FINAL STORMWATER DRAINAGE STUDY FOR LEE'S SUMMIT SENIOR LIVING COMMUNITY

SE Oldham Parkway
Lee Summit, Missouri

South Prairie Lee Watershed

Prepared for:

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2nd Submittal
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1. GENERAL INFORMATION

The following stormwater report is for the Lee's Summit Senior Living Community located near the southern boundary of the South Prairie Lee Watershed on the south side of Oldham Parkway approximately 0.4 miles east of Todd George Parkway. The proposed 157,515-sqft facility will be on a 10.45 acre± site that is currently vacant pasture land. In the existing condition the site generally flows from south to the north towards Oldham Parkway. A subtle ridge line splits the site into two sub-drainage areas. The western onsite drainage area discharges to the Oldham Parkway drainage swale at the northwest corner of the site (POI #1). The swale drains to a 5'x5' RCB culvert that flows north underneath the Oldham Parkway, US Route 50, and Blue Parkway to the E. Fork Little Blue River through an unnamed tributary. The eastern onsite drainage area intercepts offsite runoff from approximately 5-acres of agricultural land from the east. Runoff continues to flow north and northeast to an existing 30" RCP culvert (POI #2) that discharges north underneath Oldham Parkway, US Route 50, and Blue Parkway. Storm water continues north to an existing wet detention facility located south of Shenandoah Drive.

Stormwater runoff from the proposed Lee's Summit Senior Living Community will be collected and conveyed through onsite storm sewer, that is routed to proposed bioretention and extended dry detention facilities. These facilities will discharge the water in compliance with the KC APWA "Comprehensive Control Strategy" to the proposed public storm sewer that will be installed with the Oldham Parkway street improvements.

According the FEMA Flood Map Service Center the site is not located in an area of minimal flood hazard per map #29095C049G dated 01/20/2017. The FEMA FIRMette has been included in Appendix B.

Per the National Wetlands Inventory, the site has no "blue line" streams or wetlands located on site.

Soil data was taken from the USDA Natural Resources Conservation Service – Web Soil Survey of Jackson, County Missouri. The Web soil survey categorize soils on the proposed Lee's Summit Senior Living Community as:

TABLE 1. SITE SOIL CLASSIFICATION

Map Unit	Map Unit Name	Percent Slopes	Rating	Area in AOI (acres)	Percent of AOI
10000	**Arisburg Silt Loam**	1 to 5	C	15.9	85.9%
10082	**Arisburg-Urban land complex**	1 to 5	C	2.6	14.1%

*see Web Soil Survey pdf located in Appendix A

2. METHODOLOGY

This Stormwater Drainage Study has been prepared to evaluate the hydrologic impact generated by the development of the Lee's Summit Senior Living Community and adjacent public street improvements. The base data for models prepared for this report have been obtained through topographic surveys, online maps, and aerial imagery.

The following method was used to study and model existing and proposed conditions for stormwater runoff:

- TR-55 Unit Hydrograph Method
  - 2-year, 10-year, 100-year Return Frequency Storms
  - 24-Hour SCS Type II Rainfall Distribution
  - SCS Runoff Curve Numbers Per SCS TR-55
  - SCS TR-55 Methods for determining Time of Concentration and Travel Time

Rainfall depth & duration data were taken from the National Oceanic and Atmospheric Administration (NOAA). A summary of the rainfall data used in the calculations are presented in Table 2.

TABLE 2. RAINFALL PRECIPITATION

Annual Exceedance Probability (AEP)	**Rainfall Depth** (inches)
1-year	3.71
10-year	5.66
100-year	9.25

*Hydraflow reports have been provided in Appendix A

3. EXISTING CONDITIONS ANALYSIS

Existing conditions where modeled assuming pasture in good condition. This assumption was used to calculate existing condition flow rates and the level service required for proposed BMP

implementation. Discharge from the proposed development will adhere to APWA and Lee's Summit discharge requirements. Refer to Figure 1 for existing condition sub-drainage area locations, runoff curve numbers, and sub-drainage area acreage.

In the existing condition, the site generally flows from south to the north towards Oldham Parkway. A subtle ridge line splits the site into two sub-drainage areas. The western onsite drainage area (EX10) discharges to the Oldham Parkway drainage swale at the northwest corner of the site (POI #1). The swale drains to a 5'x5' RCB culvert that flows north underneath the Oldham Parkway, US Route 50, and Blue Parkway to the E. Fork Little Blue River through an unnamed tributary.

The eastern onsite drainage area (EX20) intercepts offsite runoff from approximately 5-acres of pasture land from the east (OFF20). Runoff continues to flow north and northeast to an existing 30" RCP culvert (POI #2) that discharges north underneath Oldham Parkway, US Route 50, and Blue Parkway. Storm water continues north to an existing wet detention facility located south of Shenandoah Drive.

The following table(s), Table 3A & 3B, summarizes the results of the existing conditions analysis:

TABLE 3A. EXISTING CONDITIONS ANALYSIS SUMMARY POINT OF INTEREST #1

Subarea	Existing $Q_{2\text{-year}}$ (cfs)	Existing $Q_{10\text{-year}}$ (cfs)	Existing $Q_{100\text{-year}}$ (cfs)
EX POI #1	16.24	34.88	72.52

TABLE 3B. EXISTING CONDITIONS ANALYSIS SUMMARY POINT OF INTEREST #2

Subarea	Existing $Q_{2\text{-year}}$ (cfs)	Existing $Q_{10\text{-year}}$ (cfs)	Existing $Q_{100\text{-year}}$ (cfs)
EX PO1 #2	16.94	36.47	75.73

4. PROPOSED CONDITIONS ANALYSIS

The proposed conditions section of this analysis assumes completion of the Lee's Summit Senior Living Community and adjacent public street improvements. A CN value of 98 was used for all building and pavement surfaces. A CN values of 80 was used for all developed open space. As in the existing conditions, the proposed conditions stormwater runoff model was created and ran for the 2, 10, and 100-year storm events. The complete output for the Hydraflow model has been included in Appendix A. Refer to Figure 2 for developed sub-drainage area locations, runoff curve numbers, and sub-drainage area acreage.

In the developed condition drainage area DEV 10 flows into Bio Detention Facility #1 before flowing into the proposed dry detention basin. Drainage area DEV 20 is routed through Bio Detention Facility #2 before it is discharged to the dry detention basin. Drainage area DEV 30 is conveyed into the dry detention basin through an underground storm sewer system. The detention facility discharges to Point of Interest #1, Discharge from the detention basin will be less than allowable flow rates established using the "Comprehensive Control Strategy". Additionally, the dry detention will provide a 40-hour minimum extended drainage time of the 90% storm runoff volume. Stormwater flow from the detention facility, DA12 and OFF11 combine at Point of Interest #1 located immediately upstream of the existing 5'x5' box culvert to flows north beneath Oldham Parkway.

Point of Interest #2 accepts the accumulation of flow from OFF 20, DA 21, and DA 22. Offsite and public right-of-way stormwater runoff is collected in an underground storm sewer system and conveyed to the 30-inch concrete pipe that flows north beneath Oldham Parkway.

The following tables contain input data and summarize the computed results of the developed conditions analysis:

TABLE 4A. DEVELOPED CONDITIONS ANALYSIS SUMMARY POINT OF INTEREST #1

Subarea	Drainage Area (acres)	Curve Number	Tc (Minutes)	Developed $Q_{2\text{-year}}$ (cfs)	Developed $Q_{10\text{-year}}$ (cfs)	Developed $Q_{100\text{-year}}$ (cfs)
DEV 10	2.94	92	5	13.29	21.46	36.24
BIO #1				12.54	20.61	35.10
DEV 20	2.40	89	5	10.01	16.75	28.97
BIO #2				8.13	15.53	25.01
DEV 30	4.08	89	5	17.02	28.48	49.26
DRY DET. DISCHARGE	**9.42**			**1.24**	**5.91**	**15.89**
ALLOWABLE				**4.71**	**18.84**	**28.26**
DA 12 (R/W)	1.21	87	5	4.75	8.15	14.36
OFF 11	8.28	74	25.6	10.78	23.30	48.68

TABLE 4B. DEVELOPED CONDITIONS ANALYSIS SUMMARY POINT OF INTEREST #2

Subarea	Drainage Area (acres)	Curve Number	Tc (Minutes)	Developed $Q_{2\text{-year}}$ (cfs)	Developed $Q_{10\text{-year}}$ (cfs)	Developed $Q_{100\text{-year}}$ (cfs)
DA 21 (R/W)	1.5	88	5	6.07	10.29	17.96
DA 22 (R/W)	0.54	85	5	1.98	3.50	6.28
OFF 20	5.39	75	32.7	6.44	13.67	28.27

TABLE 5A. DRY DETENTION FACILITY SUMMARY

Return Frequency	Developed Q_{DEV} (cfs)	Detention Volume (cf)	WSE (ft)
2	1.24	43,010	1017.21
10	5.91	72,321	1018.62
100	15.89	128,492	1020.77

TABLE 5B. BIO DETENTION #1 FACILITY SUMMARY

Return Frequency	Developed Q_{DEV} (cfs)	Detention Volume (cf)	WSE (ft)
2	12.54	8,754	1021.24
10	20.61	9,607	1021.33
100	35.10	10,893	1021.48

TABLE 5C. BIO DETENTION #2 FACILITY SUMMARY

Return Frequency	Developed Q_{DEV} (cfs)	Detention Volume (cf)	WSE (ft)
2	8.13	8,037	1022.79
10	15.53	9,138	1022.94
100	25.10	10,956	1023.15

TABLE 6A. POINT OF INTEREST #1 SUMMARY

Return Frequency	Existing Q_{pre} (cfs)	Developed Q_{DEV} (cfs)
2	**16.24**	**11.96**
10	**34.88**	**28.37**
100	**72.52**	**66.43**

TABLE 6B. POINT OF INTEREST #2 SUMMARY

Return Frequency	Existing Q_{pre} (cfs)	Developed Q_{DEV} (cfs)
2	**16.94**	10.95
10	**36.47**	20.60
100	**75.73**	39.30

5. POST CONSTRUCTION WATER QUALITY

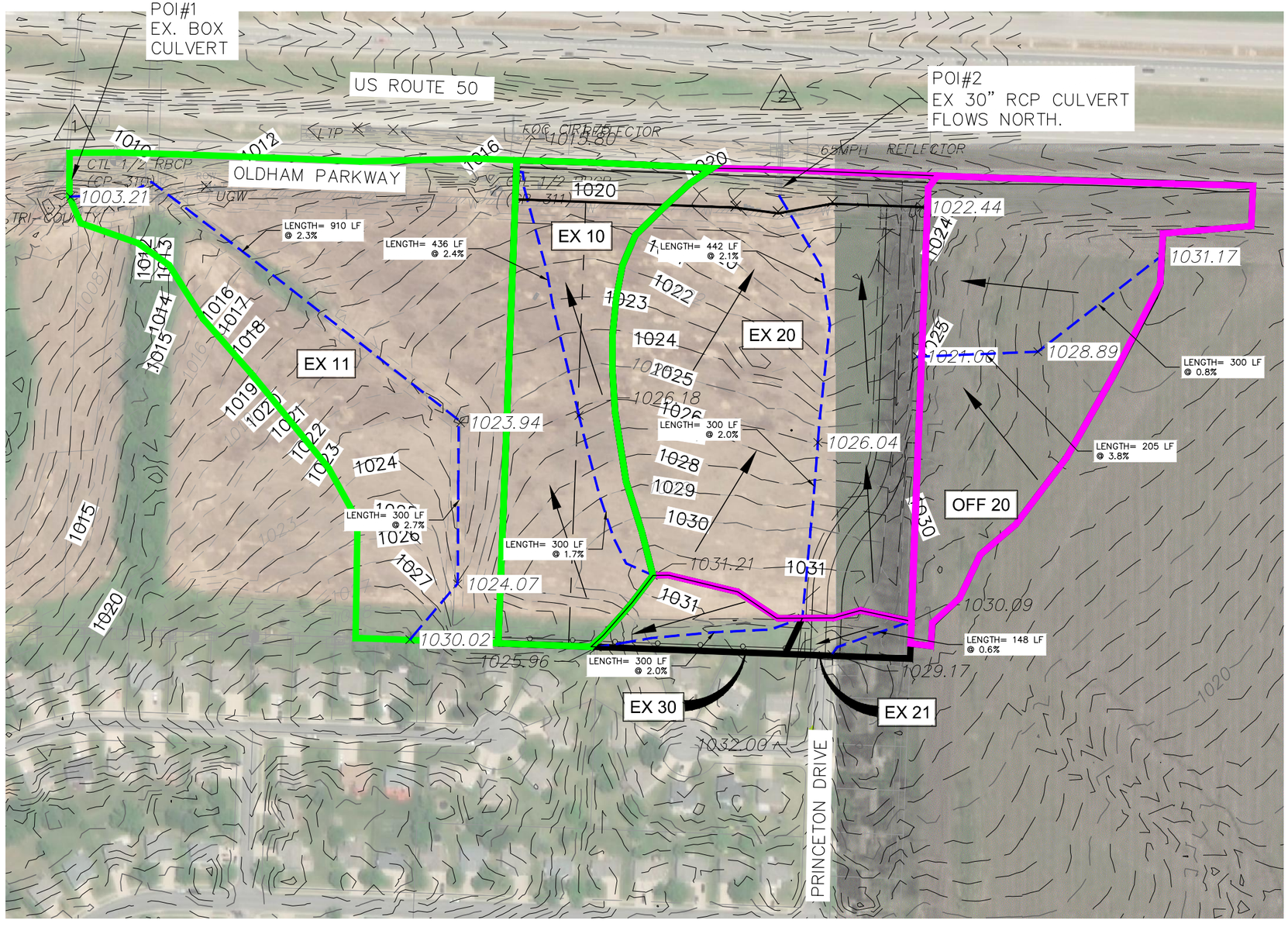
Water quality volume treatment calculations were determined using the 2012 APWA/MARC BMP manual level of surface calculations. The level of surface calculation considered all onsite development. Existing offsite right-of-way and proposed public right-of-way will not be conveyed through onsite BMPs. Water quality level of service and water quality volume calculations are provided in Appendix C.

6. CONCLUSIONS & RECOMMENDATIONS

The Lee's Summit Senior Living Community has been evaluated in this report to show that the stormwater discharge from the site will remain within the acceptable levels. A new detention basin and two new biodetention basins are to be constructed to handle the increased runoff created from the development.

In conclusion, all peak discharges at the points of interest for all events are below the pre-development flow rates. Additionally, post construction storm water BMPs will be provided to meet the required level of service for this development. See Appendix F for City of Lee's Summit BMP Level of Service Worksheet.

It is therefore requested that Lee's Summit, Missouri approve this "Lee's Summit Senior Living Community Final Stormwater Drainage Study." This study will be verified with the final construction documents for the construction with the development.



LEGEND

- POI#1 DRAINAGE AREA BOUNDARY
- POI#2 DRAINAGE AREA BOUNDARY
- TC ROUTE
- FLOW DIRECTION
- 1 — POINT OF INTEREST

SUMMARY TABLE			
SUBBASIN	AREA (AC)	CN	TC (MIN.)
EX 10	3.98	75	26.30
EX 11	8.27	74	25.10
EX 20	8.28	74	25.60
EX 21	0.31	74	18.81
EX30	0.69	74	19.75
OFF 20	4.94	75	28.90

N

0’ 100’ 200’ 400’

SCALE IN FEET

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USER: rjeppson

PROJECT:	018-1450
DRAWN BY:	TDD
DATE:	07/19/2019

EXISTING CONDITIONS DRAINAGE AREA MAP

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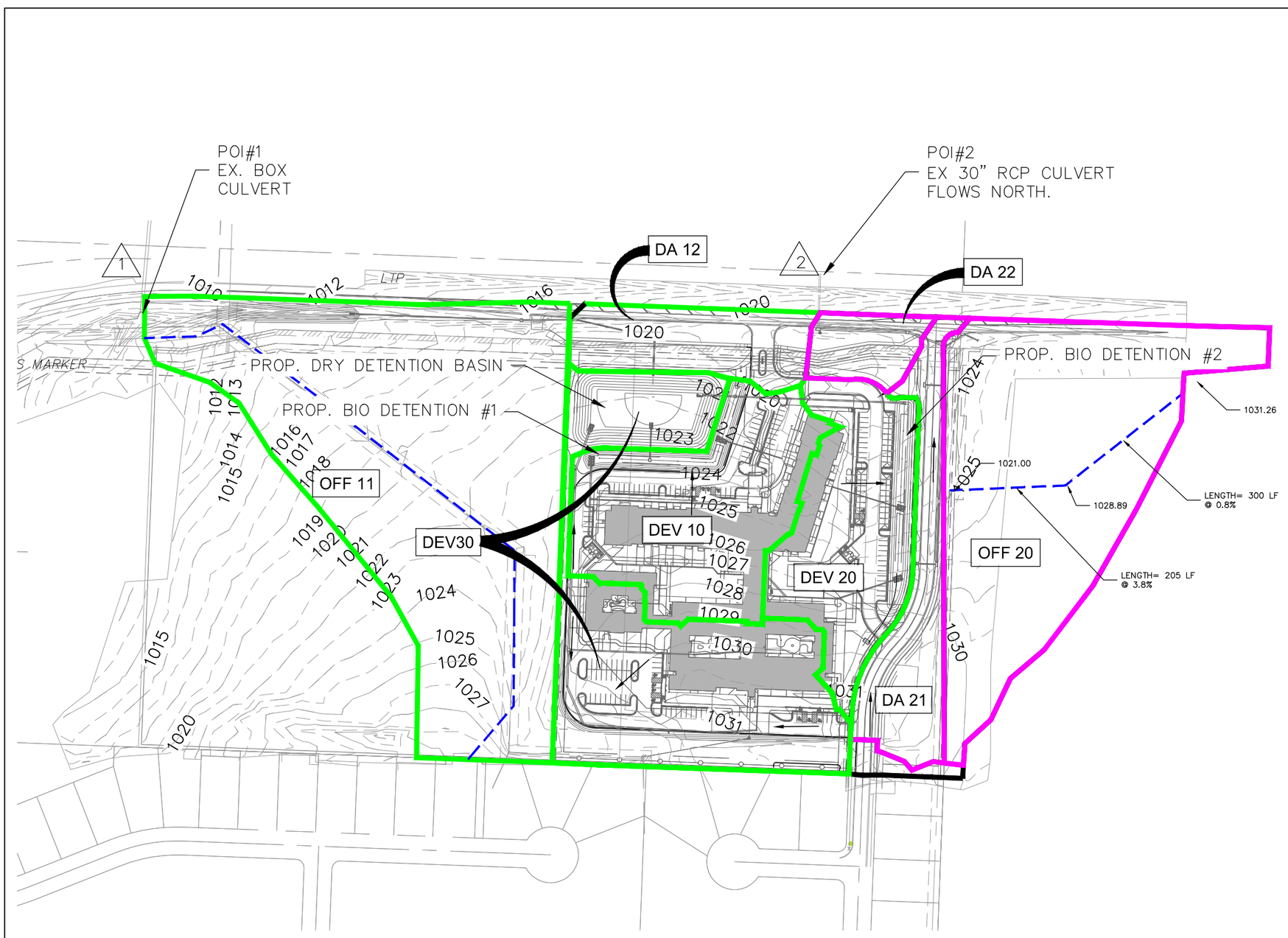
FIGURE
F-1



LEGEND

- POI#1 DRAINAGE AREA BOUNDARY
- POI#2 DRAINAGE AREA BOUNDARY
- TC ROUTE
- FLOW DIRECTION
- POINT OF INTEREST

SUMMARY TABLE			
SUBBASIN	AREA (AC)	CN	TC (MIN.)
DEV 10	2.94	92	5.00
DA 12	1.21	87	5.00
DEV 30	4.08	89	5.00
DEV 20	2.40	89	5.00
DA 21	1.50	88	5.00
DA 22	0.54	85	5.00
OFF 11	8.28	74	25.60
OFF 20	5.94	76	29.90

N

0' 100' 200' 400'

SCALE IN FEET

PROJECT: 018-1450
DRAWN BY: TDD
DATE: 07/19/2019

DEVELOPED CONDITIONS DRAINAGE AREA MAP

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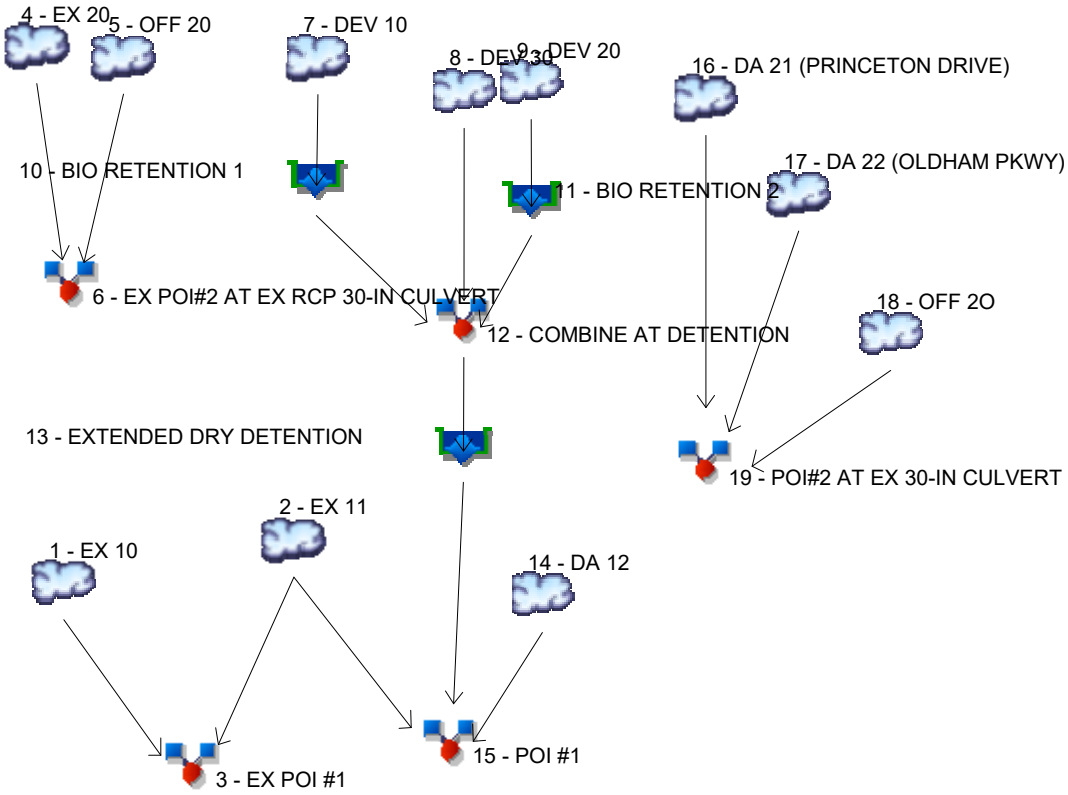
FIGURE
F-2

APPENDIX A

Hydrology & Detention Calculations

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX 10
2	SCS Runoff	EX 11
3	Combine	EX POI #1
4	SCS Runoff	EX 20
5	SCS Runoff	OFF 20
6	Combine	EX POI#2 AT EX RCP 30-IN CULVERT
7	SCS Runoff	DEV 10
8	SCS Runoff	DEV 30
9	SCS Runoff	DEV 20
10	Reservoir	BIO RETENTION 1
11	Reservoir	BIO RETENTION 2
12	Combine	COMBINE AT DETENTION
13	Reservoir	EXTENDED DRY DETENTION
14	SCS Runoff	DA 12
15	Combine	POI #1
16	SCS Runoff	DA 21 (PRINCETON DRIVE)
17	SCS Runoff	DA 22 (OLDHAM PKWY)
18	SCS Runoff	OFF 2O
19	Combine	POI#2 AT EX 30-IN CULVERT

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	5.462	2	730	20,656	------	------	------	EX 10
2	SCS Runoff	10.78	2	730	41,034	------	------	------	EX 11
3	Combine	16.24	2	730	61,691	1, 2	------	------	EX POI #1
4	SCS Runoff	10.77	2	730	40,985	------	------	------	EX 20
5	SCS Runoff	6.443	2	734	28,774	------	------	------	OFF 20
6	Combine	16.94	2	730	69,759	4, 5	------	------	EX POI#2 AT EX RCP 30-IN CULVE
7	SCS Runoff	13.29	2	716	28,396	------	------	------	DEV 10
8	SCS Runoff	17.02	2	716	35,433	------	------	------	DEV 30
9	SCS Runoff	10.01	2	716	20,843	------	------	------	DEV 20
10	Reservoir	12.54	2	718	21,778	7	1021.24	8,754	BIO RETENTION 1
11	Reservoir	8.129	2	720	14,839	9	1022.79	8,037	BIO RETENTION 2
12	Combine	36.65	2	718	72,051	8, 10, 11	------	------	COMBINE AT DETENTION
13	Reservoir	1.241	2	836	72,040	12	1017.21	43,010	EXTENDED DRY DETENTION
14	SCS Runoff	4.750	2	716	9,768	------	------	------	DA 12
15	Combine	11.96	2	730	122,842	2, 13, 14	------	------	POI #1
16	SCS Runoff	6.074	2	716	12,562	------	------	------	DA 21 (PRINCETON DRIVE)
17	SCS Runoff	1.984	2	716	4,044	------	------	------	DA 22 (OLDHAM PKWY)
18	SCS Runoff	6.443	2	734	28,774	------	------	------	OFF 2O
19	Combine	10.95	2	718	45,380	16, 17, 18	------	------	POI#2 AT EX 30-IN CULVERT

