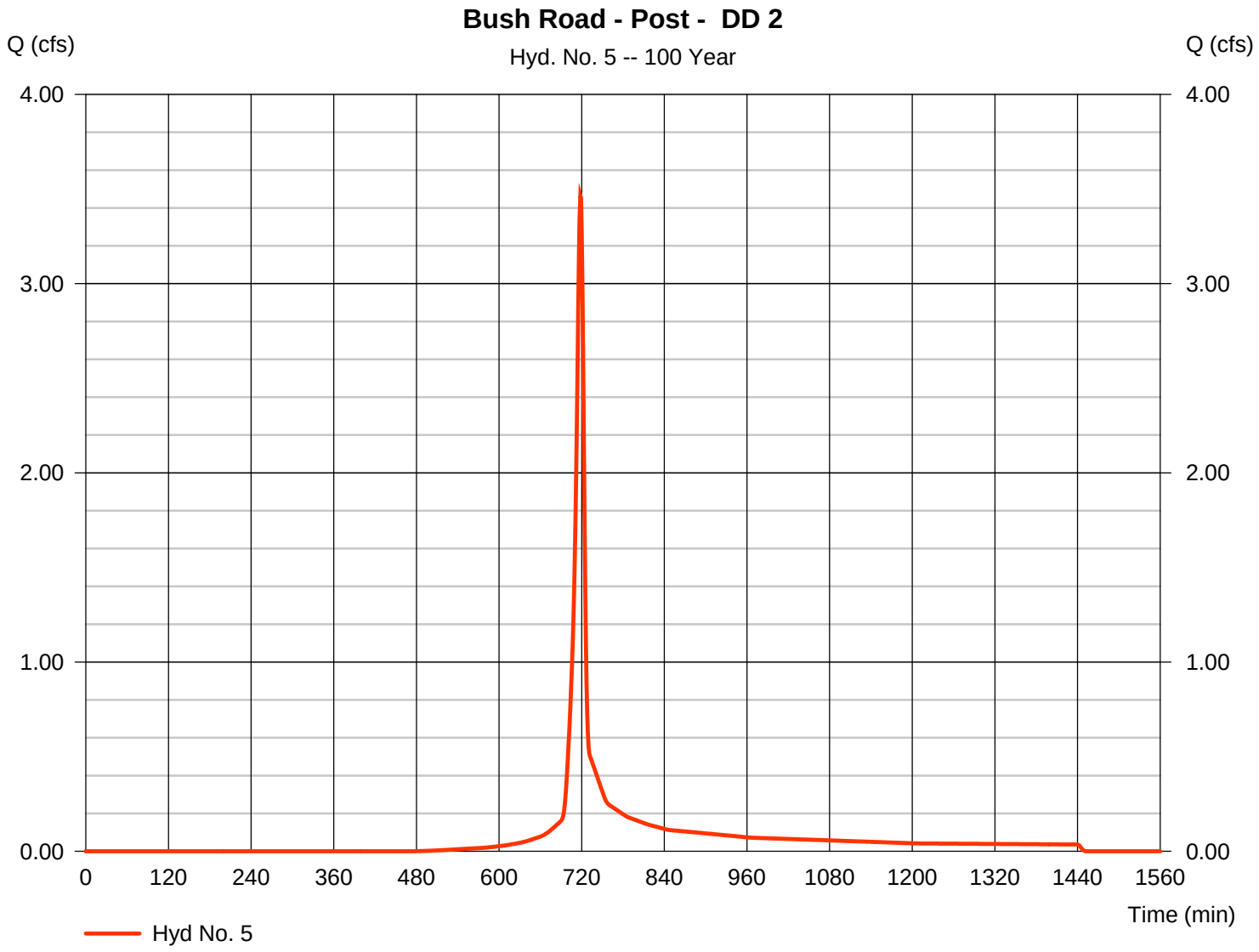
Hydrograph Report

Hyd. No. 5

Bush Road - Post - DD 2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.464 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 7,349 cuft
Drainage area	= 0.760 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 5.13 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 70) + (0.010 x 77) + (0.640 x 78)] / 0.760



TR55 Tc Worksheet

Hyd. No. 5

Bush Road - Post - DD 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.45		0.00		0.00		
Land slope (%)	= 22.00		0.00		0.00		
Travel Time (min)	**= 4.29**	**+**	**0.00**	**+**	**0.00**	**=**	**4.29**
Shallow Concentrated Flow							
Flow length (ft)	= 210.00		510.00		0.00		
Watercourse slope (%)	= 25.00		9.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=8.07		4.84		0.00		
Travel Time (min)	**= 0.43**	**+**	**1.76**	**+**	**0.00**	**=**	**2.19**
Channel Flow							
X sectional flow area (sqft)	= 1.03		0.00		0.00		
Wetted perimeter (ft)	= 3.28		0.00		0.00		
Channel slope (%)	= 9.00		0.00		0.00		
Manning's n-value	= 0.060		0.015		0.015		
Velocity (ft/s)	=3.43						
			0.00				
					0.00		
Flow length (ft)	({0})45.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