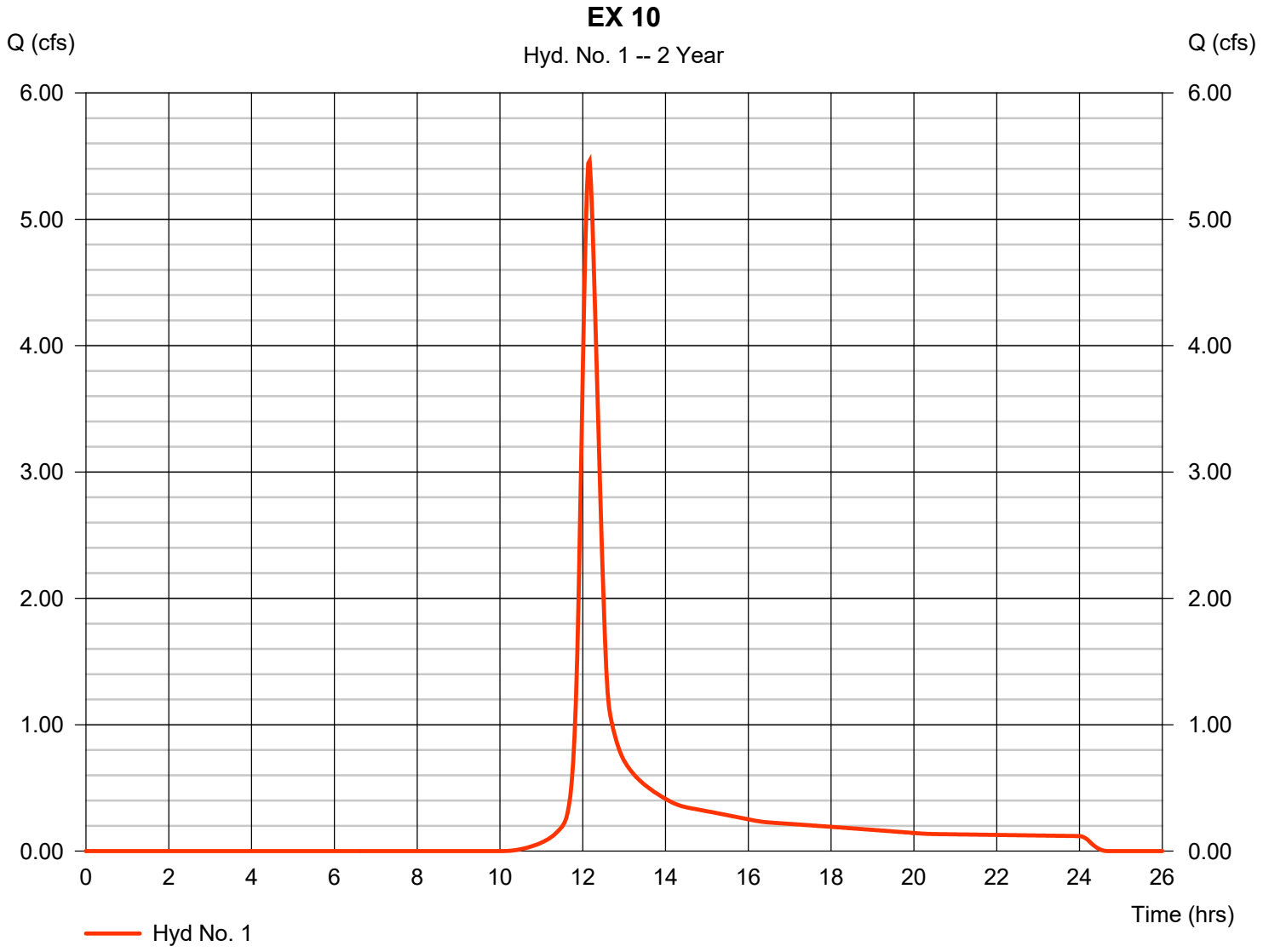
Hydrograph Report

Hyd. No. 1

EX 10

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.462 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	20,656 cuft
Drainage area	=	3.980 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.30 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.090 x 98) + (3.890 x 74)] / 3.980



TR55 Tc Worksheet

Hyd. No. 1

EX 10

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.71		0.00		0.00		
Land slope (%)	= 1.70		0.00		0.00		
Travel Time (min)	**= 23.39**	**+**	**0.00**	**+**	**0.00**	**=**	**23.39**
Shallow Concentrated Flow							
Flow length (ft)	= 435.00		0.00		0.00		
Watercourse slope (%)	= 2.40		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.50		0.00		0.00		
Travel Time (min)	**= 2.90**	**+**	**0.00**	**+**	**0.00**	**=**	**2.90**
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**

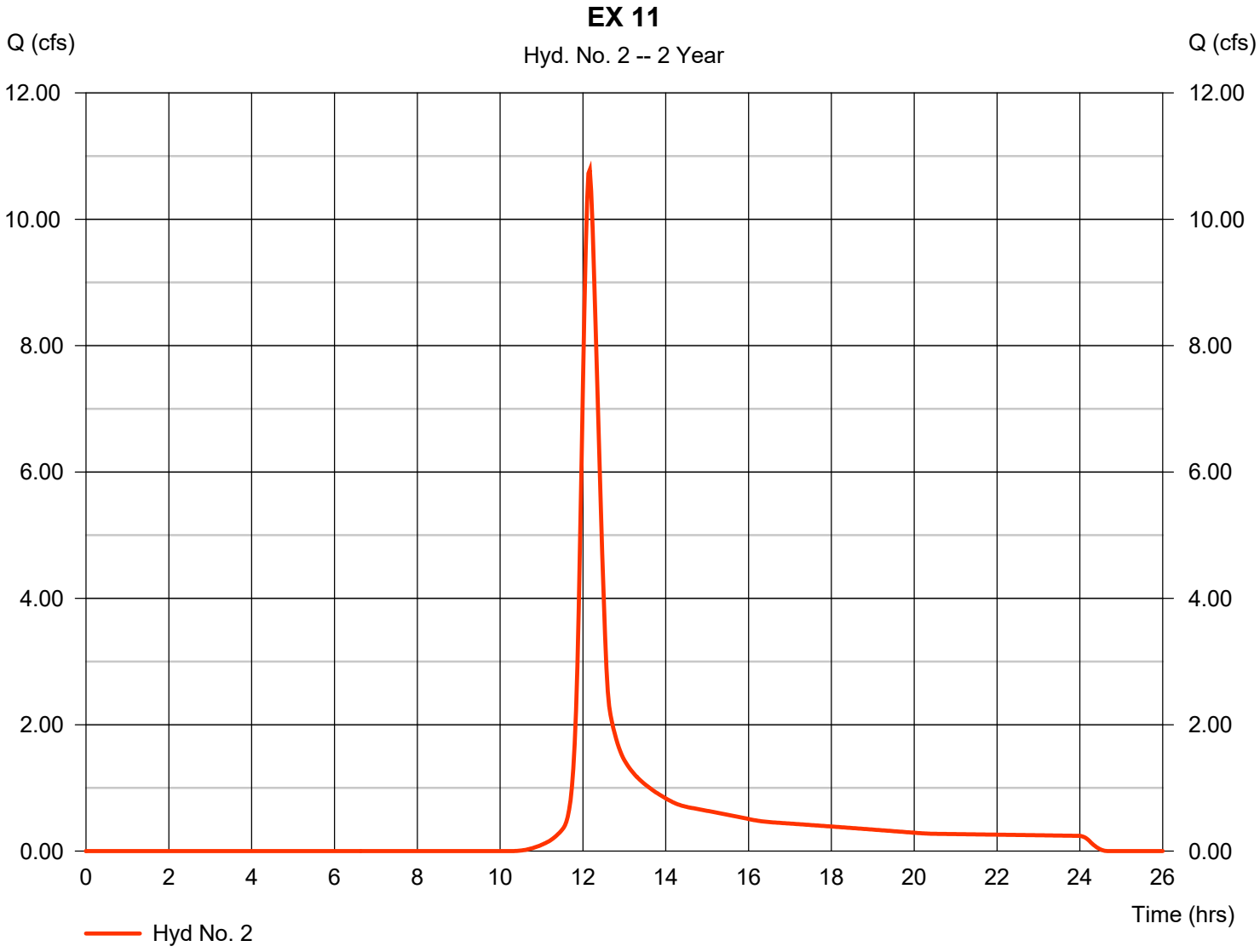
Total Travel Time, Tc ..... 26.30 min

Hydrograph Report

Hyd. No. 2

EX 11

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.78 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	41,034 cuft
Drainage area	=	8.280 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.60 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 2

EX 11

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.71		0.00		0.00		
Land slope (%)	= 2.70		0.00		0.00		
Travel Time (min)	**= 19.44**	**+**	**0.00**	**+**	**0.00**	**=**	**19.44**
Shallow Concentrated Flow							
Flow length (ft)	= 910.00		0.00		0.00		
Watercourse slope (%)	= 2.30		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.45		0.00		0.00		
Travel Time (min)	**= 6.20**	**+**	**0.00**	**+**	**0.00**	**=**	**6.20**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		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**

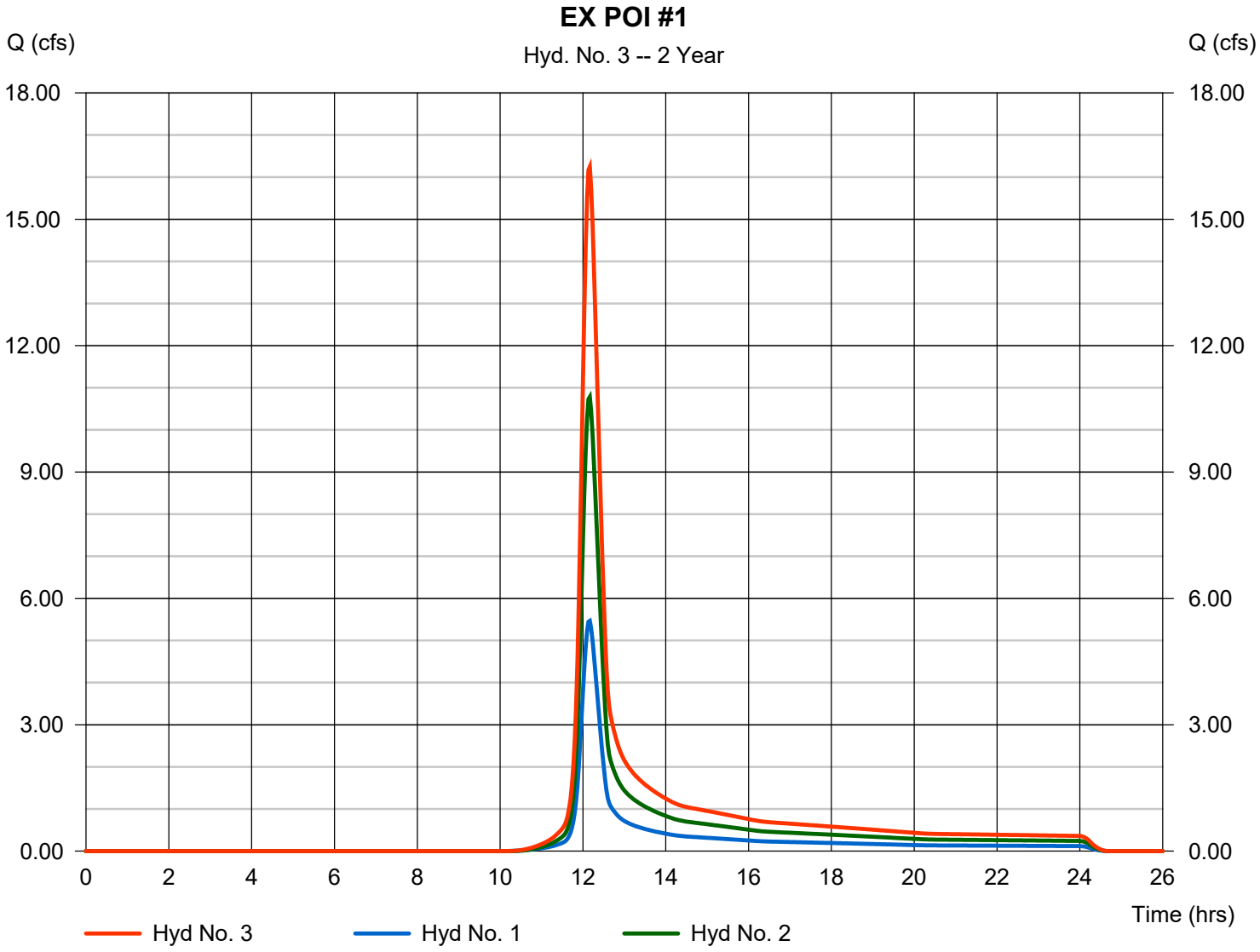
Total Travel Time, Tc ..... 25.60 min

Hydrograph Report

Hyd. No. 3

EX POI #1

Hydrograph type	=	Combine	Peak discharge	=	16.24 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	61,691 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	12.260 ac



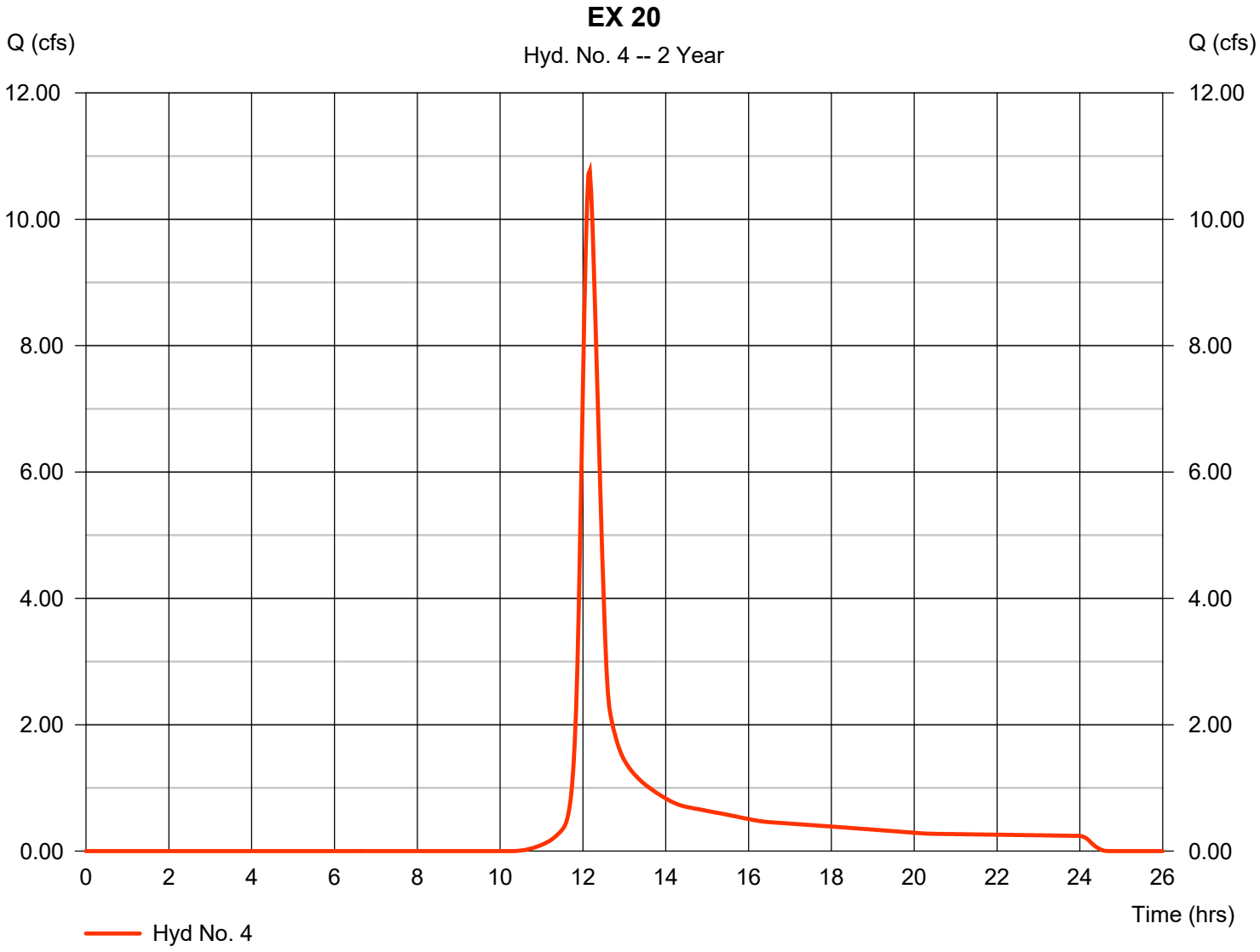
Hydrograph Report

Hyd. No. 4

EX 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.77 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	40,985 cuft
Drainage area	=	8.270 ac	Curve number	=	74*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.10 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 98) + (8.160 x 74)] / 8.270



TR55 Tc Worksheet

Hyd. No. 4

EX 20

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.71		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 21.91**	**+**	**0.00**	**+**	**0.00**	**=**	**21.91**
Shallow Concentrated Flow							
Flow length (ft)	= 440.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 3.21**	**+**	**0.00**	**+**	**0.00**	**=**	**3.21**
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 ..... 25.10 min

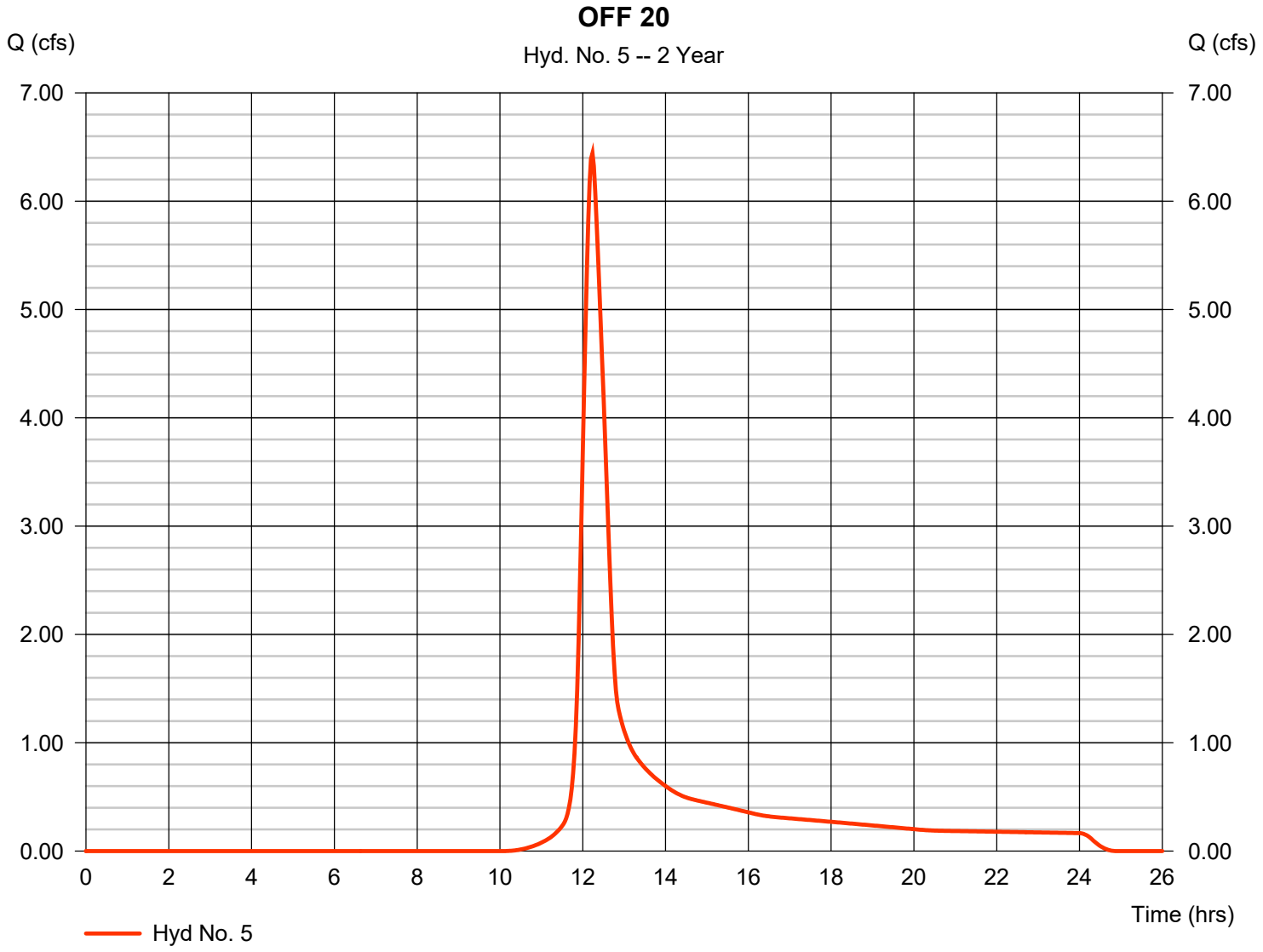
Hydrograph Report

Hyd. No. 5

OFF 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.443 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.23 hrs
Time interval	=	2 min	Hyd. volume	=	28,774 cuft
Drainage area	=	5.390 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.70 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.130 x 98) + (5.260 x 74)] / 5.390



TR55 Tc Worksheet

Hyd. No. 5

OFF 20

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.71		0.00		0.00		
Land slope (%)	= 0.80		0.00		0.00		
Travel Time (min)	**= 31.62**	**+**	**0.00**	**+**	**0.00**	**=**	**31.62**
Shallow Concentrated Flow							
Flow length (ft)	= 205.00		0.00		0.00		
Watercourse slope (%)	= 3.80		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.15		0.00		0.00		
Travel Time (min)	**= 1.09**	**+**	**0.00**	**+**	**0.00**	**=**	**1.09**
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**

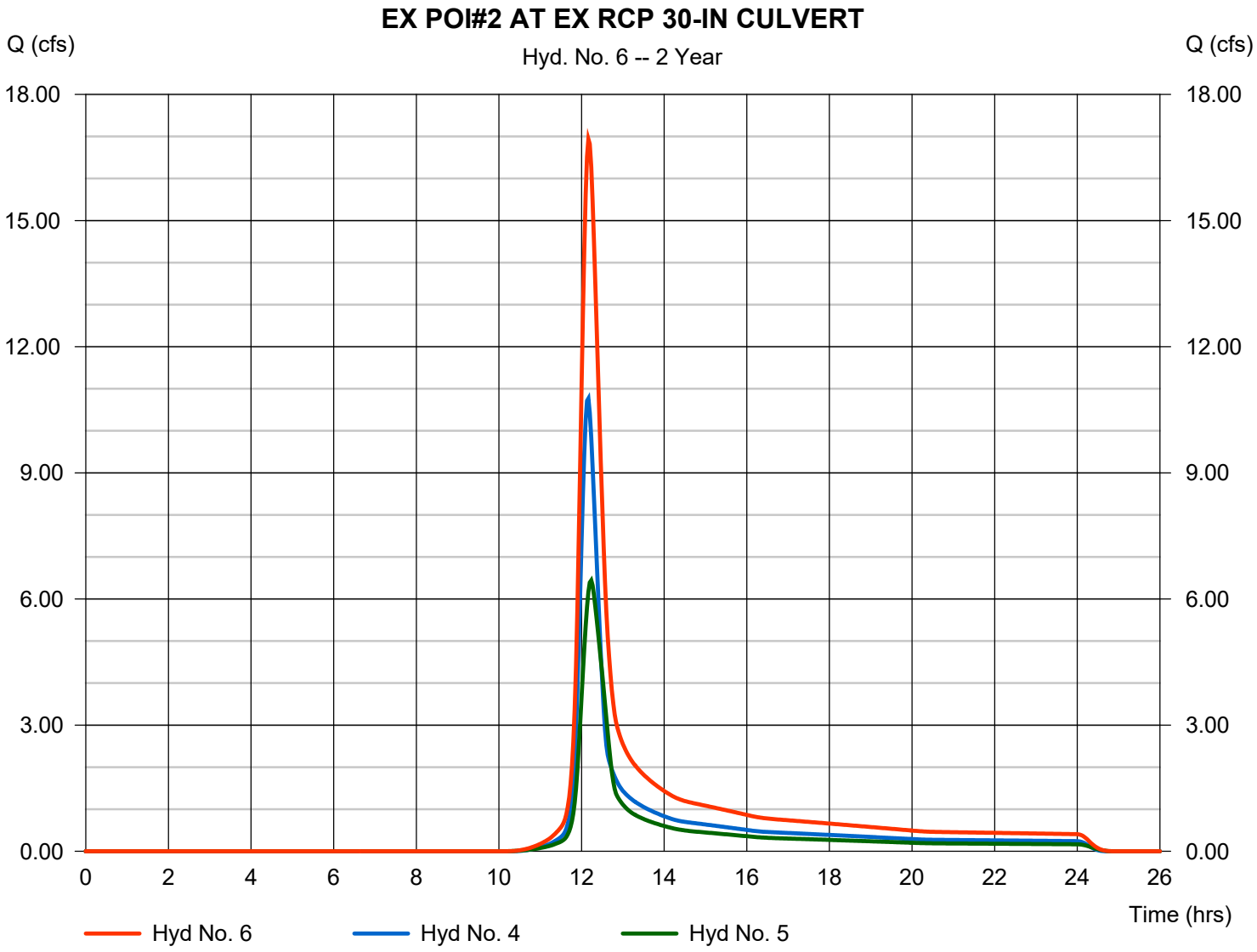
Total Travel Time, Tc ..... 32.70 min

Hydrograph Report

Hyd. No. 6

EX POI#2 AT EX RCP 30-IN CULVERT

Hydrograph type	= Combine	Peak discharge	= 16.94 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 69,759 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 13.660 ac