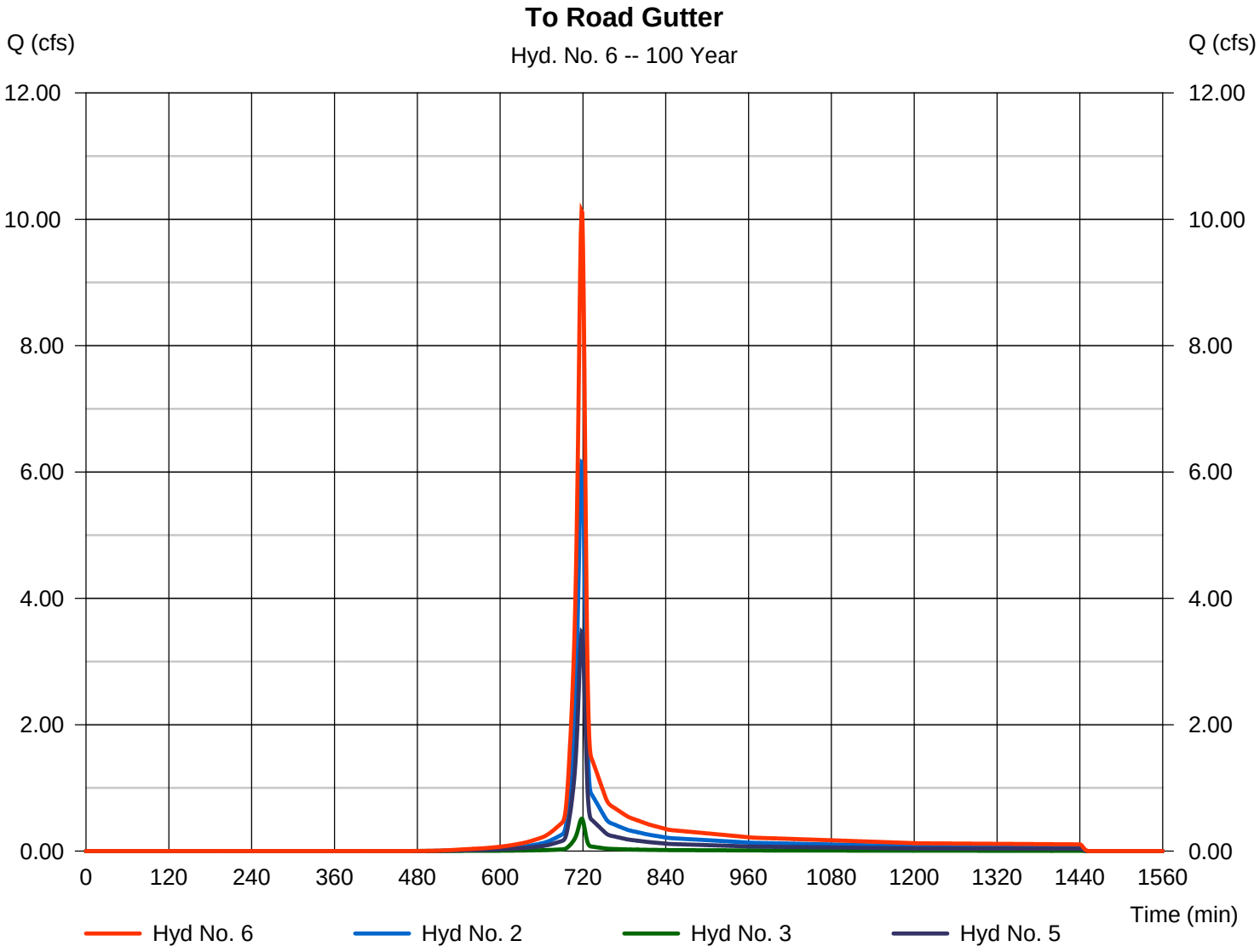
Total Travel Time, Tc ..... 6.70 min

Hydrograph Report

Hyd. No. 6

To Road Gutter

Hydrograph type	= Combine	Peak discharge	= 10.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 21,468 cuft
Inflow hyds.	= 2, 3, 5	Contrib. drain. area	= 2.300 ac