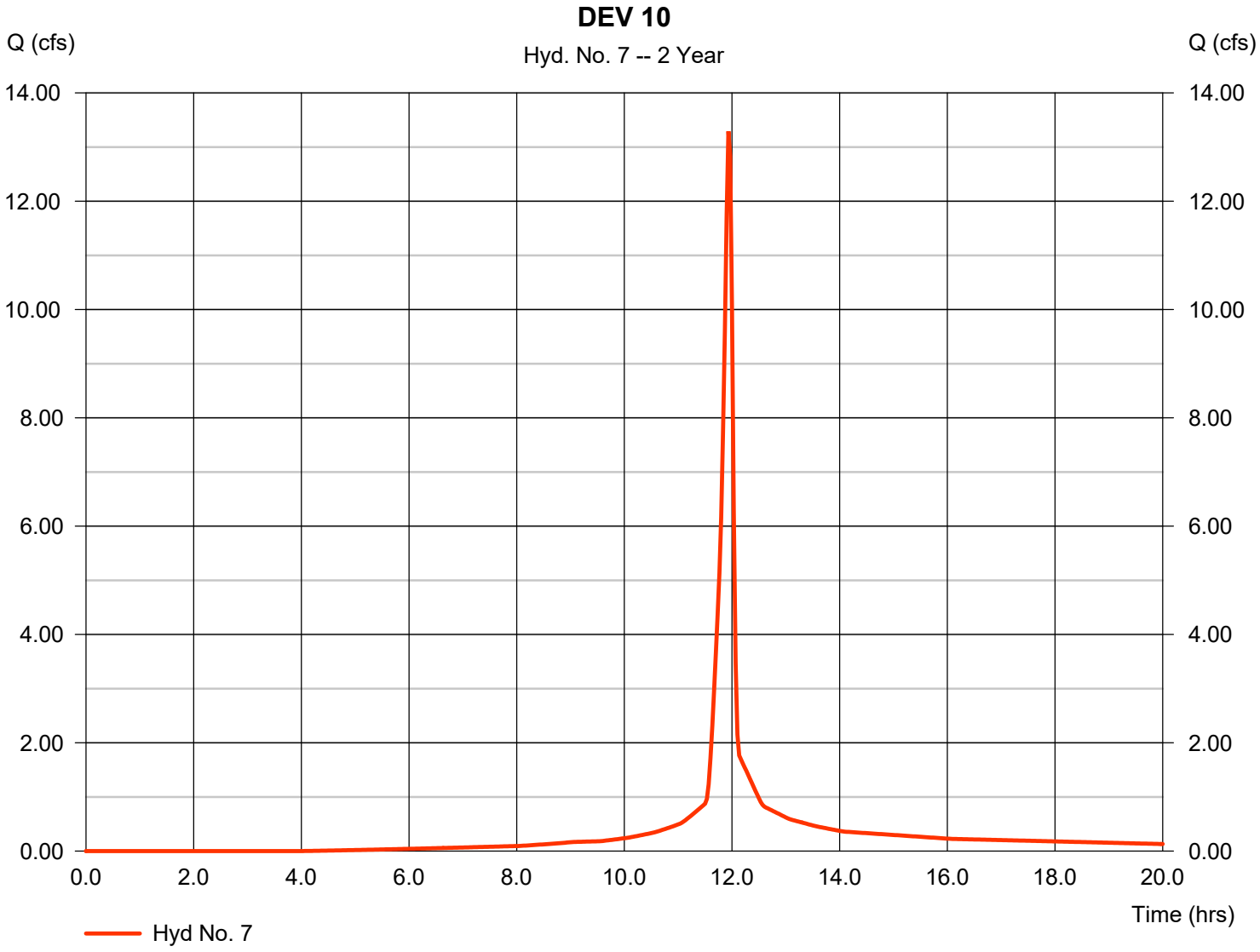
Hydrograph Report

Hyd. No. 7

DEV 10

Hydrograph type	=	SCS Runoff	Peak discharge	=	13.29 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	28,396 cuft
Drainage area	=	2.940 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.970 x 98) + (0.970 x 80)] / 2.940



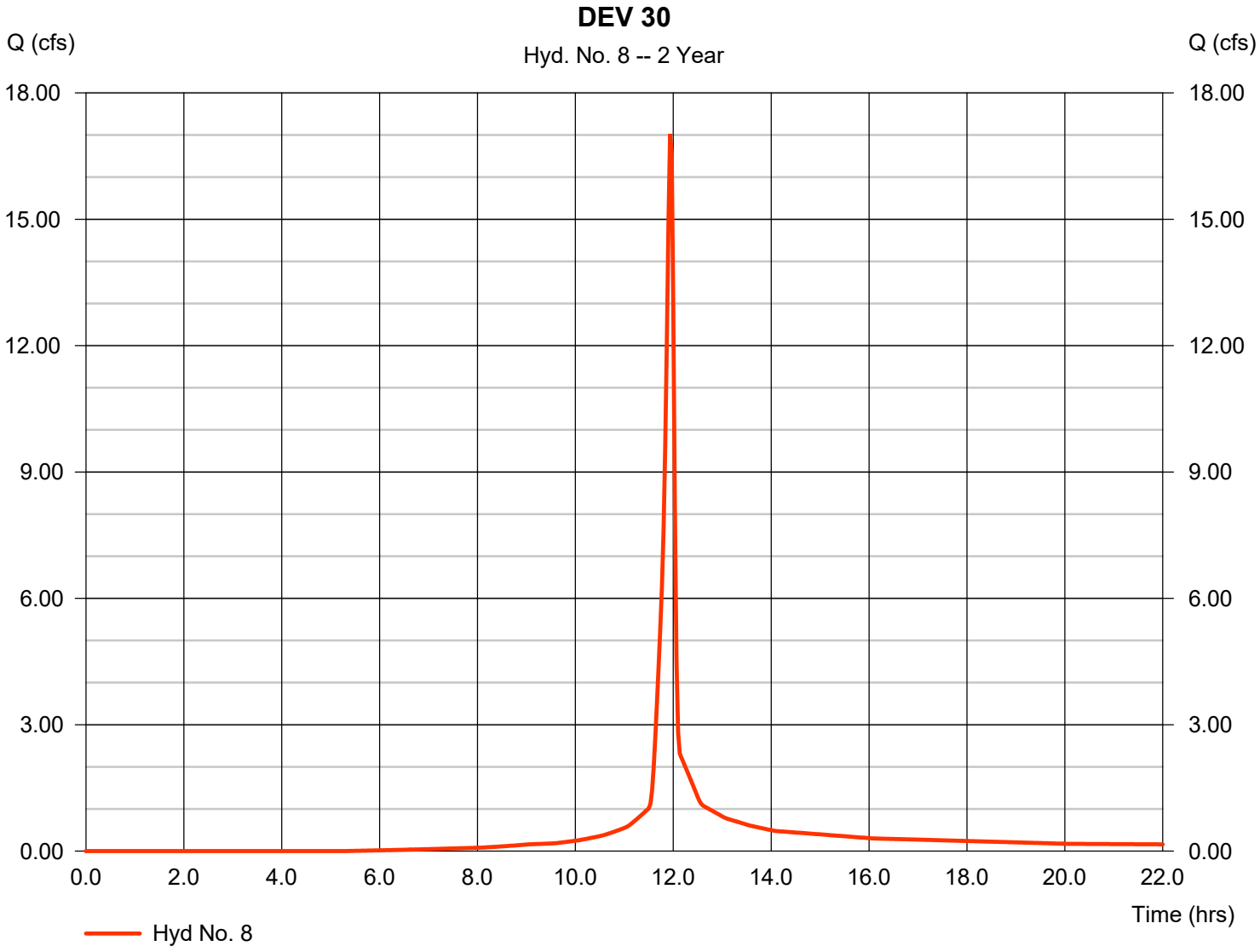
Hydrograph Report

Hyd. No. 8

DEV 30

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.02 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	35,433 cuft
Drainage area	=	4.080 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.040 x 98) + (2.040 x 80)] / 4.080



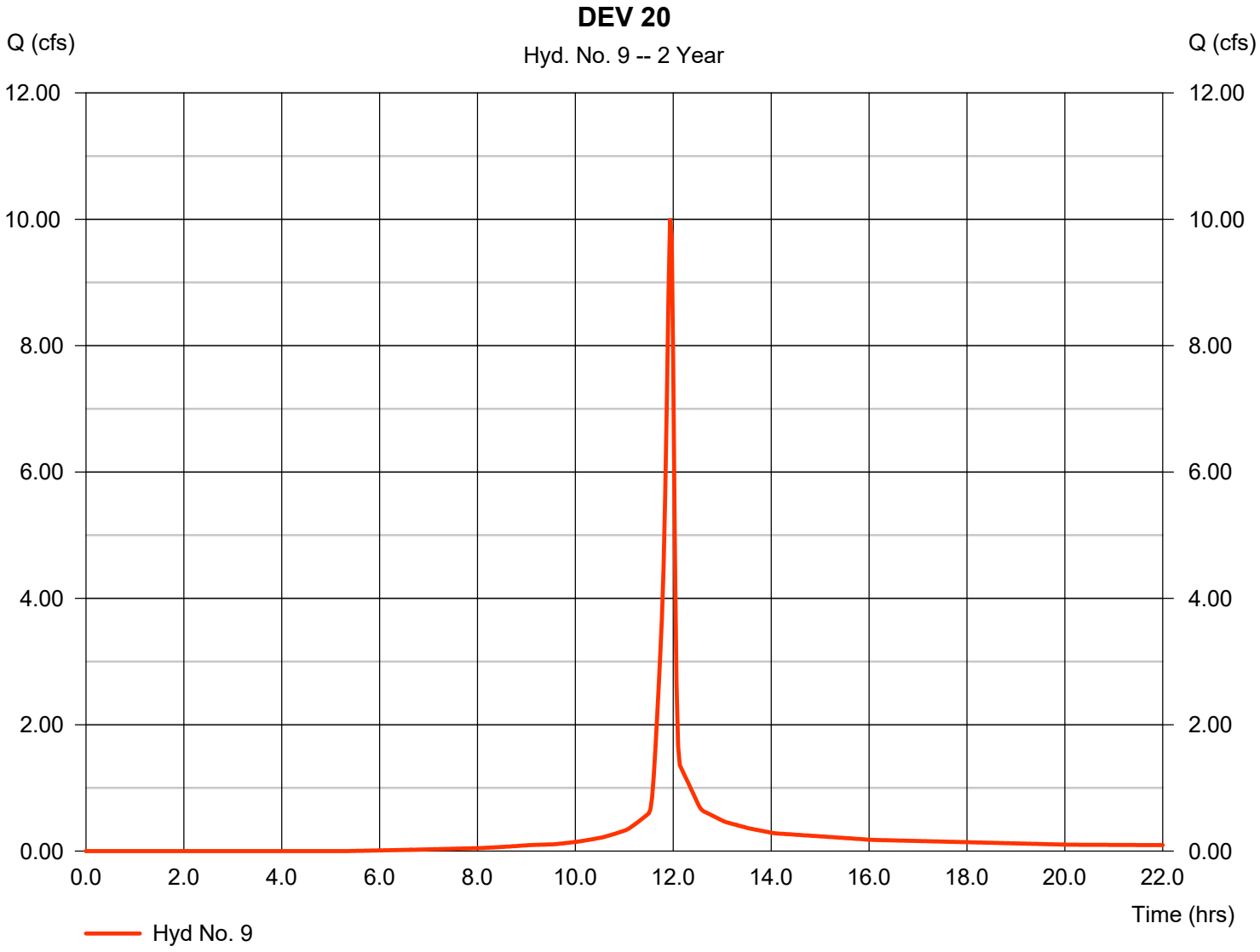
Hydrograph Report

Hyd. No. 9

DEV 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.01 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	20,843 cuft
Drainage area	=	2.400 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.150 x 98) + (1.250 x 80)] / 2.400



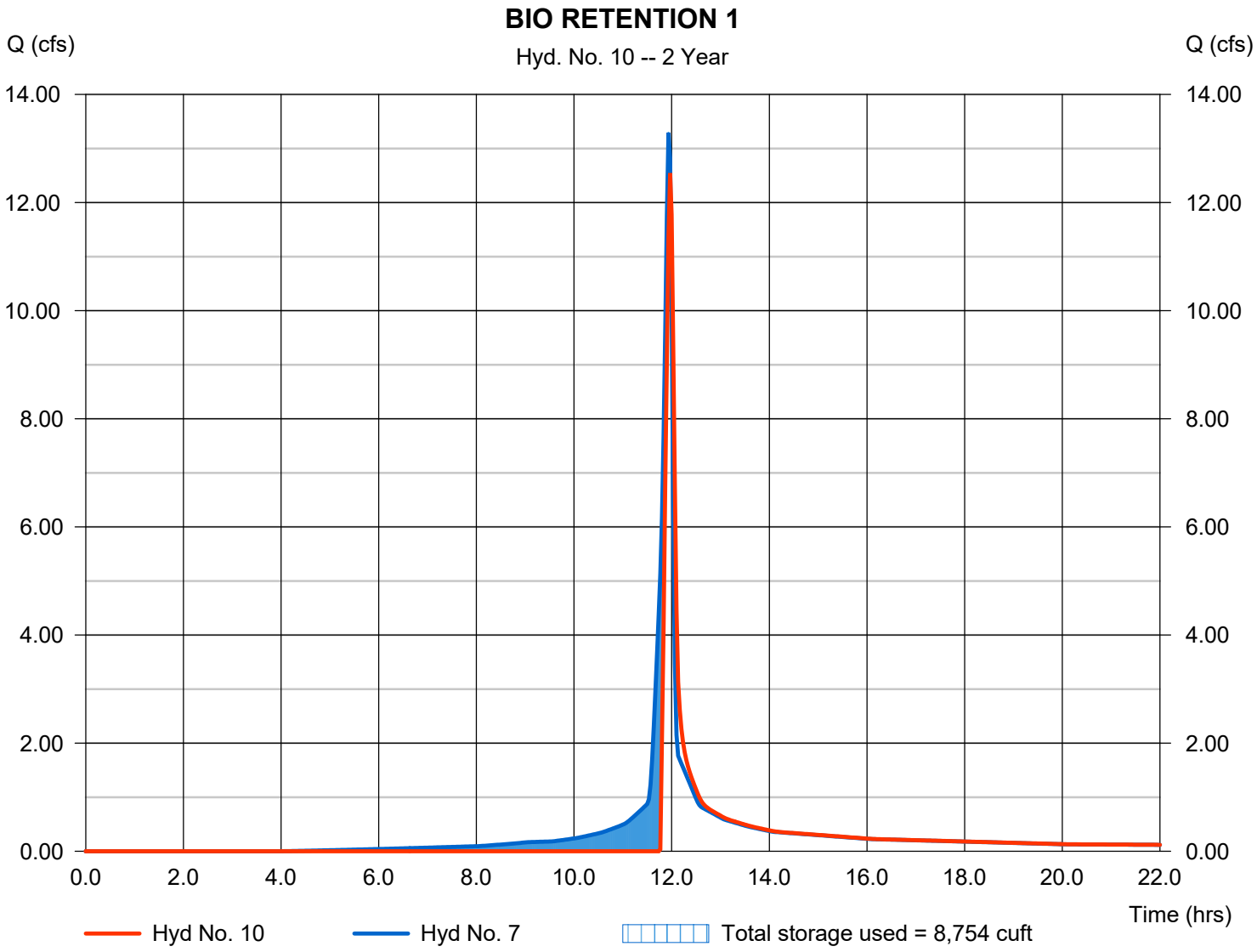
Hydrograph Report

Hyd. No. 10

BIO RETENTION 1

Hydrograph type	=	Reservoir	Peak discharge	=	12.54 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	21,778 cuft
Inflow hyd. No.	=	7 - DEV 10	Max. Elevation	=	1021.24 ft
Reservoir name	=	BIORETENTION 1	Max. Storage	=	8,754 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - BIORETENTION 1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1020.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1020.00	5,489	0	0
1.00	1021.00	7,817	6,618	6,618
2.00	1022.00	10,202	8,982	15,600
3.00	1023.00	12,644	11,400	27,000

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 2	1	1	0
Invert El. (ft)	= 1015.29	0.00	0.00	0.00
Length (ft)	= 58.56	0.00	0.50	0.00
Slope (%)	= 0.50	0.00	0.50	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

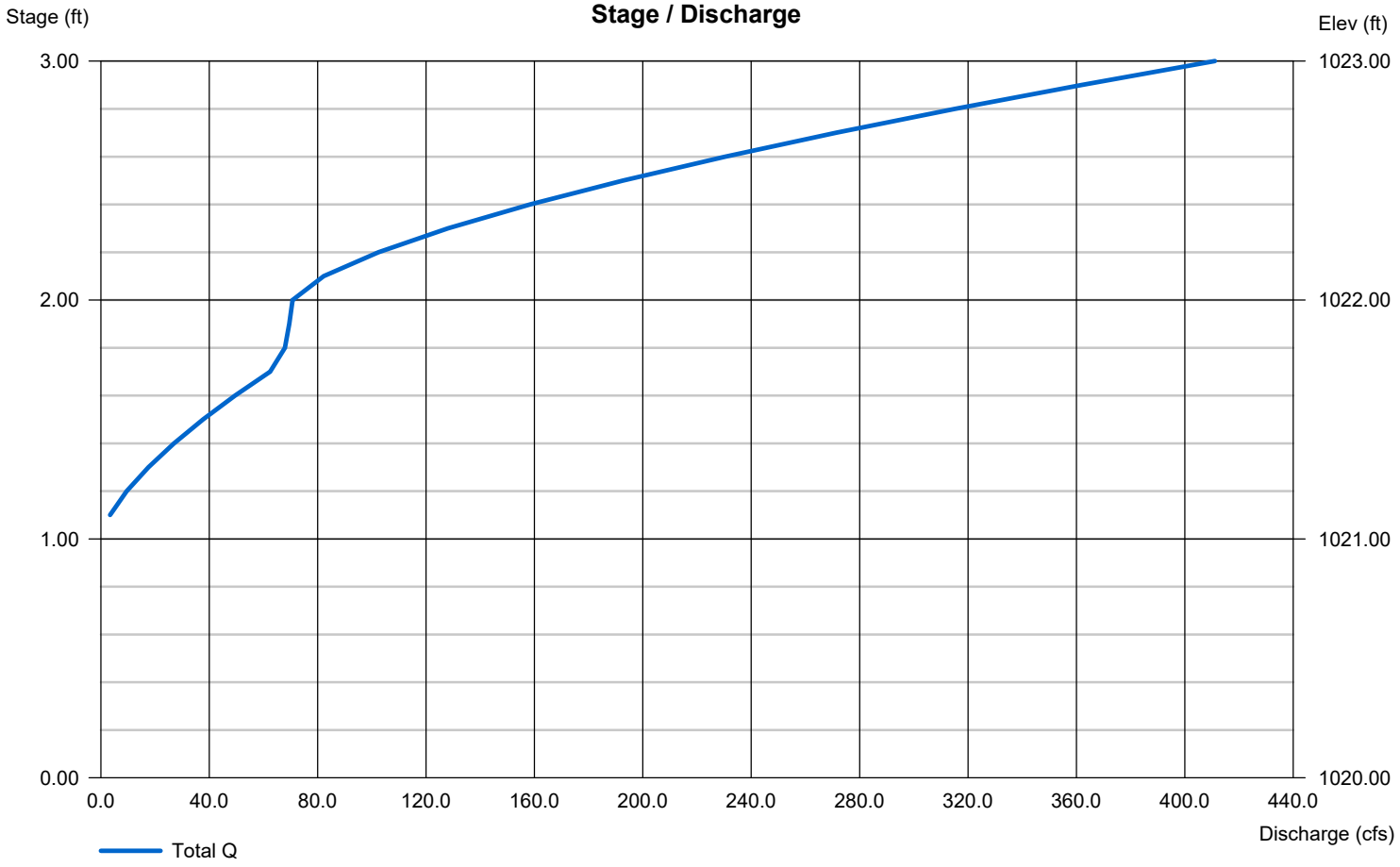
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 32.00	100.00	0.00	0.00
Crest El. (ft)	= 1021.00	1022.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



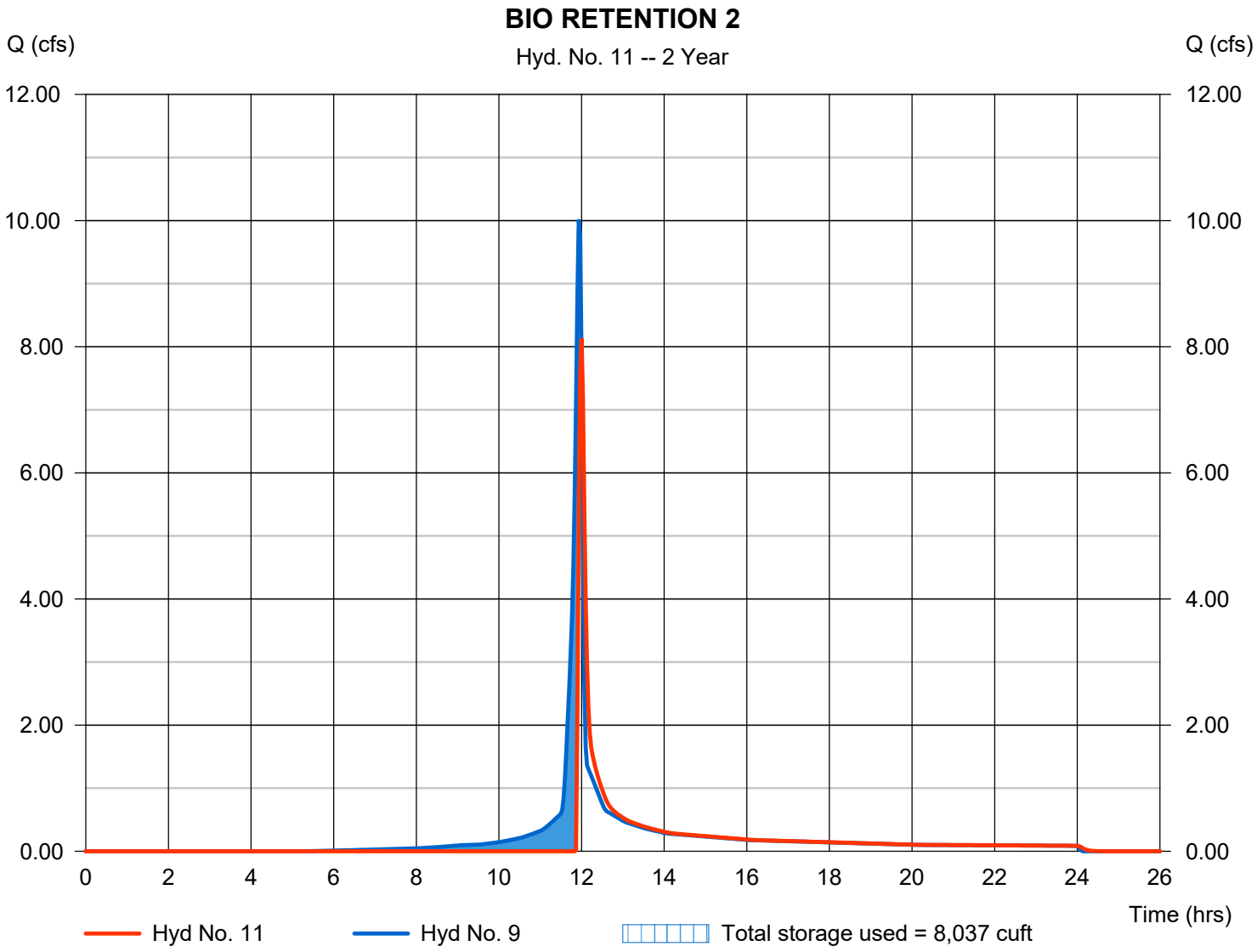
Hydrograph Report

Hyd. No. 11

BIO RETENTION 2

Hydrograph type	=	Reservoir	Peak discharge	=	8.129 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	14,839 cuft
Inflow hyd. No.	=	9 - DEV 20	Max. Elevation	=	1022.79 ft
Reservoir name	=	BIORETENTION 2	Max. Storage	=	8,037 cuft

Storage Indication method used.