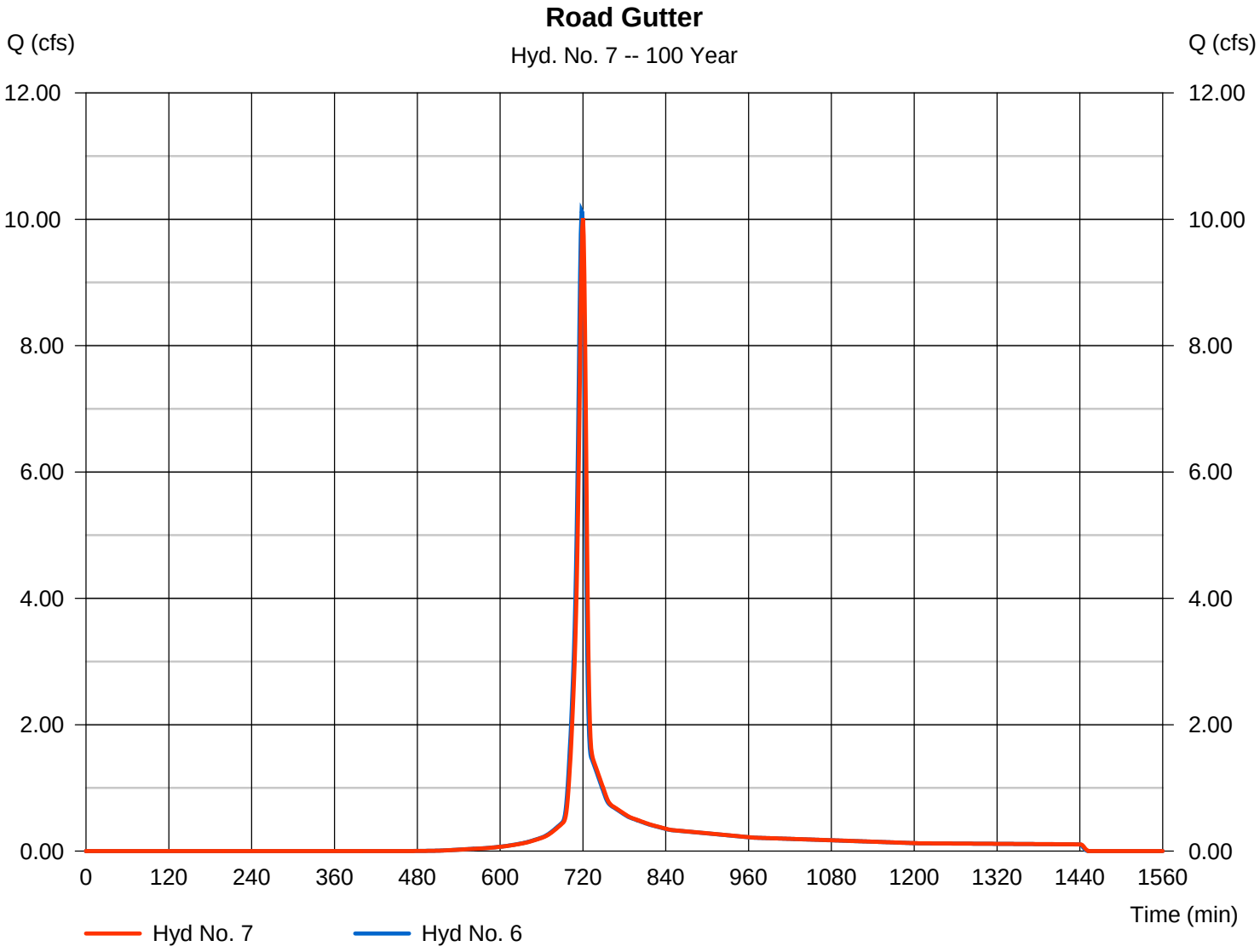
Hydrograph Report

Hyd. No. 7

Road Gutter

Hydrograph type	=	Reach	Peak discharge	=	10.02 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	21,468 cuft
Inflow hyd. No.	=	6 - To Road Gutter	Section type	=	Triangular
Reach length	=	500.0 ft	Channel slope	=	4.0 %
Manning's n	=	0.030	Bottom width	=	0.0 ft
Side slope	=	2.0:1	Max. depth	=	0.0 ft
Rating curve x	=	4.975	Rating curve m	=	1.333
Ave. velocity	=	0.00 ft/s	Routing coeff.	=	0.6445

Modified Att-Kin routing method used.