Pond Report

Pond No. 3 - BIORETENTION 2

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1021.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1021.50	4,007	0	0
0.50	1022.00	5,756	2,427	2,427
1.50	1023.00	8,647	7,152	9,579
2.50	1024.00	11,639	10,105	19,684

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1017.01	0.00	0.00	0.00
Length (ft)	= 303.54	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

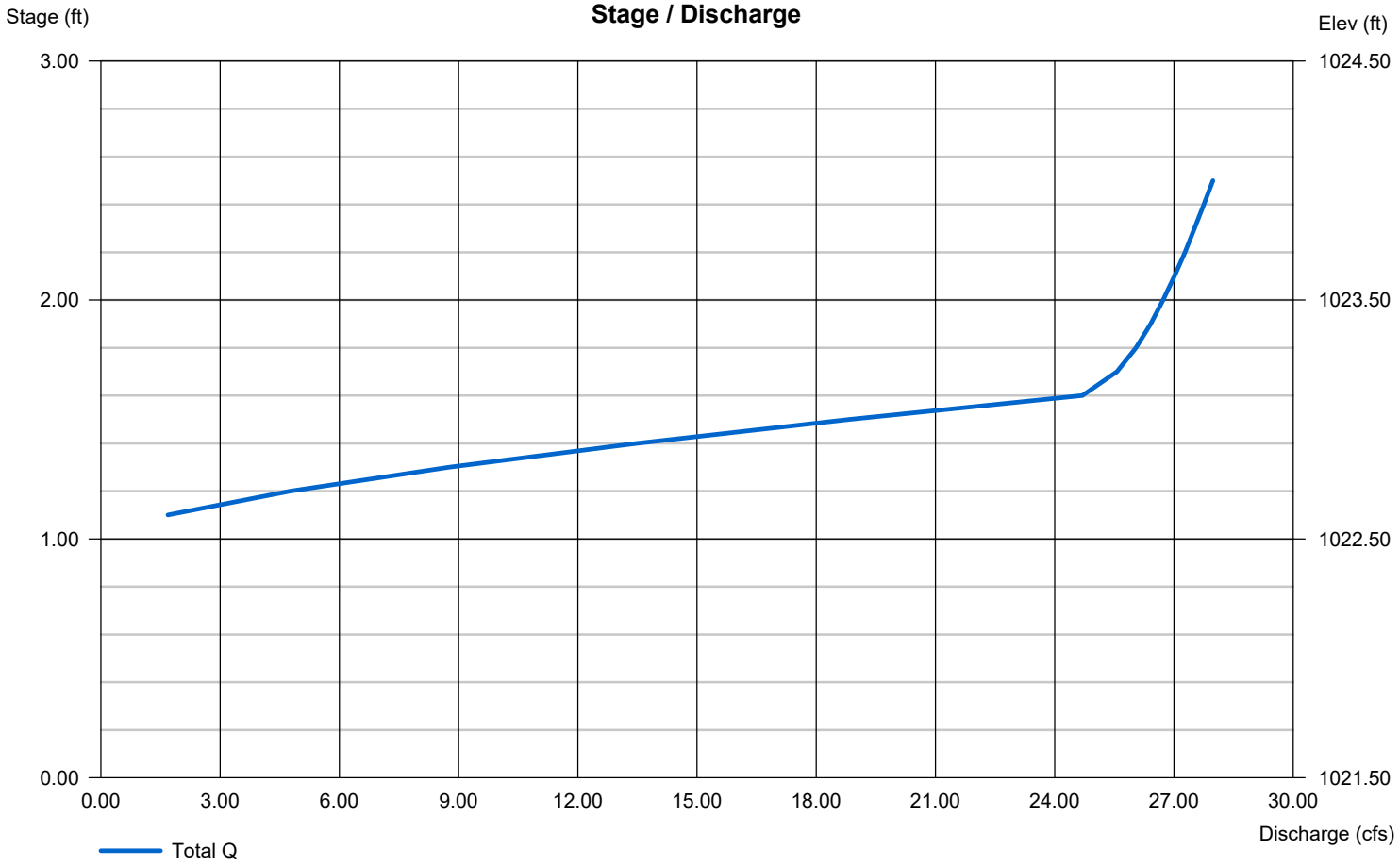
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 1022.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

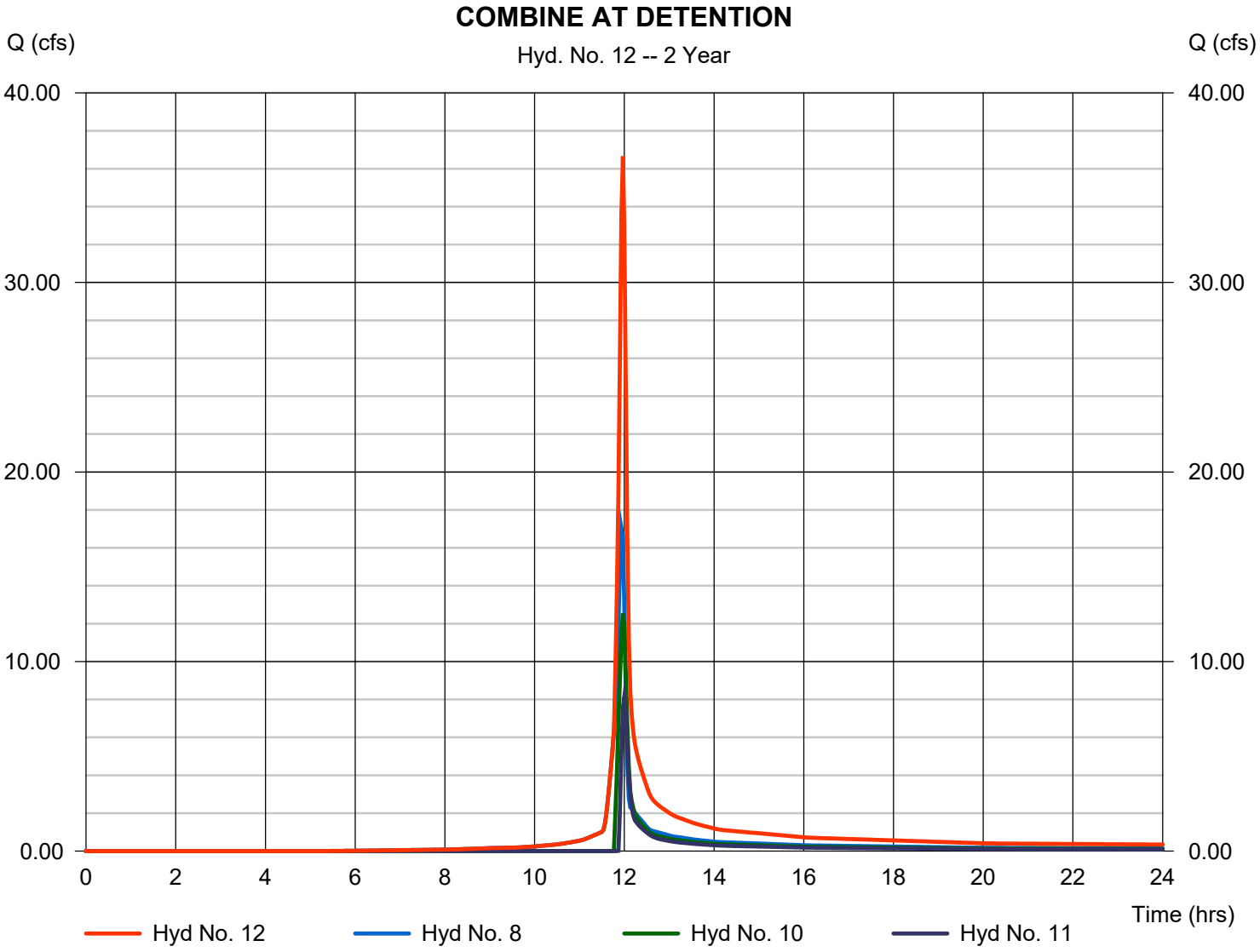


Hydrograph Report

Hyd. No. 12

COMBINE AT DETENTION

Hydrograph type	=	Combine	Peak discharge	=	36.65 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	72,051 cuft
Inflow hyds.	=	8, 10, 11	Contrib. drain. area	=	4.080 ac



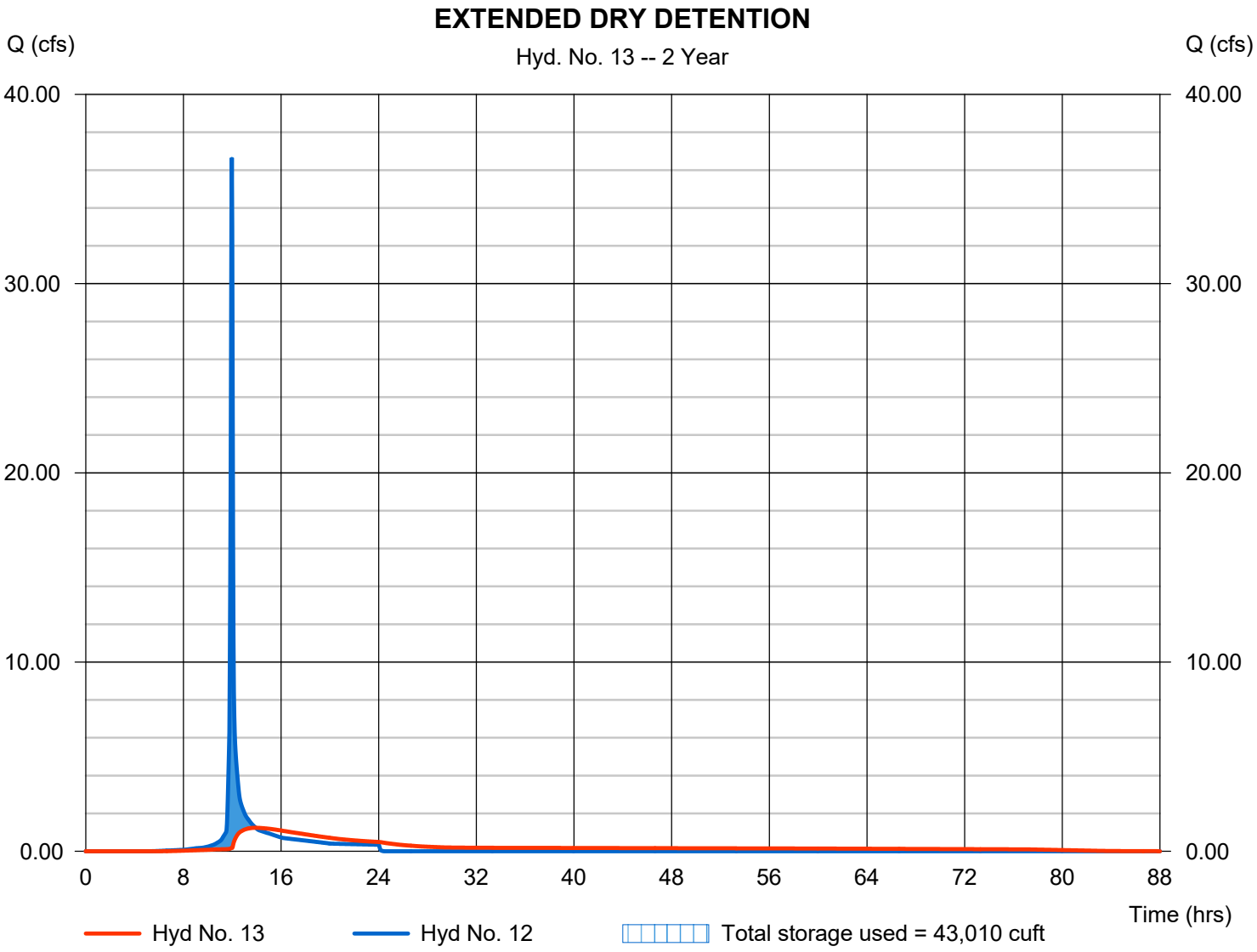
Hydrograph Report

Hyd. No. 13

EXTENDED DRY DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	1.241 cfs
Storm frequency	=	2 yrs	Time to peak	=	13.93 hrs
Time interval	=	2 min	Hyd. volume	=	72,040 cuft
Inflow hyd. No.	=	12 - COMBINE AT DETENTION	Max. Elevation	=	1017.21 ft
Reservoir name	=	DRY DETENTION 1	Max. Storage	=	43,010 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - DRY DETENTION 1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1013.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1013.00	00	0	0
1.00	1014.00	4,594	1,531	1,531
2.00	1015.00	11,499	7,786	9,317
3.00	1016.00	15,079	13,247	22,565
4.00	1017.00	17,882	16,459	39,024
5.00	1018.00	20,841	19,341	58,364
6.00	1019.00	23,958	22,379	80,744
7.00	1020.00	27,232	25,575	106,319
8.00	1021.00	30,663	28,928	135,246
9.00	1022.00	34,251	32,437	167,683

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	2.00	0.00	0.00
Span (in)	= 15.00	2.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 1011.71	1013.00	0.00	0.00
Length (ft)	= 69.50	0.50	0.00	0.00
Slope (%)	= 0.50	0.50	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

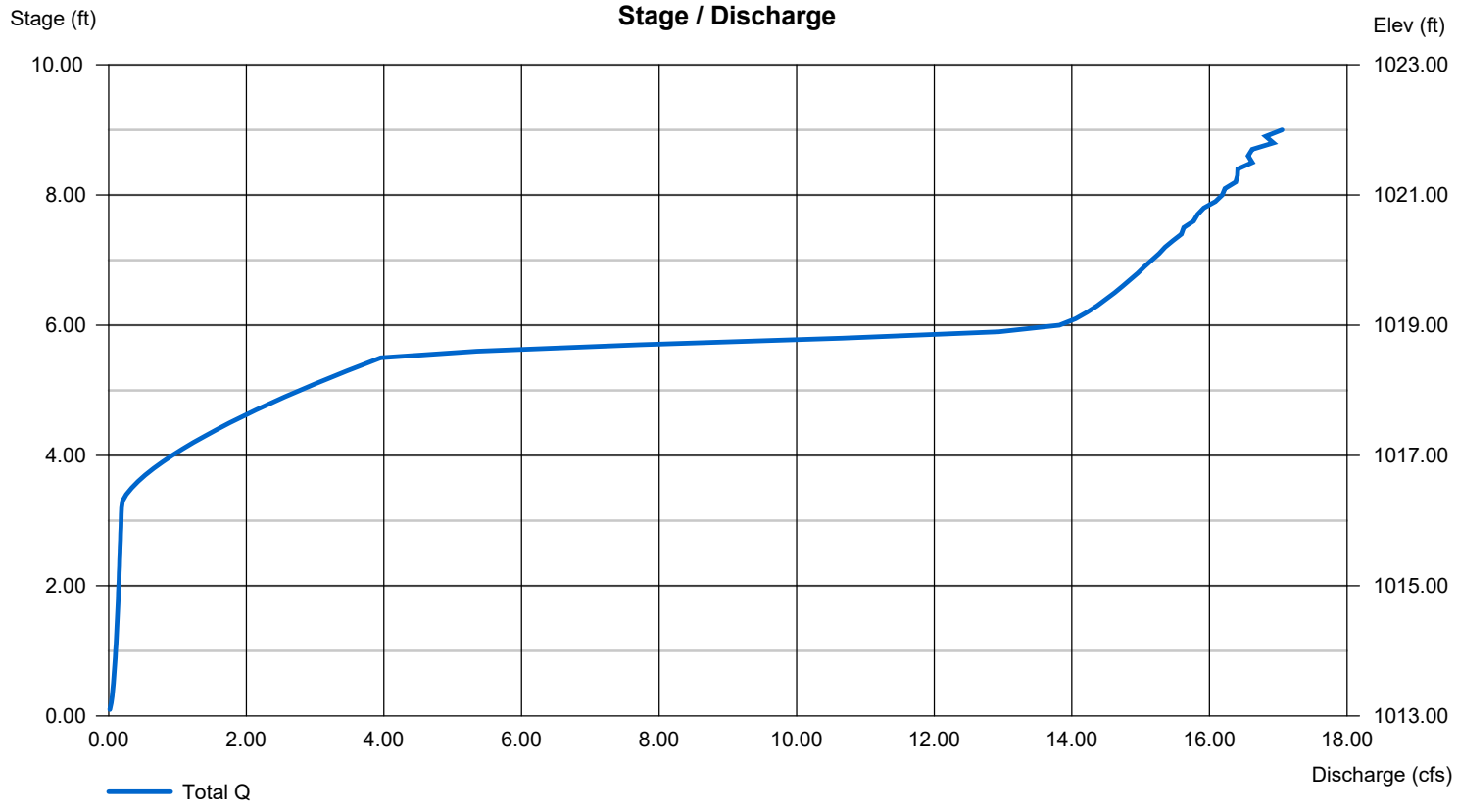
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.33	11.00	Inactive	0.00
Crest El. (ft)	= 1016.25	1018.50	1016.75	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	Rect	---
Multi-Stage	= Yes	Yes	Yes	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



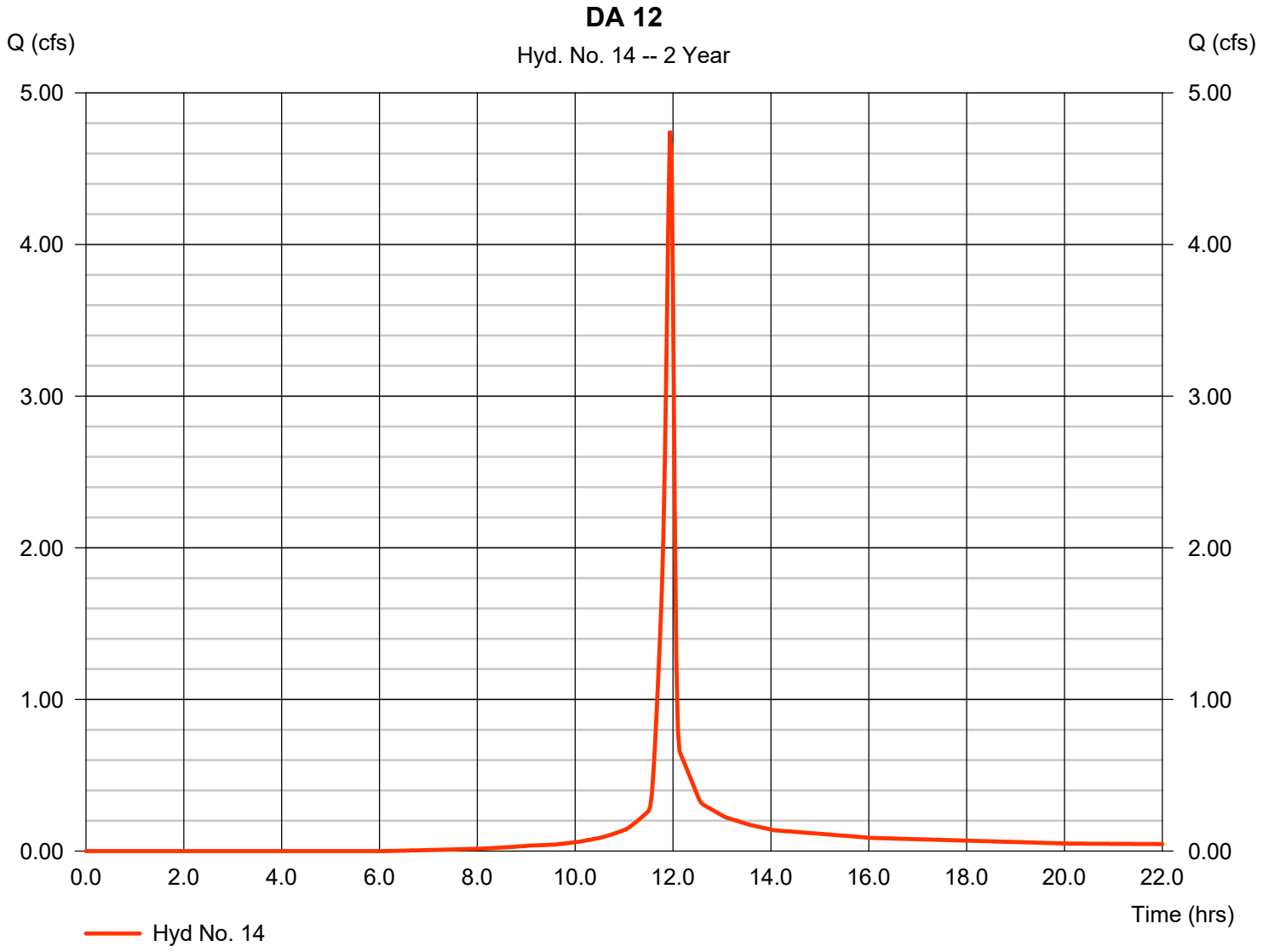
Hydrograph Report

Hyd. No. 14

DA 12

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.750 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	9,768 cuft
Drainage area	=	1.210 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.460 x 98) + (0.750 x 80)] / 1.210

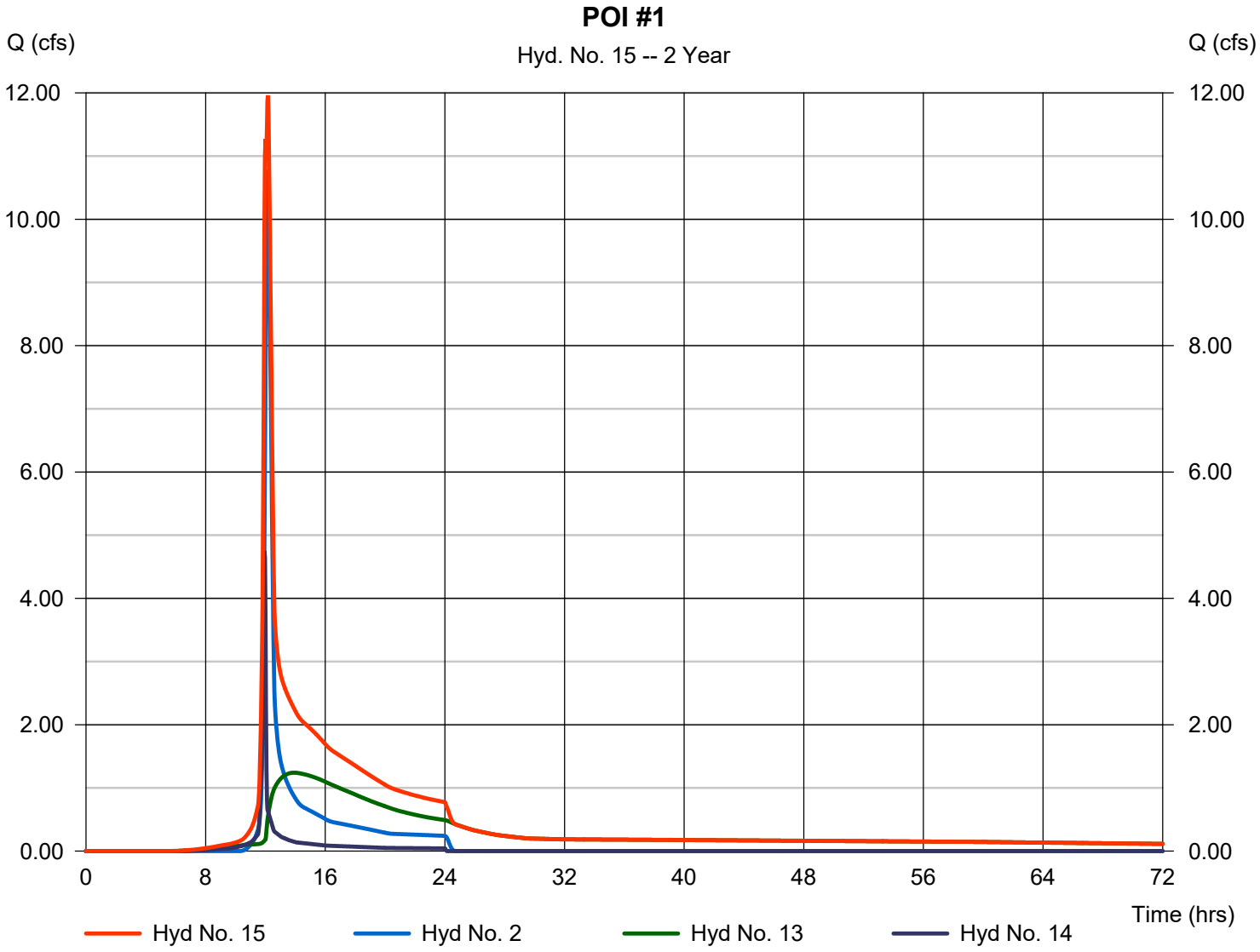


Hydrograph Report

Hyd. No. 15

POI #1

Hydrograph type	=	Combine	Peak discharge	=	11.96 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	122,842 cuft
Inflow hyds.	=	2, 13, 14	Contrib. drain. area	=	9.490 ac



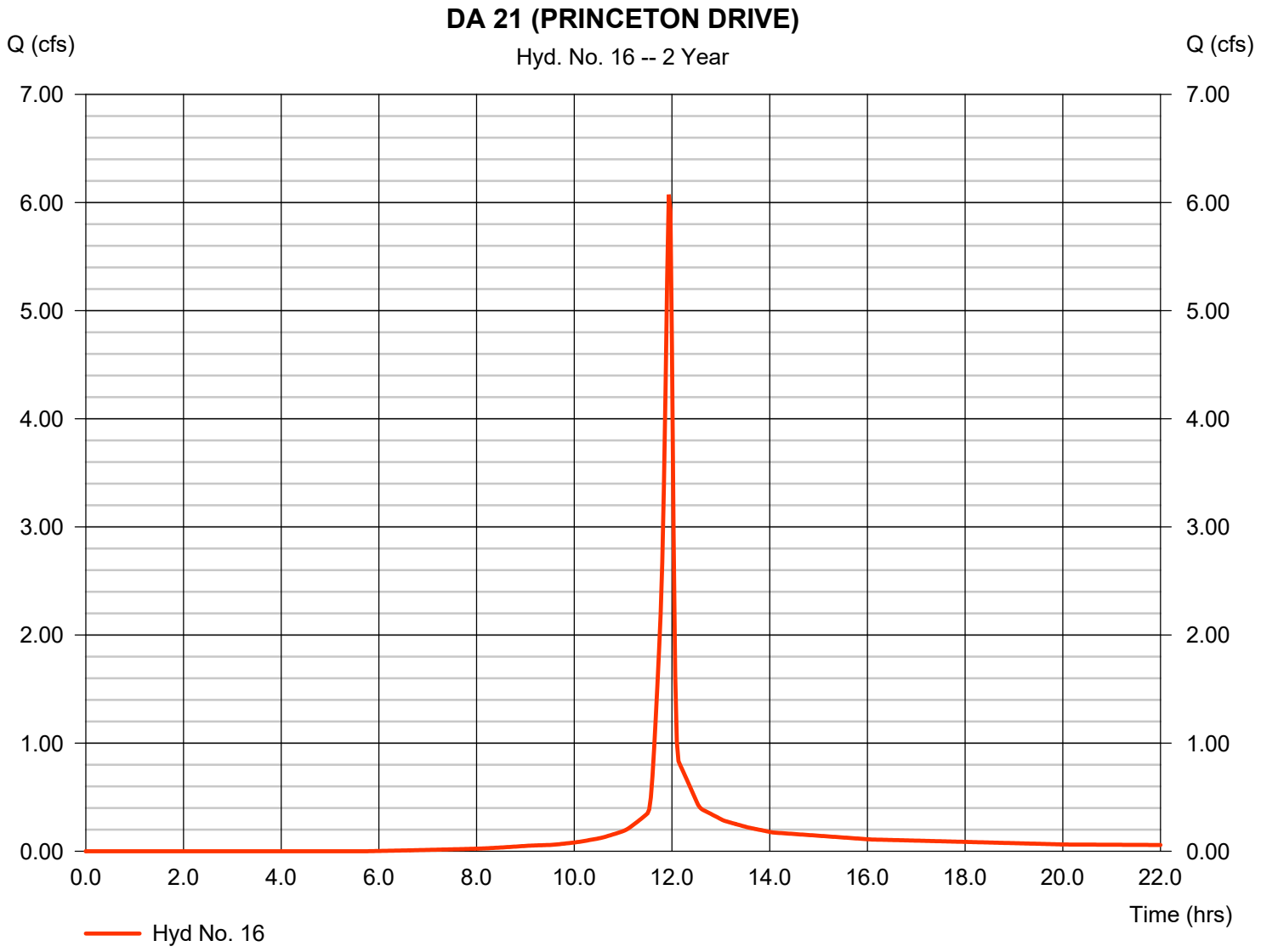
Hydrograph Report

Hyd. No. 16

DA 21 (PRINCETON DRIVE)

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.074 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	12,562 cuft
Drainage area	=	1.500 ac	Curve number	=	88*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.630 x 98) + (0.870 x 80)] / 1.500



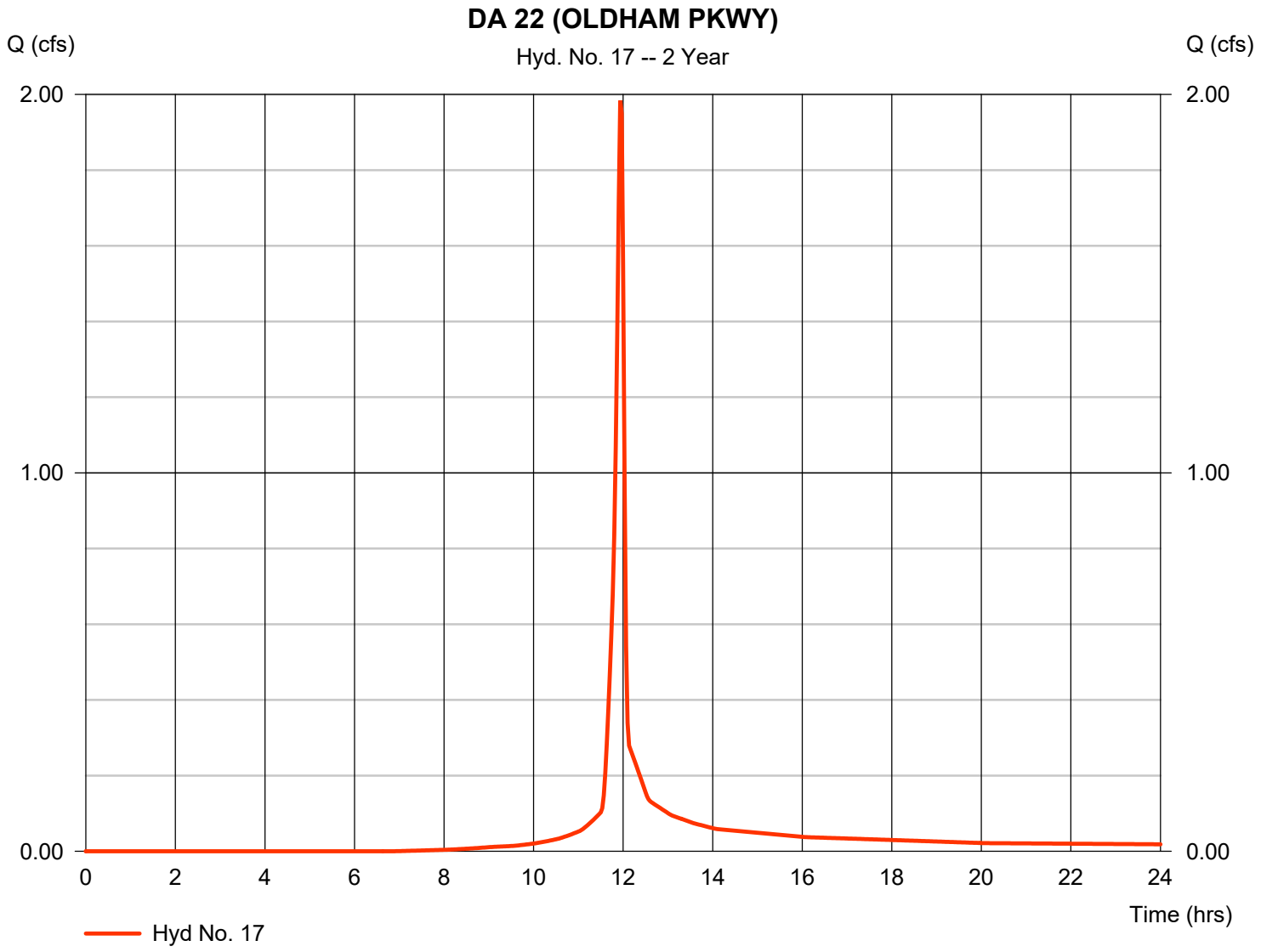
Hydrograph Report

Hyd. No. 17

DA 22 (OLDHAM PKWY)

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.984 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	4,044 cuft
Drainage area	=	0.540 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.150 x 98) + (0.390 x 80)] / 0.540



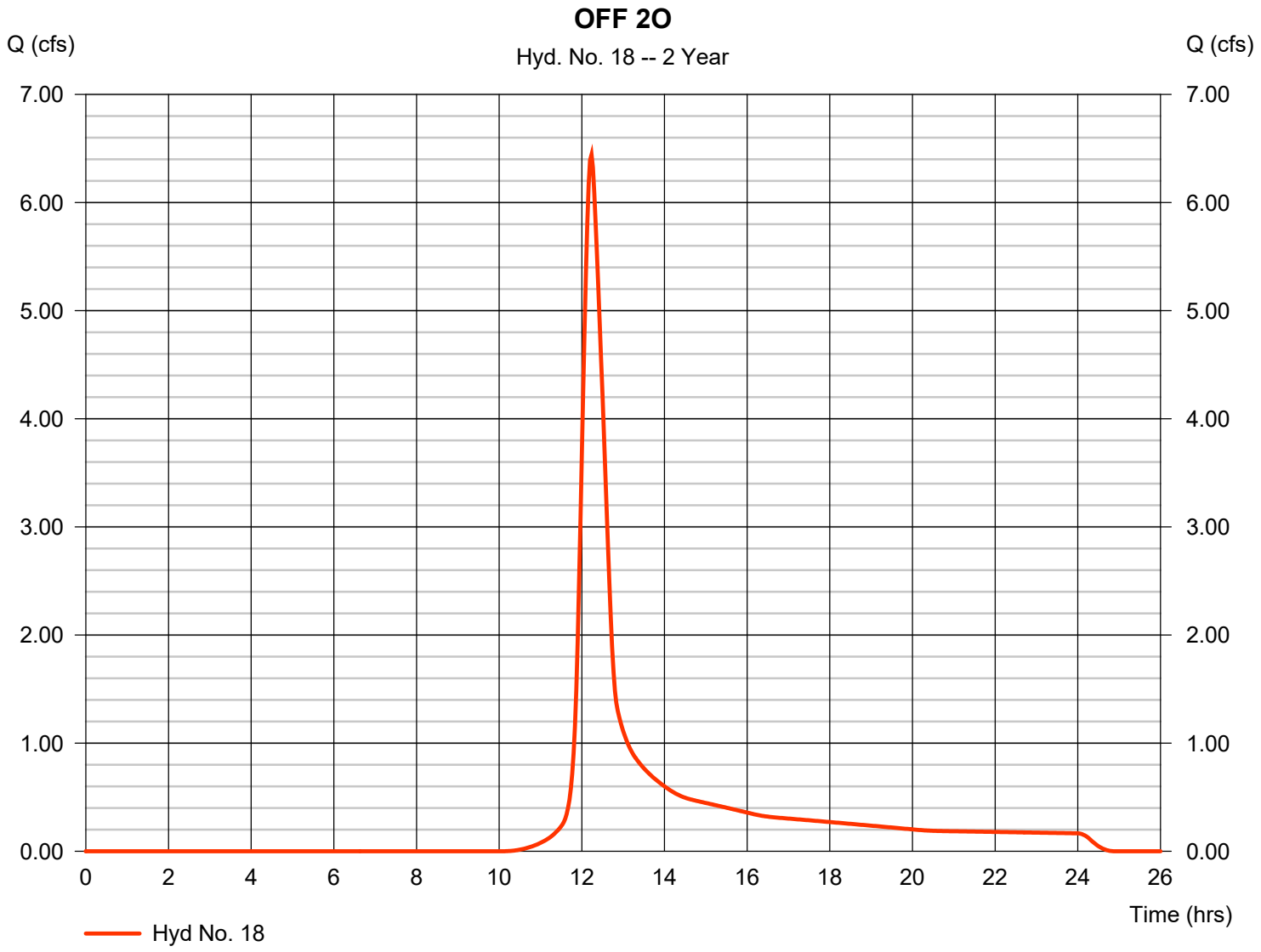
Hydrograph Report

Hyd. No. 18

OFF 2O

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.443 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.23 hrs
Time interval	=	2 min	Hyd. volume	=	28,774 cuft
Drainage area	=	5.390 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.70 min
Total precip.	=	3.71 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.240 x 98) + (5.150 x 74)] / 5.390



TR55 Tc Worksheet

Hyd. No. 18

OFF 2O

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.71		0.00		0.00		
Land slope (%)	= 0.80		0.00		0.00		
Travel Time (min)	**= 31.62**	**+**	**0.00**	**+**	**0.00**	**=**	**31.62**
Shallow Concentrated Flow							
Flow length (ft)	= 205.00		0.00		0.00		
Watercourse slope (%)	= 3.80		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.15		0.00		0.00		
Travel Time (min)	**= 1.09**	**+**	**0.00**	**+**	**0.00**	**=**	**1.09**
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**

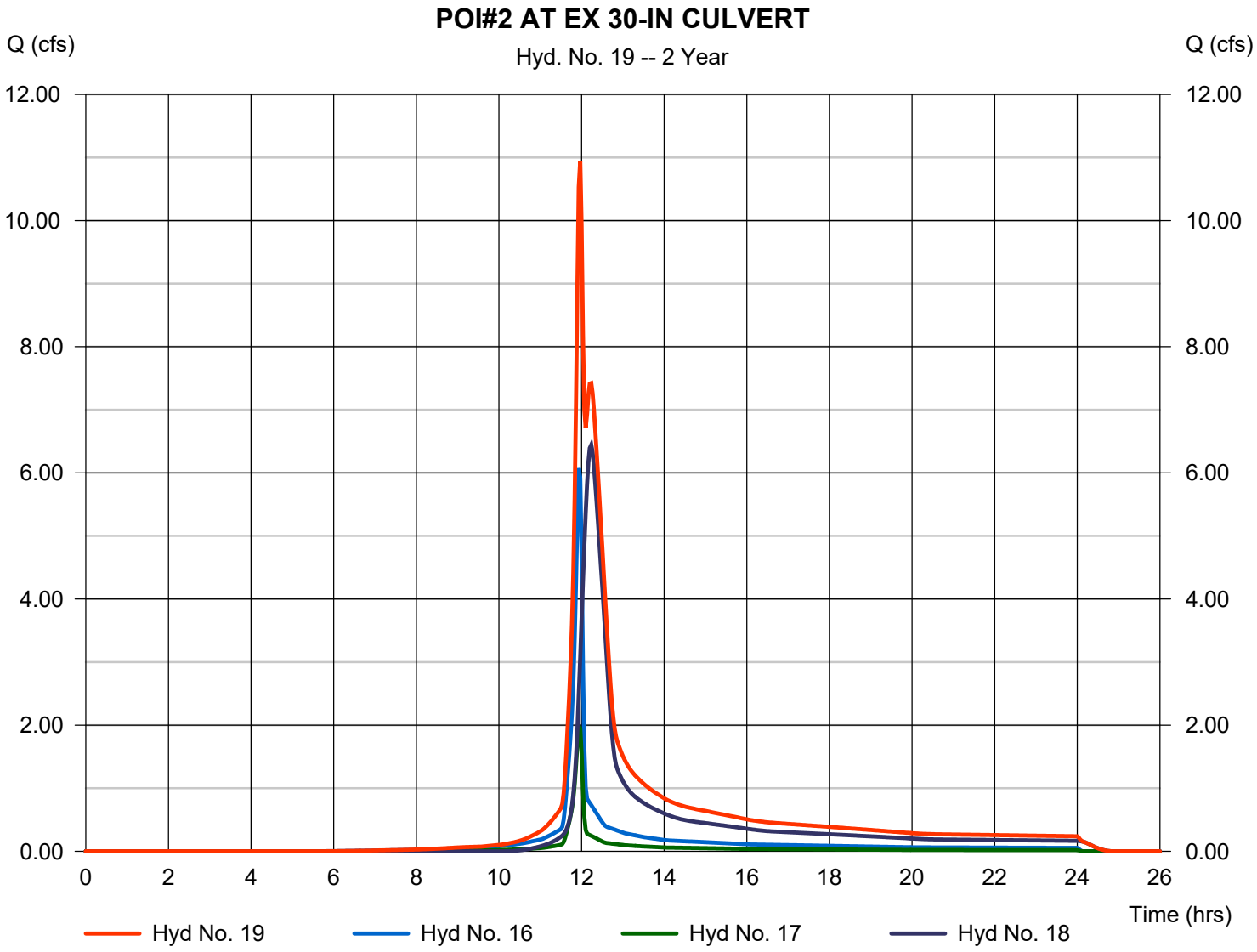
Total Travel Time, Tc ..... 32.70 min

Hydrograph Report

Hyd. No. 19

POI#2 AT EX 30-IN CULVERT

Hydrograph type	= Combine	Peak discharge	= 10.95 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 45,380 cuft
Inflow hyds.	= 16, 17, 18	Contrib. drain. area	= 7.430 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	11.58	2	728	42,585	------	------	------	EX 10
2	SCS Runoff	23.30	2	728	85,835	------	------	------	EX 11
3	Combine	34.88	2	728	128,420	1, 2	------	------	EX POI #1
4	SCS Runoff	23.27	2	728	85,731	------	------	------	EX 20
5	SCS Runoff	13.67	2	732	59,320	------	------	------	OFF 20
6	Combine	36.47	2	730	145,051	4, 5	------	------	EX POI#2 AT EX RCP 30-IN CULVE
7	SCS Runoff	21.46	2	716	47,379	------	------	------	DEV 10
8	SCS Runoff	28.48	2	716	61,185	------	------	------	DEV 30
9	SCS Runoff	16.75	2	716	35,991	------	------	------	DEV 20
10	Reservoir	20.61	2	718	40,761	7	1021.33	9,607	BIO RETENTION 1
11	Reservoir	15.53	2	718	29,987	9	1022.94	9,138	BIO RETENTION 2
12	Combine	63.59	2	718	131,933	8, 10, 11	------	------	COMBINE AT DETENTION
13	Reservoir	5.909	2	746	131,923	12	1018.62	72,321	EXTENDED DRY DETENTION
14	SCS Runoff	8.155	2	716	17,264	------	------	------	DA 12
15	Combine	28.37	2	730	235,022	2, 13, 14	------	------	POI #1
16	SCS Runoff	10.29	2	716	21,945	------	------	------	DA 21 (PRINCETON DRIVE)
17	SCS Runoff	3.500	2	716	7,319	------	------	------	DA 22 (OLDHAM PKWY)
18	SCS Runoff	13.67	2	732	59,320	------	------	------	OFF 2O
19	Combine	20.60	2	718	88,584	16, 17, 18	------	------	POI#2 AT EX 30-IN CULVERT

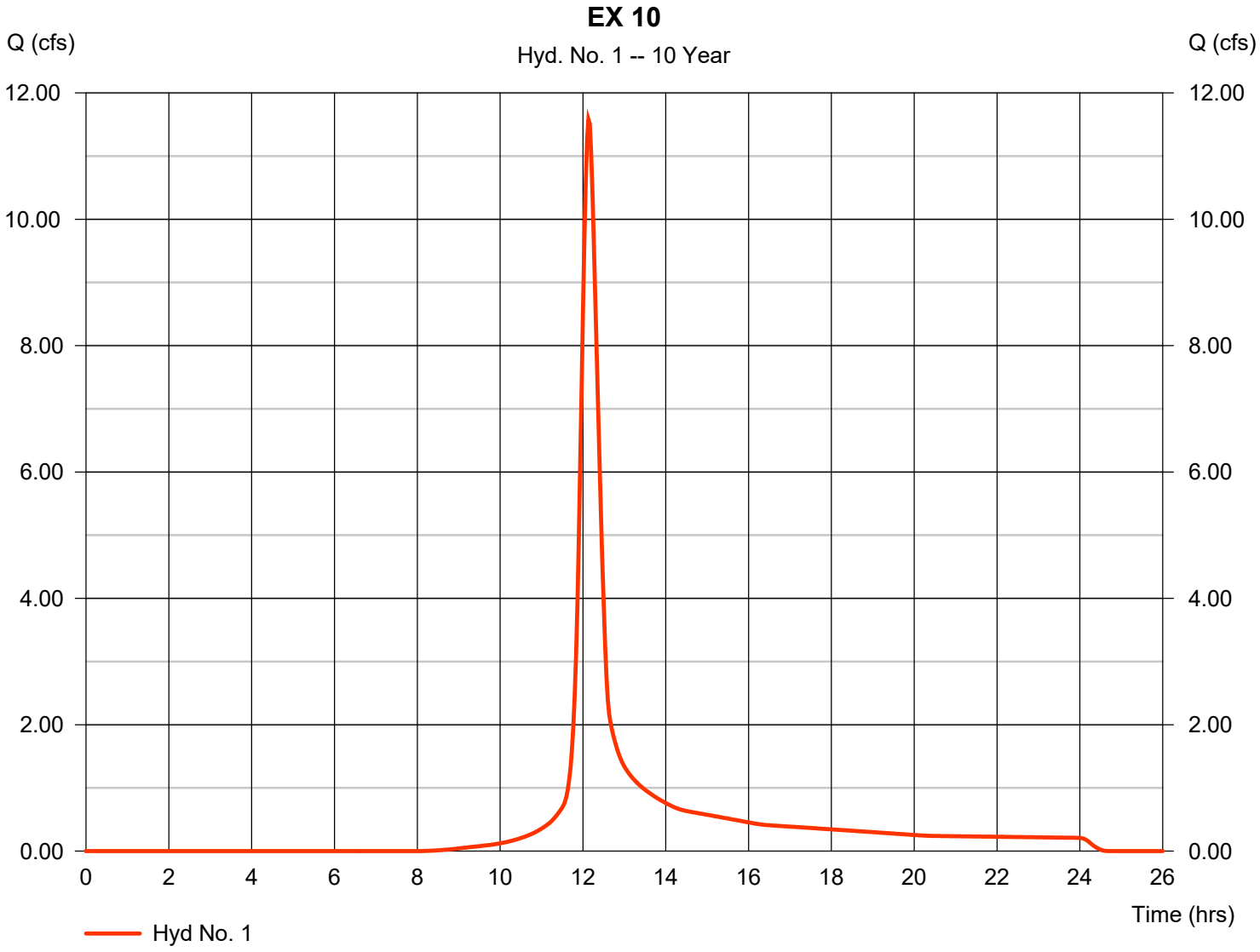
Hydrograph Report

Hyd. No. 1

EX 10

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.58 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	42,585 cuft
Drainage area	=	3.980 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.30 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.090 x 98) + (3.890 x 74)] / 3.980

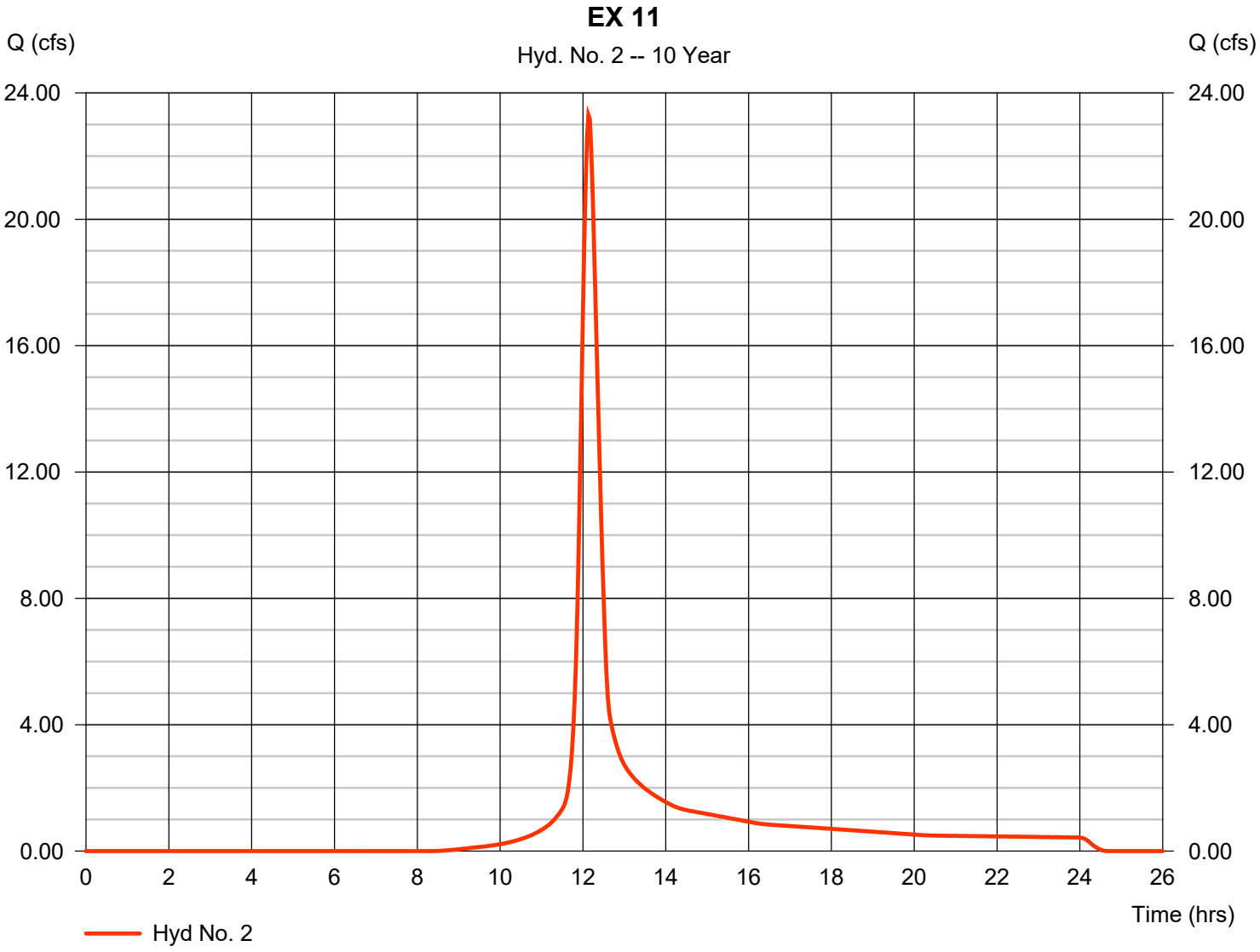


Hydrograph Report

Hyd. No. 2

EX 11

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.30 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	85,835 cuft
Drainage area	=	8.280 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.60 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

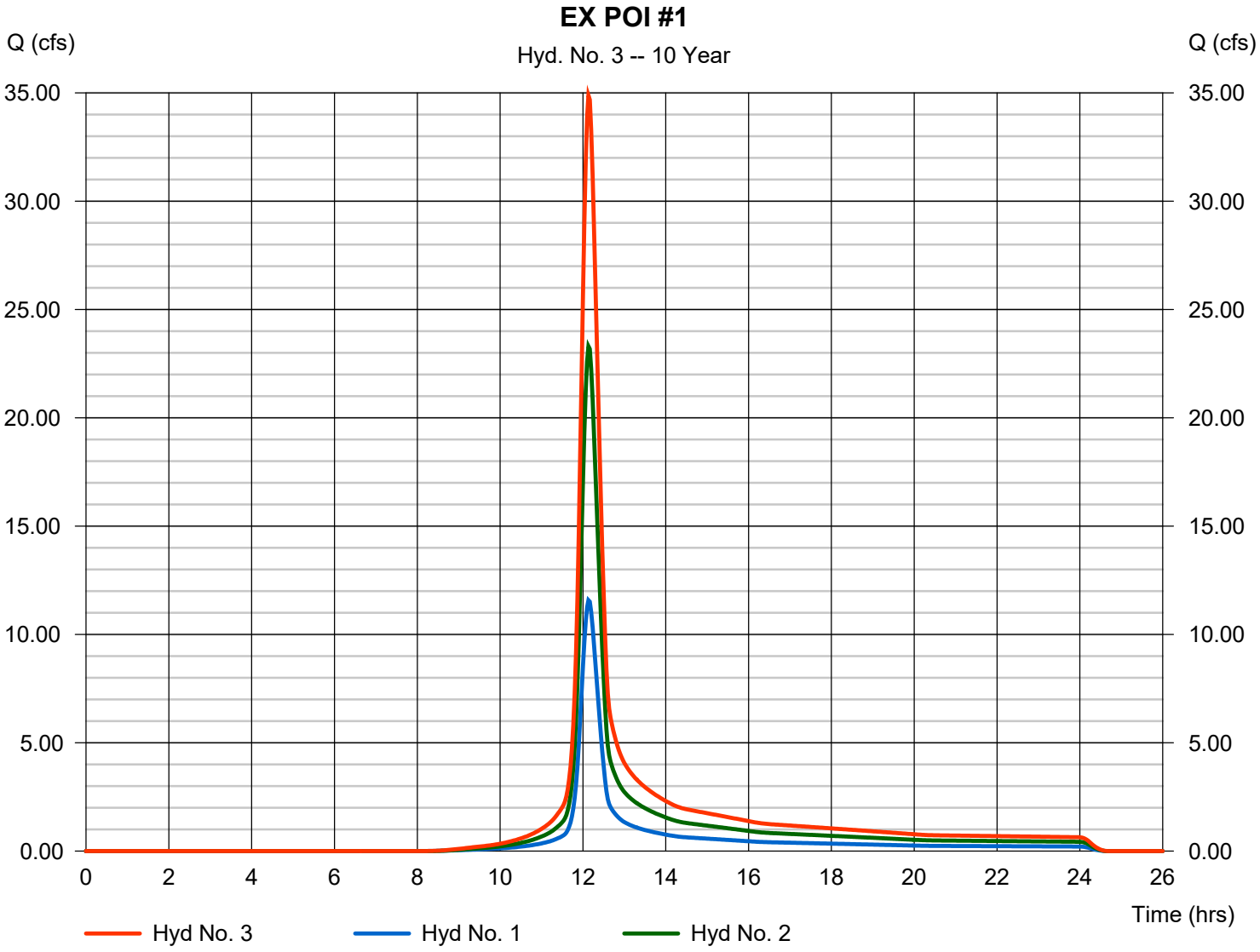


Hydrograph Report

Hyd. No. 3

EX POI #1

Hydrograph type	=	Combine	Peak discharge	=	34.88 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	128,420 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	12.260 ac