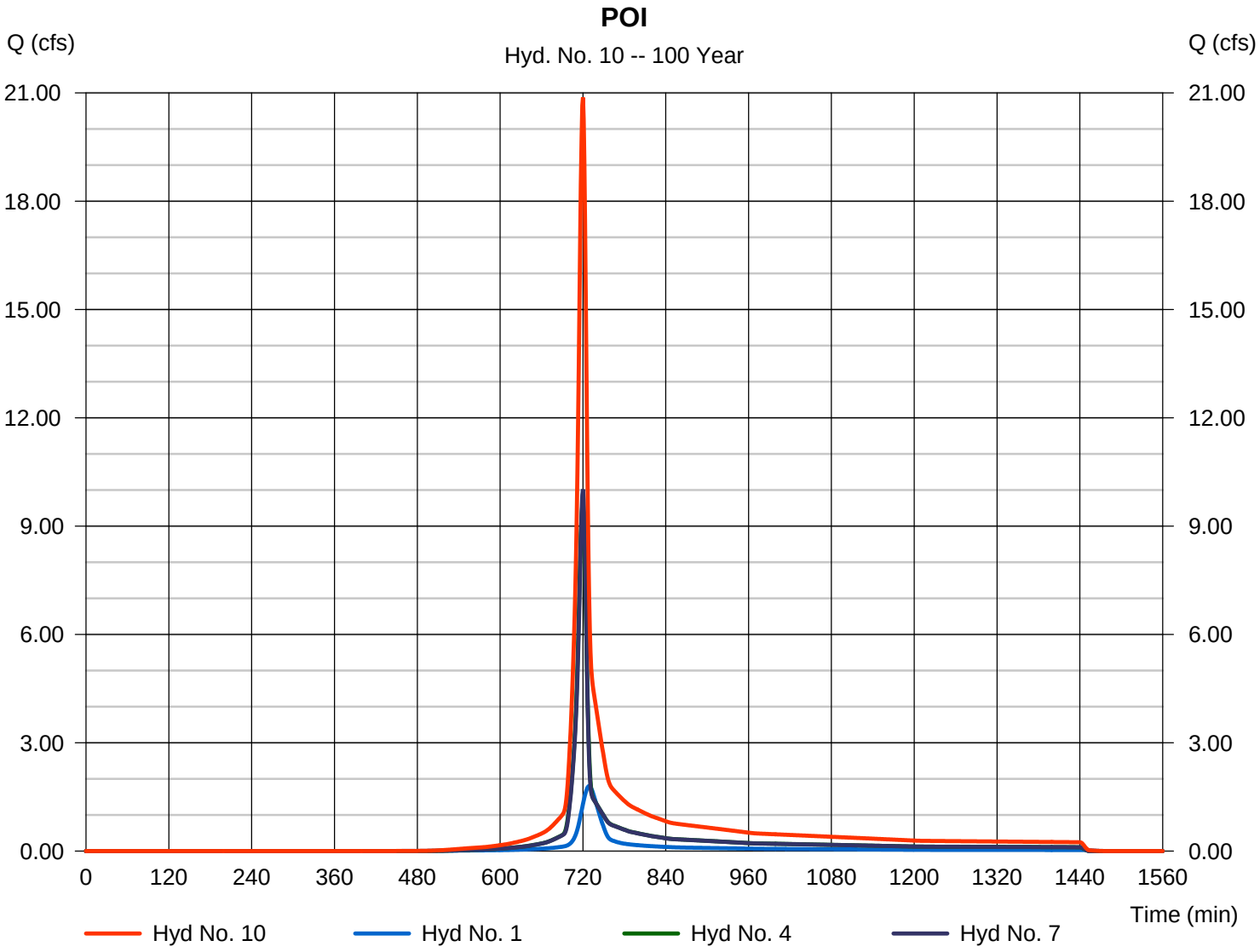


Hydrograph Report

Hyd. No. 10

POI

Hydrograph type	=	Combine	Peak discharge	=	20.87 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	49,860 cuft
Inflow hyds.	=	1, 4, 7	Contrib. drain. area	=	2.870 ac



ATTACHMENT D
BUSH RD
DIVERSION CHANNEL DESIGN

TETRA TECH, INC.

By:	LMD	Date: 10/03/16	Subject:	Sunoco PA Pipeline Project	Sheet No.: of
Chkd. By:	RJM	Date: 01/29/17		Bush Road	Proj. No.: 112IC05958

DIVERSION DITCH DESIGN

DESIGN DISCHARGE

Channel	Design Discharge (cfs)
DD-1	11.25
DD-2	4.00

The design discharge is the 100-year 24-hour storm runoff from the watershed.