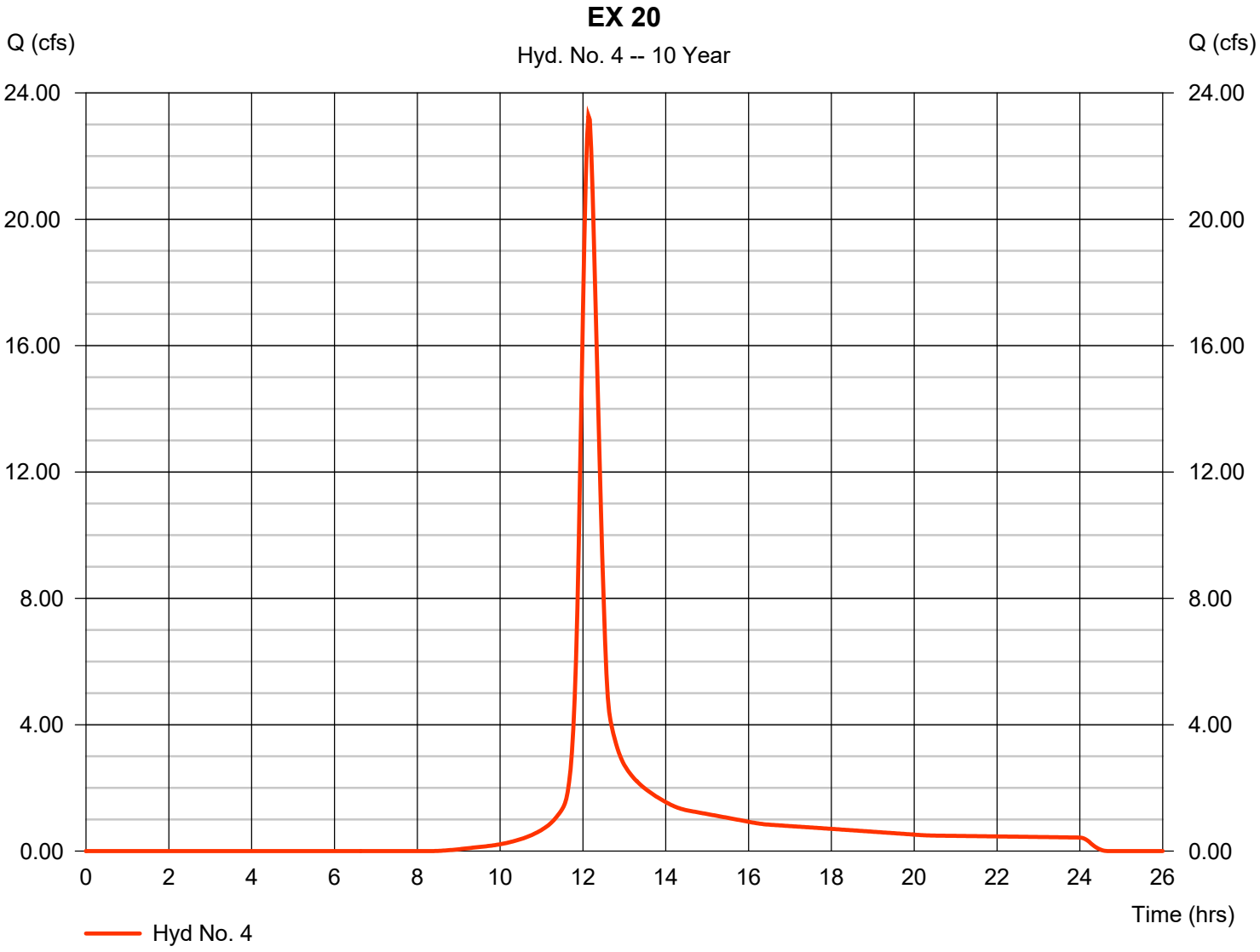
Hydrograph Report

Hyd. No. 4

EX 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.27 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	85,731 cuft
Drainage area	=	8.270 ac	Curve number	=	74*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.10 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 98) + (8.160 x 74)] / 8.270



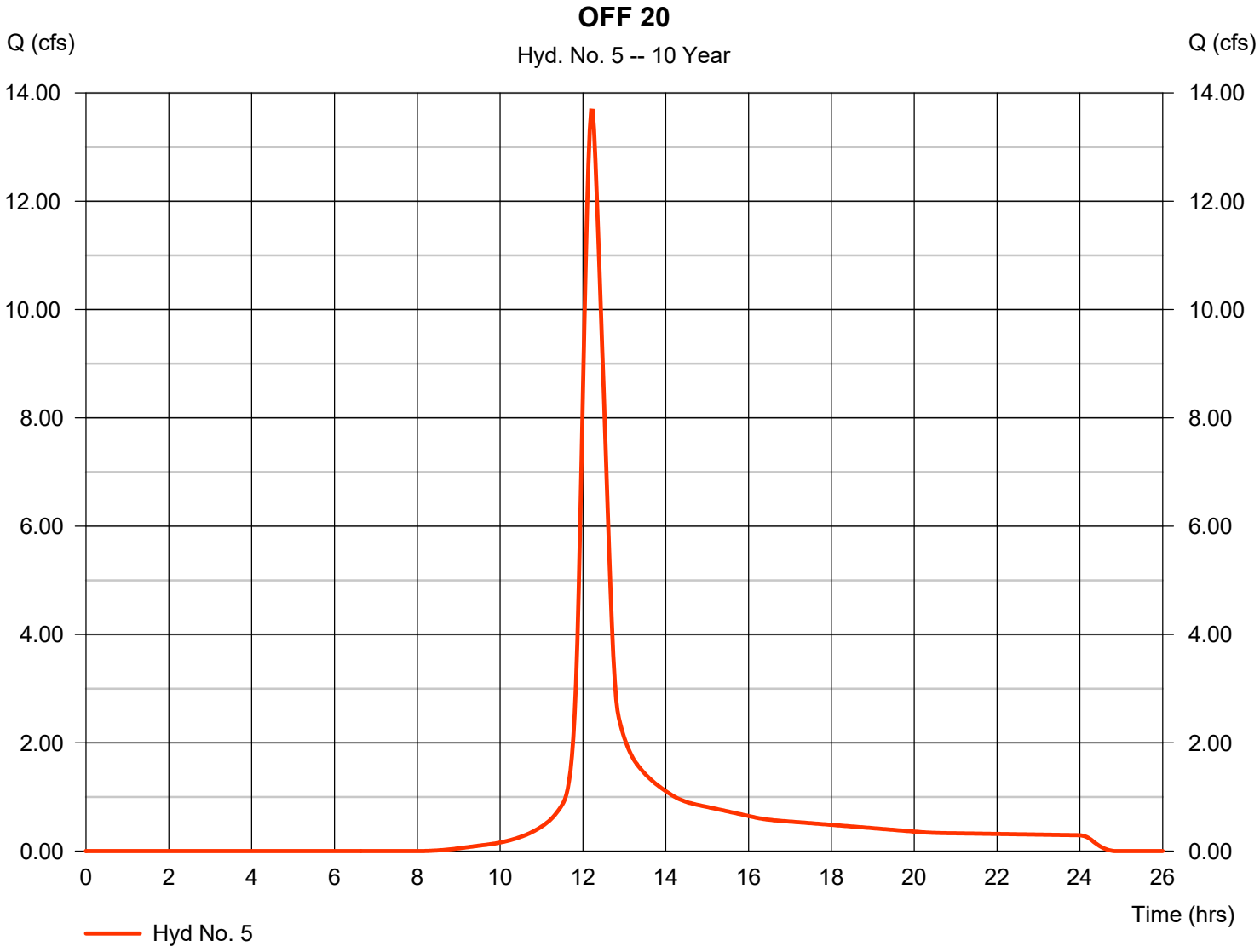
Hydrograph Report

Hyd. No. 5

OFF 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	13.67 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	59,320 cuft
Drainage area	=	5.390 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.70 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.130 x 98) + (5.260 x 74)] / 5.390

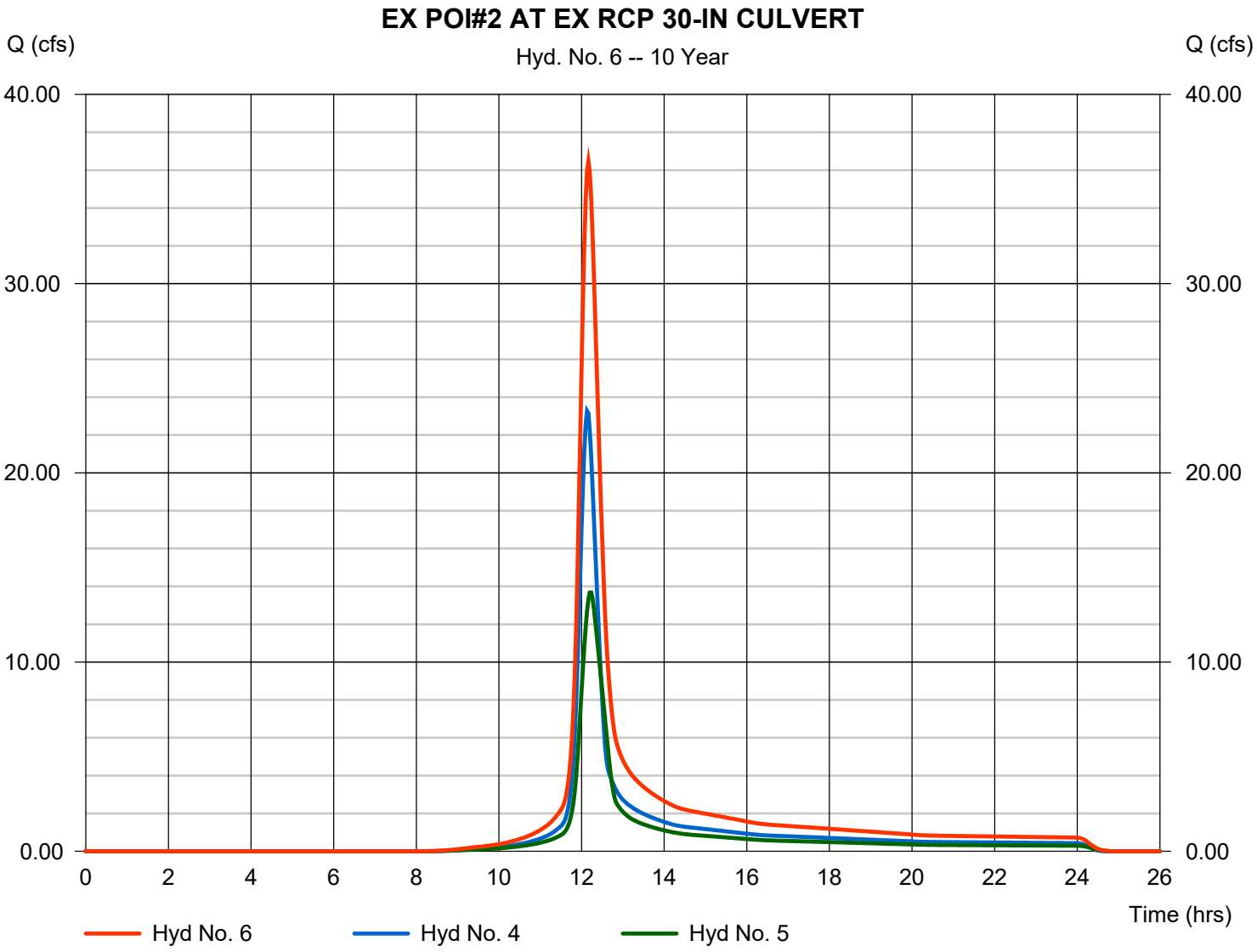


Hydrograph Report

Hyd. No. 6

EX POI#2 AT EX RCP 30-IN CULVERT

Hydrograph type	=	Combine	Peak discharge	=	36.47 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	145,051 cuft
Inflow hyds.	=	4, 5	Contrib. drain. area	=	13.660 ac



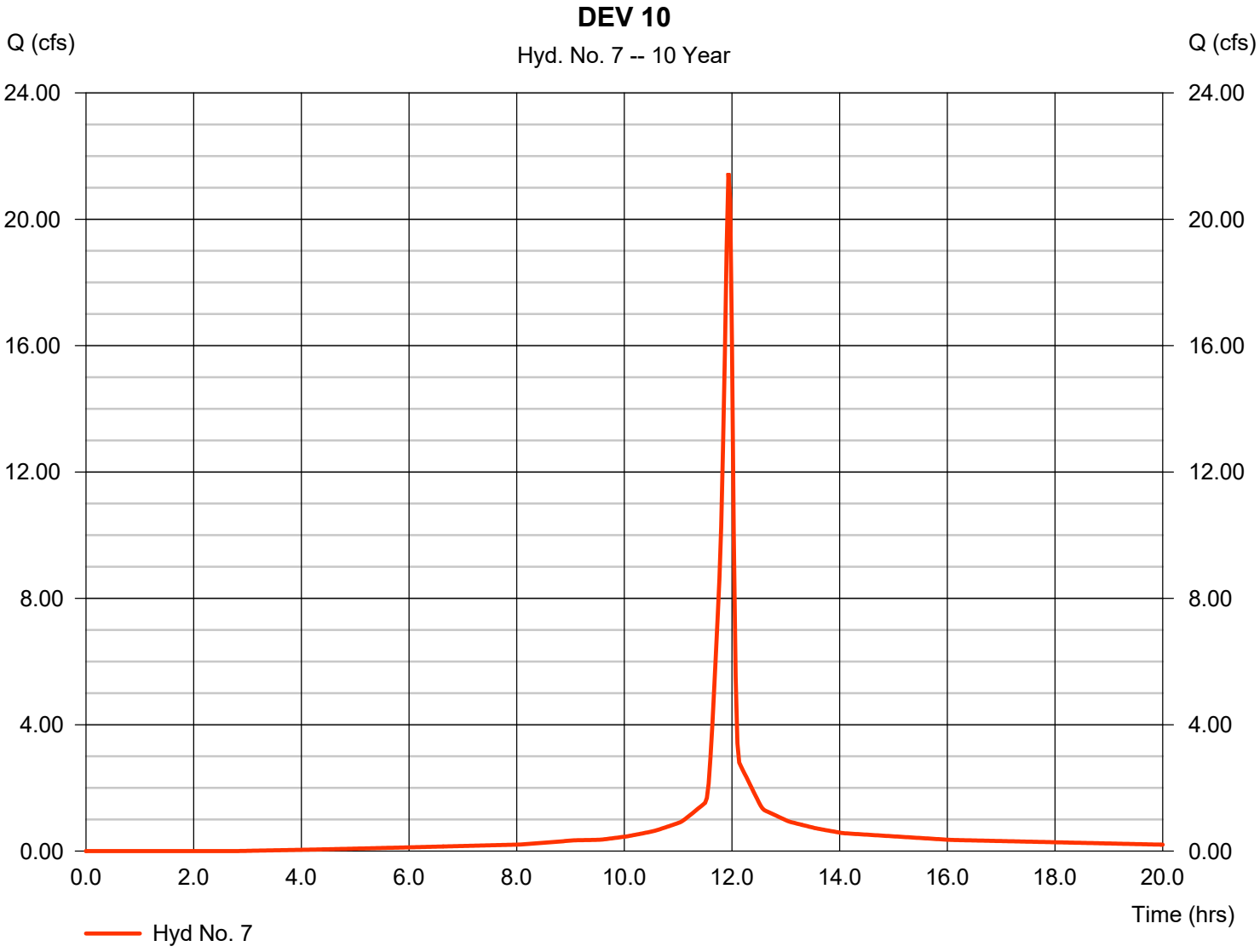
Hydrograph Report

Hyd. No. 7

DEV 10

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.46 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	47,379 cuft
Drainage area	=	2.940 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.970 x 98) + (0.970 x 80)] / 2.940



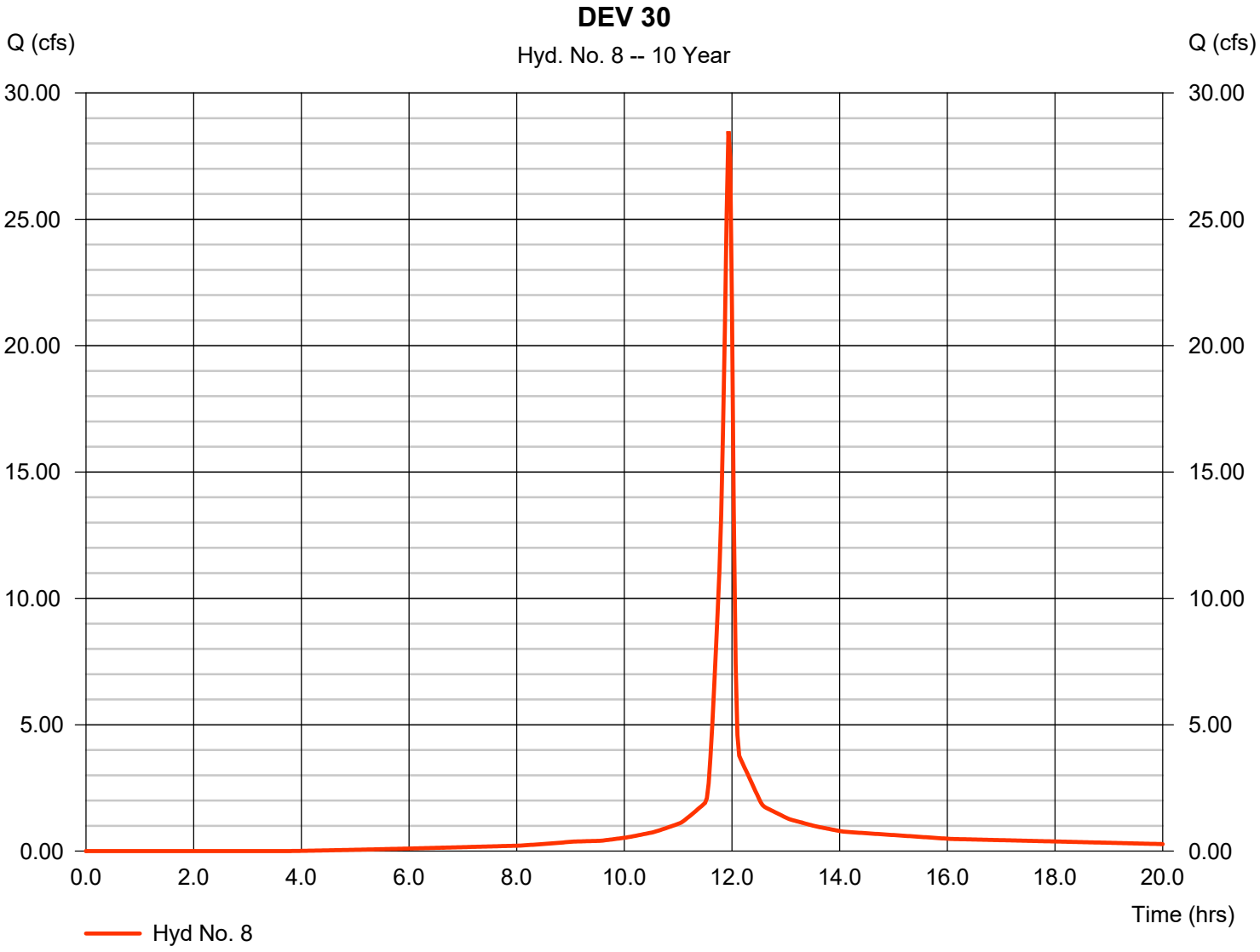
Hydrograph Report

Hyd. No. 8

DEV 30

Hydrograph type	=	SCS Runoff	Peak discharge	=	28.48 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	61,185 cuft
Drainage area	=	4.080 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.040 x 98) + (2.040 x 80)] / 4.080



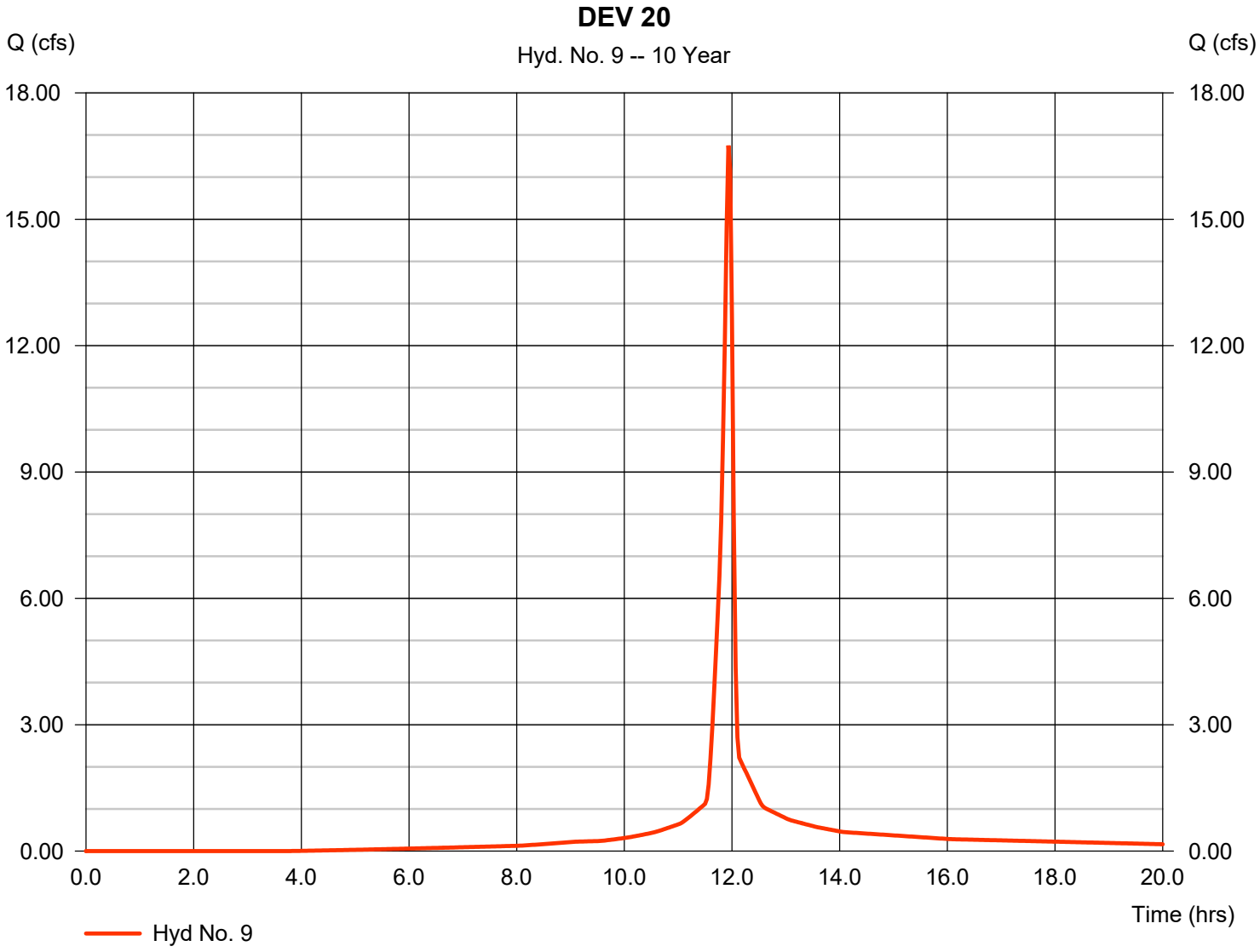
Hydrograph Report

Hyd. No. 9

DEV 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.75 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	35,991 cuft
Drainage area	=	2.400 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.150 x 98) + (1.250 x 80)] / 2.400



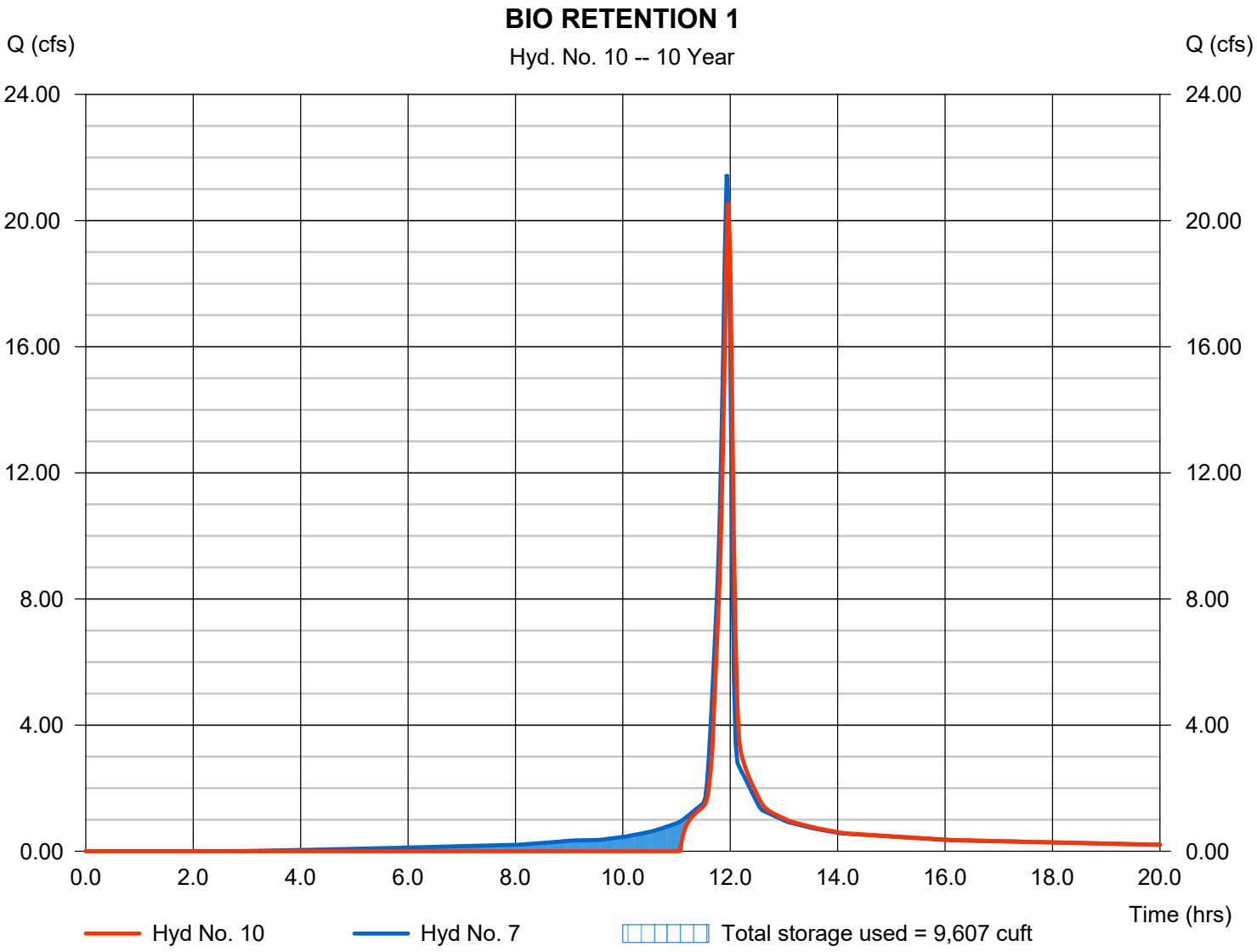
Hydrograph Report

Hyd. No. 10

BIO RETENTION 1

Hydrograph type	=	Reservoir	Peak discharge	=	20.61 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	40,761 cuft
Inflow hyd. No.	=	7 - DEV 10	Max. Elevation	=	1021.33 ft
Reservoir name	=	BIORETENTION 1	Max. Storage	=	9,607 cuft

Storage Indication method used.