CHANNEL LINING

The collection channels will be vegetated and lined with a North American Green Synthetic Lining, or approved equivalent if needed for stability. The North American Green Erosion Control Materials Design Software, Version 5.0 was used to analyze the channel lining stability and hydraulic characteristics of the channel.

FREEBOARD

Channel	Velocity (ft/s)	Depth (ft)	Minimum Required Freeboard (ft)	Minimum Required Depth (ft)
DD-1	3.05	1.13	0.50	1.63
DD-2	3.07	0.60	0.50	1.10

CHANNEL CONFIGURATION SUMMARY

Channel	Bed Slope (%)	Bottom Width (ft)	Side Slopes (_LH:1V)	Side Slopes (_RH:1V)	Channel Lining	Total Depth (ft)
DD-1	2%	1	2	2	NAG P300	2.00
DD-2	6%	1	2	2	NAG P300	1.50

Notes:

1. Channel velocities and flow depths were obtained from the included computer output.
2. The channel section characteristics resulting in the largest total depth were used.

TETRA TECH, INC.

By:	LMD	Date: 10/03/16	Subject:	Sunoco PA Pipeline Project	Sheet No.: of
Chkd. By:	RJM	Date: 01/29/17		Bush Road	Proj. No.: 112IC05958

LEVEL SPREADER DESIGN

CHANNEL DESIGNATION	ENERGY DISSIPATOR TYPE	LENGTH (ft)	Downslope Protection	Q (cfs)
DD-1	Earthen Level Spreader	173	Grass/Rock	11.25

$$Q = C_w \times L \times H^{3/2}$$ (Ref #5)

Q = Flow (cfs)
L = Length of Level Spreader (ft)
C_w = Weir Coefficient 3.27
H = Driving Head (ft) 0.07 Based on V(allowable) = 1.33

$$V = 1.5 \times C_w \times H^{1/2}$$ (Ref #5)

V = Allowable velocity at the Level Spreader (fps)
Grass/Ticket = 1.33
Gravel = 1.5 (Table G.2, Ref #5)
Mulch (trees, Shrubs) = 0.67

Tensar International Corporation
5401 St. Wendel-Cynthiana Road
Poseyville, Indiana 47633
Tel. 800.772.2040
Fax 812.867.0247
www.nagreen.com

Erosion Control Materials Design Software
Version 5.0

Project Name: 112IC05958 Sunoco
Project Number: 103213
Channel Name: DD1

Discharge	11.25
Peak Flow Period	0.3
Channel Slope	0.02
Channel Bottom Width	1
Left Side Slope	2
Right Side Slope	2
Low Flow Liner	
Retardance Class	D
Vegtation Type	Mix (Sod & Bunch)
Vegetation Density	Good 75-95%
Soil Type	Silt Loam

P300 - Class D - Mix (Sod & Bunch) - Good 75-95%

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
P300 Unvegetated	Straight	11.25 cfs	4.41 ft/s	0.91 ft	0.03	3 lbs/ft2	1.13 lbs/ft2	2.65	STABLE	E
P300 Reinforced Vegetation	Straight	11.25 cfs	3.05 ft/s	1.13 ft	0.05	8 lbs/ft2	1.41 lbs/ft2	5.66	STABLE	E
Underlying Substrate	Straight	11.25 cfs	3.05 ft/s	1.13 ft	--	2 lbs/ft2	0.113 lbs/ft2	17.65	STABLE	--

Tensar International Corporation
5401 St. Wendel-Cynthiana Road
Poseyville, Indiana 47633
Tel. 800.772.2040
Fax 812.867.0247
www.nagreen.com

Erosion Control Materials Design Software
Version 5.0

Project Name: 112IC05958 Sunoco
Project Number: 103213
Channel Name: DD2

Discharge	4
Peak Flow Period	0.3
Channel Slope	0.06
Channel Bottom Width	1
Left Side Slope	2
Right Side Slope	2
Low Flow Liner	
Retardance Class	D
Vegtation Type	Mix (Sod & Bunch)
Vegetation Density	Good 75-95%
Soil Type	Silt Loam

P300 - Class D - Mix (Sod & Bunch) - Good 75-95%

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
P300 Unvegetated	Straight	4 cfs	4.64 ft/s	0.45 ft	0.034	3 lbs/ft2	1.69 lbs/ft2	1.77	STABLE	E
P300 Reinforced Vegetation	Straight	4 cfs	3.07 ft/s	0.6 ft	0.06	8 lbs/ft2	2.23 lbs/ft2	3.59	STABLE	E
Underlying Substrate	Straight	4 cfs	3.07 ft/s	0.6 ft	--	2 lbs/ft2	0.172 lbs/ft2	11.63	STABLE	--