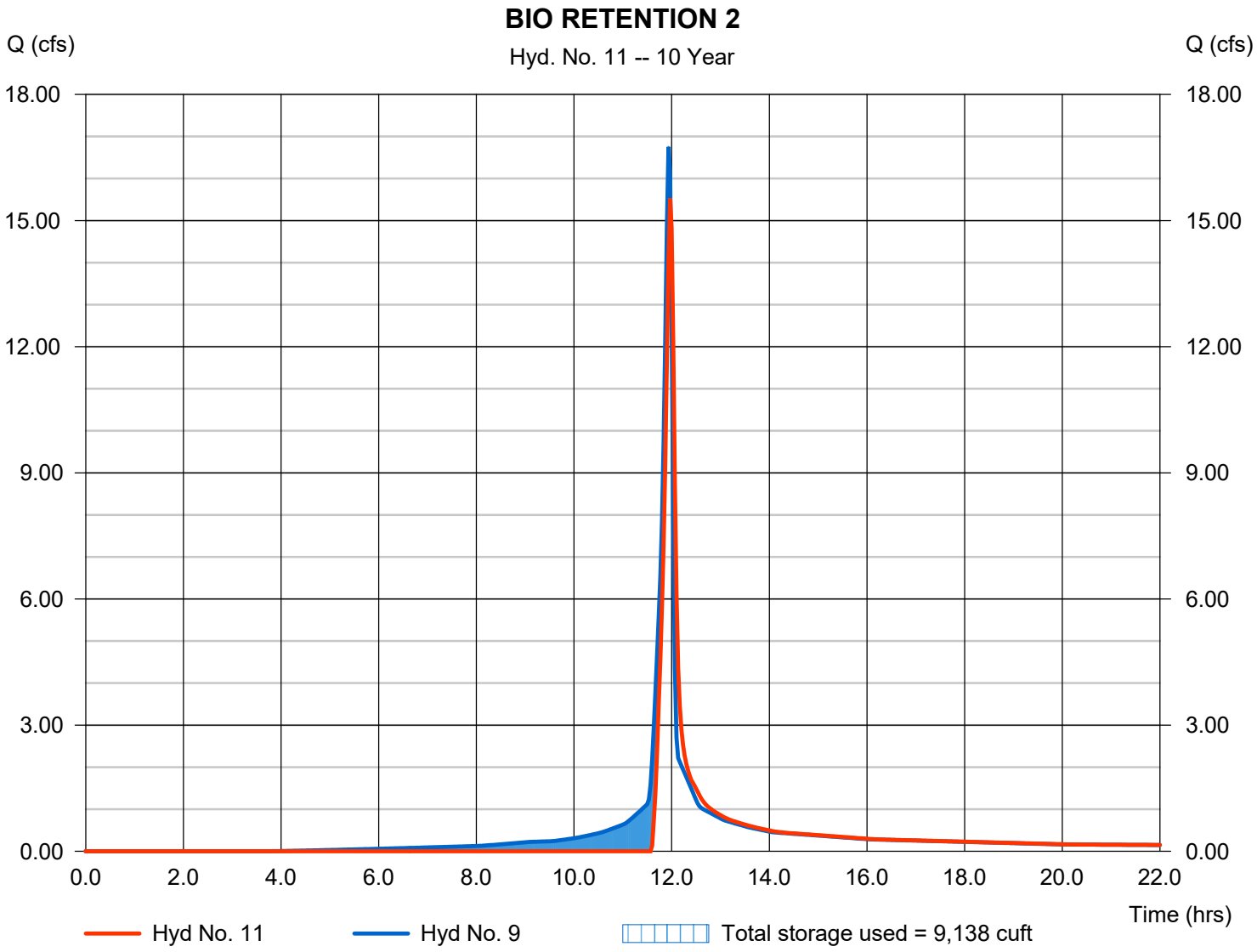
Hydrograph Report

Hyd. No. 11

BIO RETENTION 2

Hydrograph type	=	Reservoir	Peak discharge	=	15.53 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	29,987 cuft
Inflow hyd. No.	=	9 - DEV 20	Max. Elevation	=	1022.94 ft
Reservoir name	=	BIORETENTION 2	Max. Storage	=	9,138 cuft

Storage Indication method used.

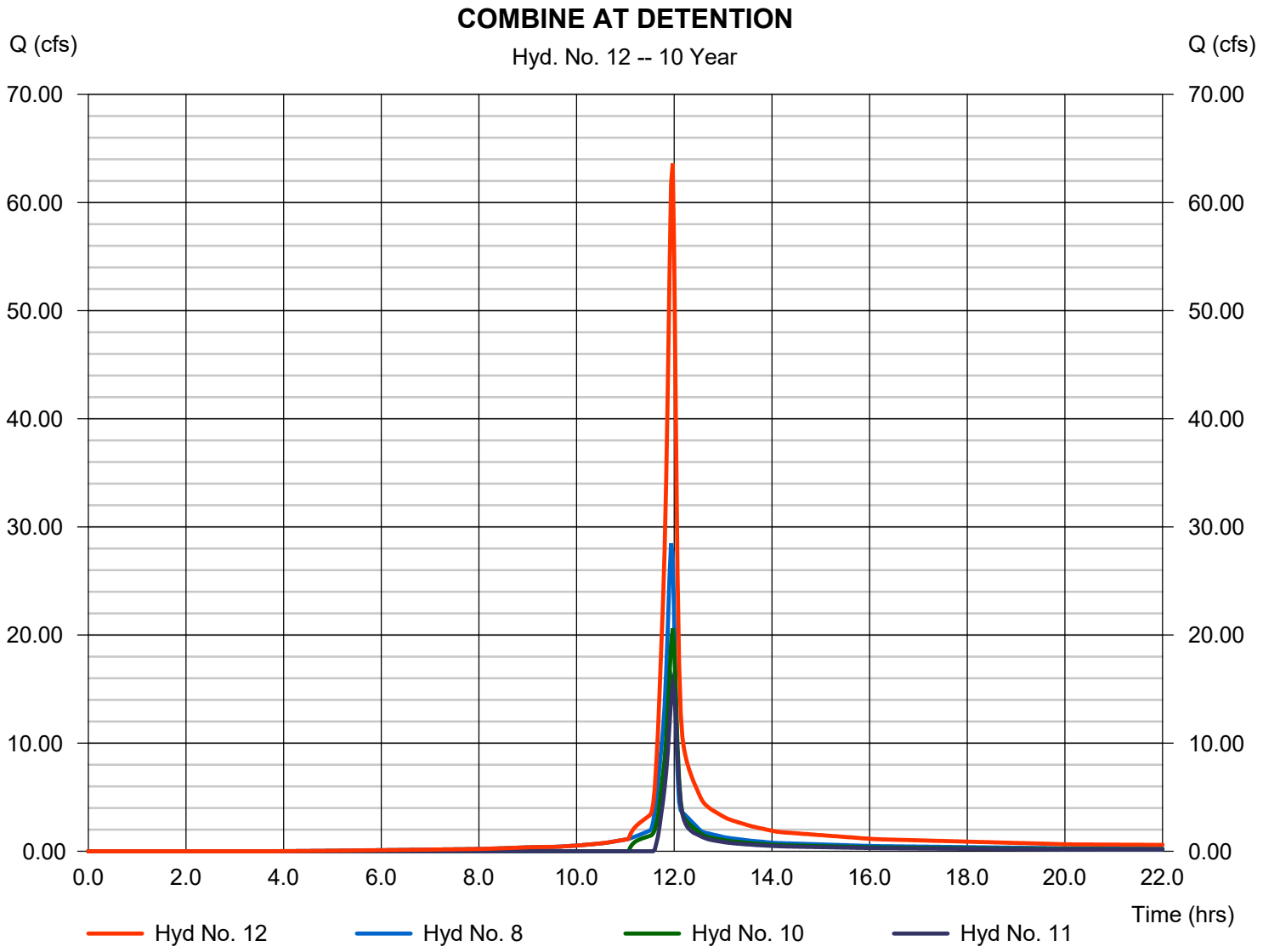


Hydrograph Report

Hyd. No. 12

COMBINE AT DETENTION

Hydrograph type	=	Combine	Peak discharge	=	63.59 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	131,933 cuft
Inflow hyds.	=	8, 10, 11	Contrib. drain. area	=	4.080 ac



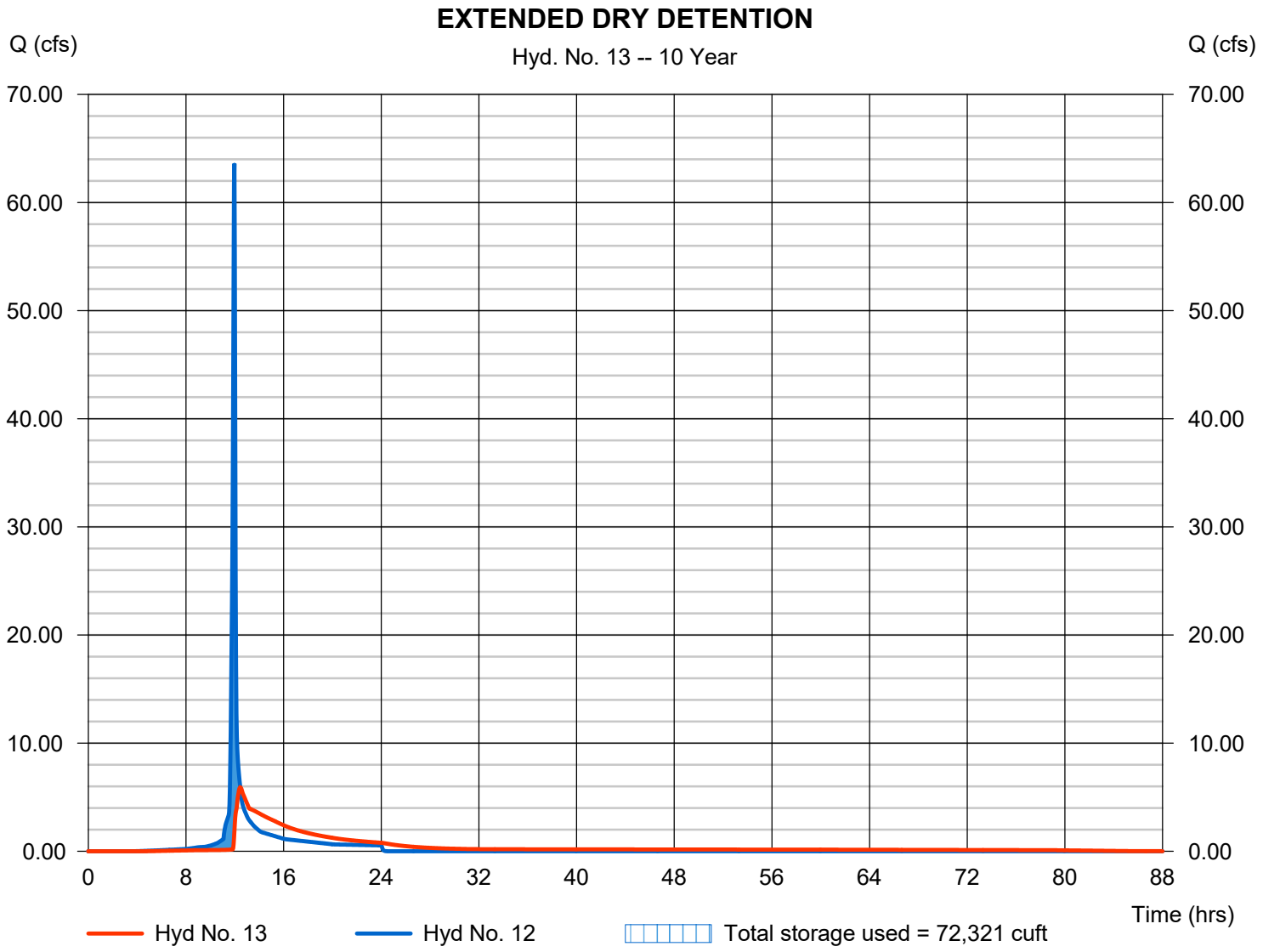
Hydrograph Report

Hyd. No. 13

EXTENDED DRY DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	5.909 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.43 hrs
Time interval	=	2 min	Hyd. volume	=	131,923 cuft
Inflow hyd. No.	=	12 - COMBINE AT DETENTION	Max. Elevation	=	1018.62 ft
Reservoir name	=	DRY DETENTION 1	Max. Storage	=	72,321 cuft

Storage Indication method used.



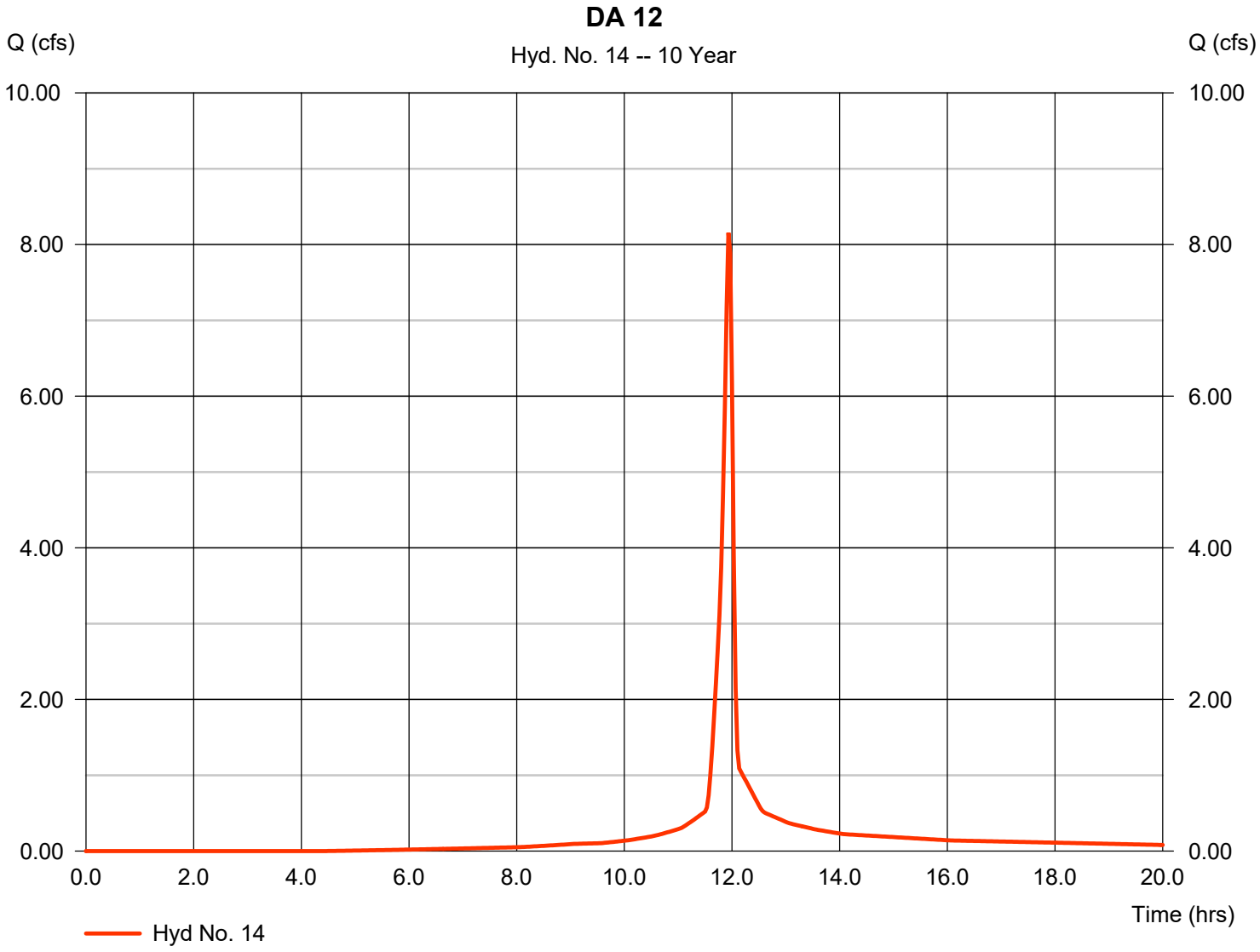
Hydrograph Report

Hyd. No. 14

DA 12

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.155 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	17,264 cuft
Drainage area	=	1.210 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.460 x 98) + (0.750 x 80)] / 1.210

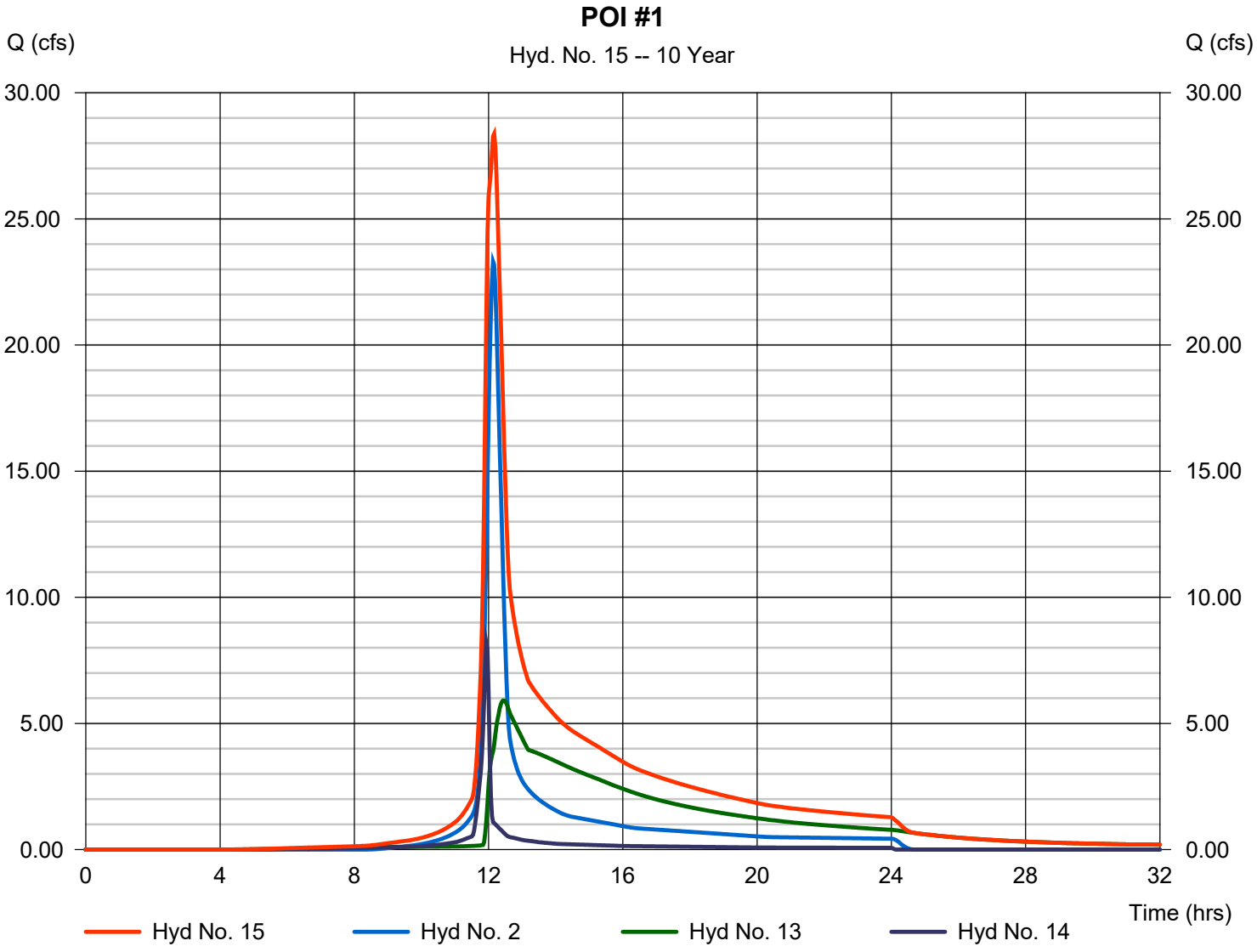


Hydrograph Report

Hyd. No. 15

POI #1

Hydrograph type	=	Combine	Peak discharge	=	28.37 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	235,022 cuft
Inflow hyds.	=	2, 13, 14	Contrib. drain. area	=	9.490 ac



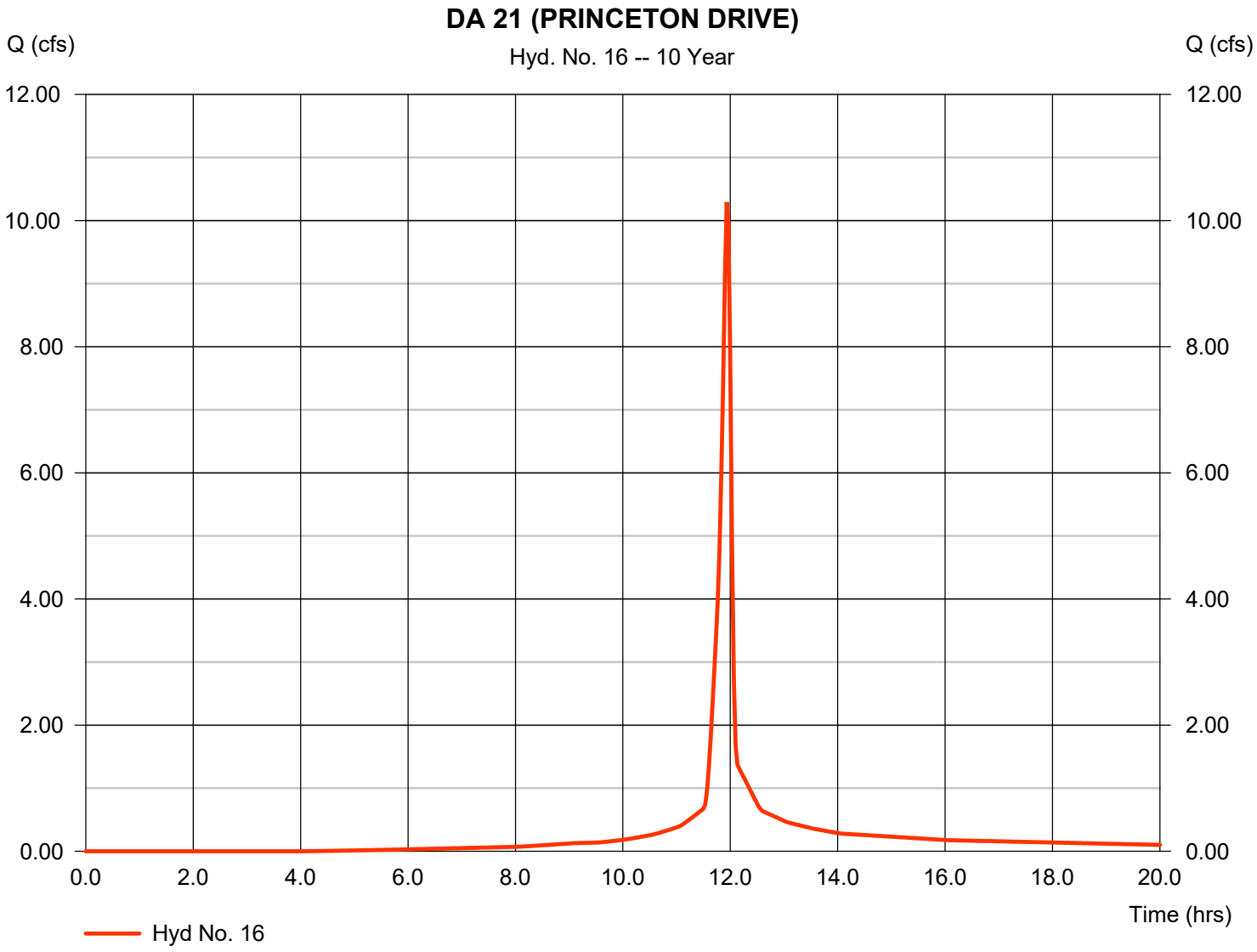
Hydrograph Report

Hyd. No. 16

DA 21 (PRINCETON DRIVE)

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.29 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	21,945 cuft
Drainage area	=	1.500 ac	Curve number	=	88*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.630 x 98) + (0.870 x 80)] / 1.500



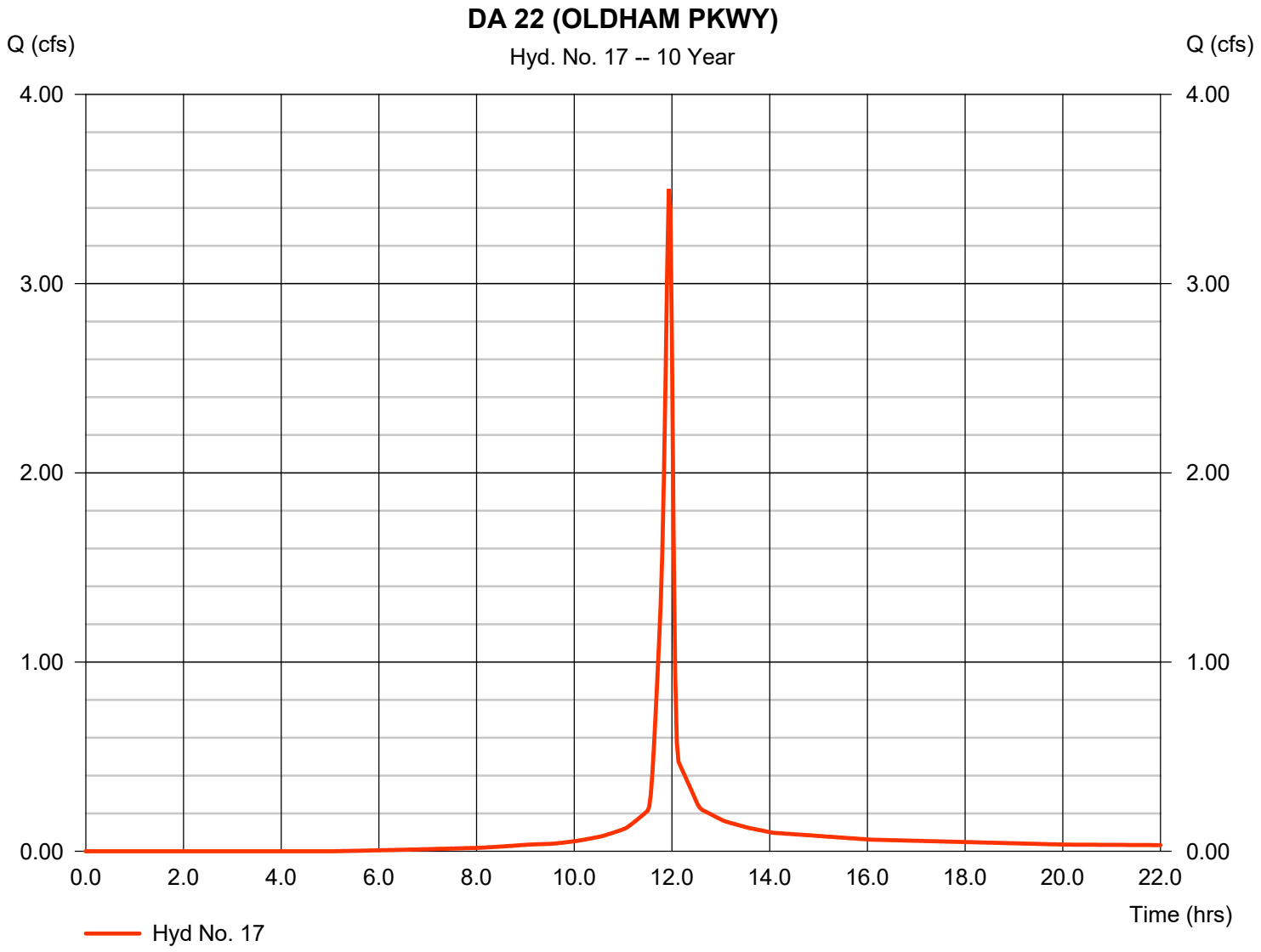
Hydrograph Report

Hyd. No. 17

DA 22 (OLDHAM PKWY)

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.500 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	7,319 cuft
Drainage area	=	0.540 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.150 x 98) + (0.390 x 80)] / 0.540



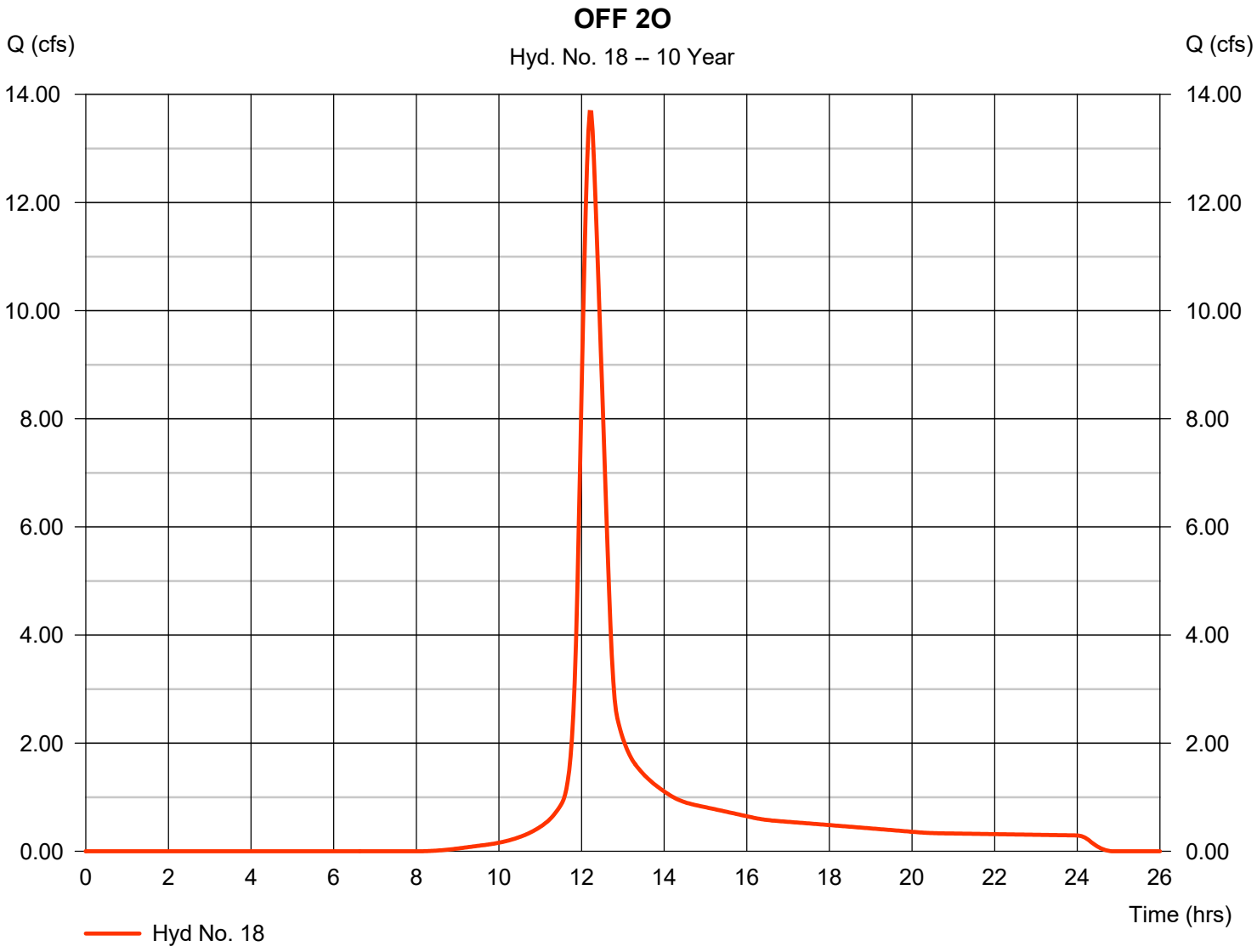
Hydrograph Report

Hyd. No. 18

OFF 2O

Hydrograph type	=	SCS Runoff	Peak discharge	=	13.67 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	59,320 cuft
Drainage area	=	5.390 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.70 min
Total precip.	=	5.66 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.240 x 98) + (5.150 x 74)] / 5.390

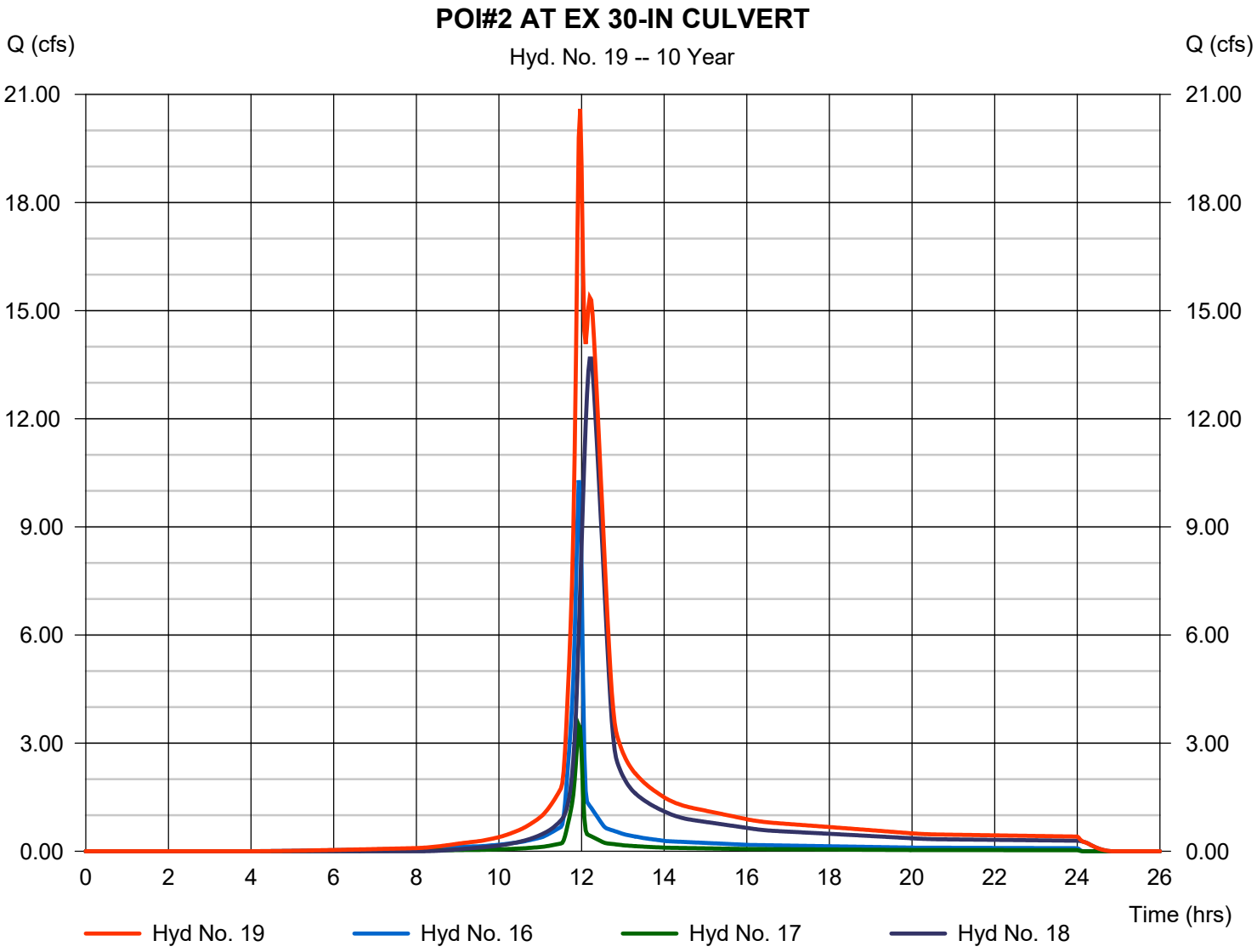


Hydrograph Report

Hyd. No. 19

POI#2 AT EX 30-IN CULVERT

Hydrograph type	=	Combine	Peak discharge	=	20.60 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	88,584 cuft
Inflow hyds.	=	16, 17, 18	Contrib. drain. area	=	7.430 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	23.85	2	728	87,924	------	------	------	EX 10
2	SCS Runoff	48.68	2	728	179,217	------	------	------	EX 11
3	Combine	72.52	2	728	267,141	1, 2	------	------	EX POI #1
4	SCS Runoff	48.62	2	728	179,000	------	------	------	EX 20
5	SCS Runoff	28.27	2	732	122,475	------	------	------	OFF 20
6	Combine	75.73	2	730	301,476	4, 5	------	------	EX POI#2 AT EX RCP 30-IN CULVE
7	SCS Runoff	36.24	2	716	82,868	------	------	------	DEV 10
8	SCS Runoff	49.26	2	716	109,912	------	------	------	DEV 30
9	SCS Runoff	28.97	2	716	64,654	------	------	------	DEV 20
10	Reservoir	35.10	2	718	76,250	7	1021.48	10,893	BIO RETENTION 1
11	Reservoir	25.01	2	718	58,651	9	1023.15	10,956	BIO RETENTION 2
12	Combine	107.32	2	718	244,813	8, 10, 11	------	------	COMBINE AT DETENTION
13	Reservoir	15.89	2	732	244,803	12	1020.77	128,492	EXTENDED DRY DETENTION
14	SCS Runoff	14.36	2	716	31,586	------	------	------	DA 12
15	Combine	66.43	2	728	455,605	2, 13, 14	------	------	POI #1
16	SCS Runoff	17.96	2	716	39,783	------	------	------	DA 21 (PRINCETON DRIVE)
17	SCS Runoff	6.284	2	716	13,644	------	------	------	DA 22 (OLDHAM PKWY)
18	SCS Runoff	28.27	2	732	122,475	------	------	------	OFF 2O
19	Combine	39.30	2	718	175,902	16, 17, 18	------	------	POI#2 AT EX 30-IN CULVERT

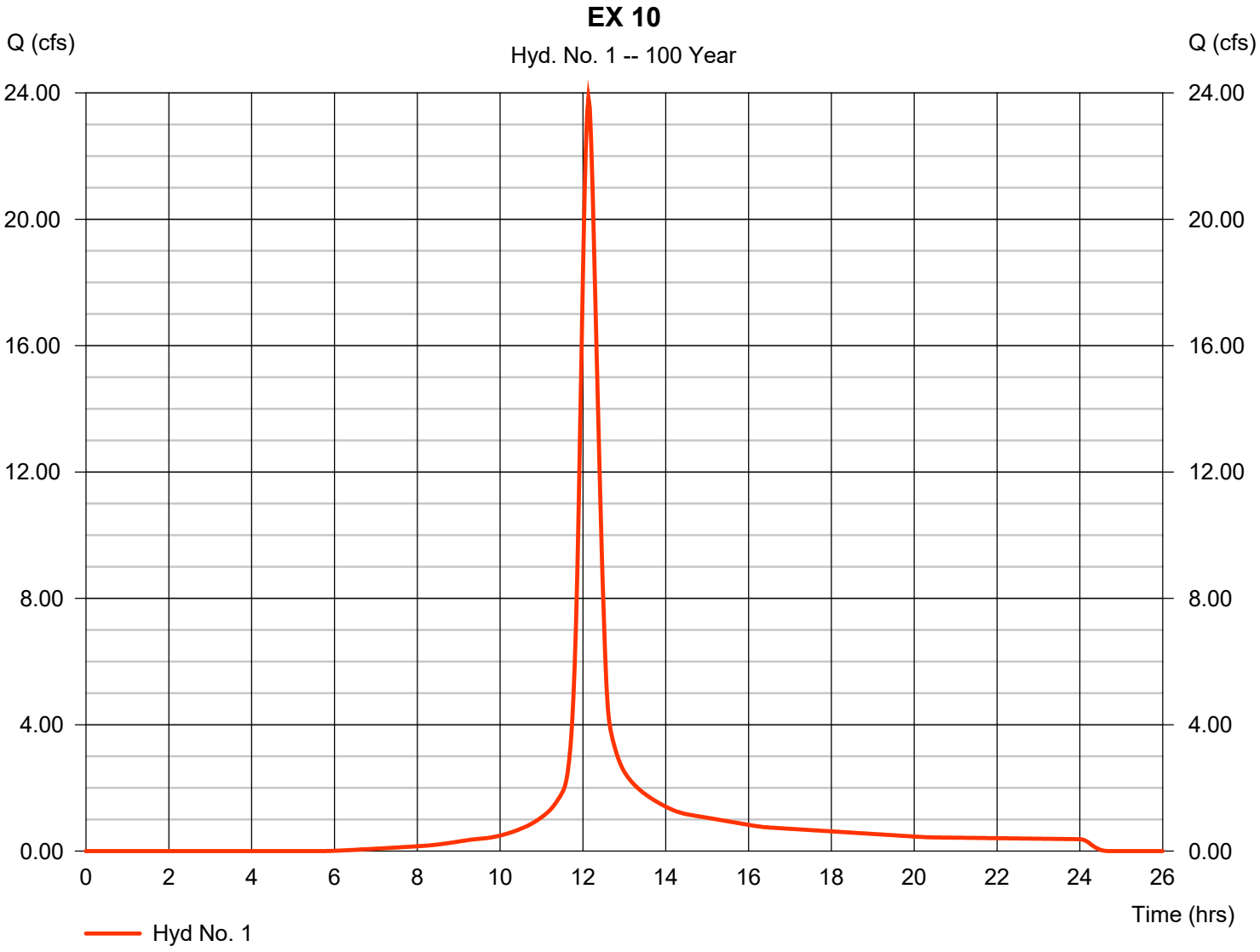
Hydrograph Report

Hyd. No. 1

EX 10

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.85 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	87,924 cuft
Drainage area	=	3.980 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.30 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.090 x 98) + (3.890 x 74)] / 3.980

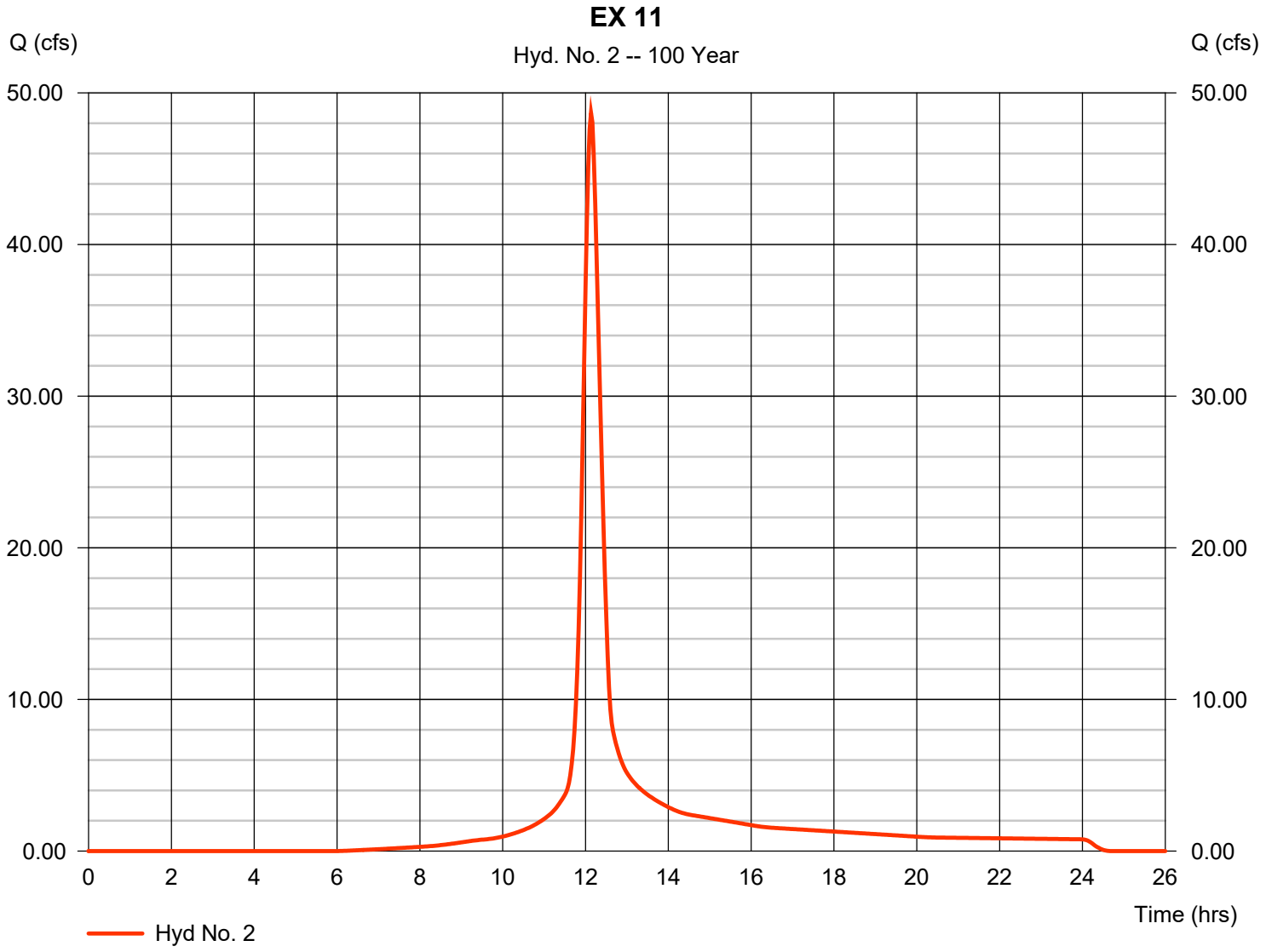


Hydrograph Report

Hyd. No. 2

EX 11

Hydrograph type	=	SCS Runoff	Peak discharge	=	48.68 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	179,217 cuft
Drainage area	=	8.280 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.60 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

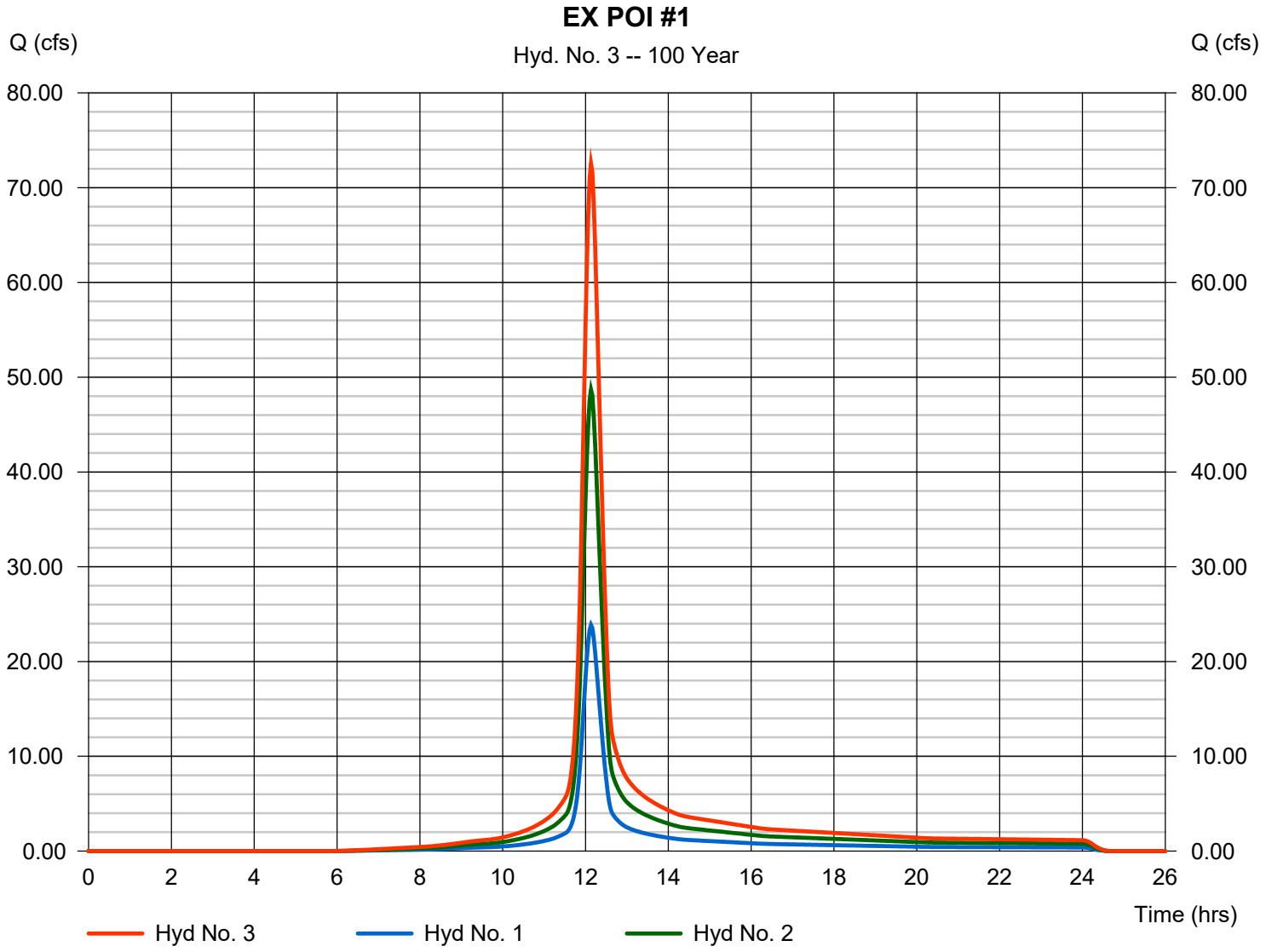


Hydrograph Report

Hyd. No. 3

EX POI #1

Hydrograph type	=	Combine	Peak discharge	=	72.52 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	267,141 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	12.260 ac



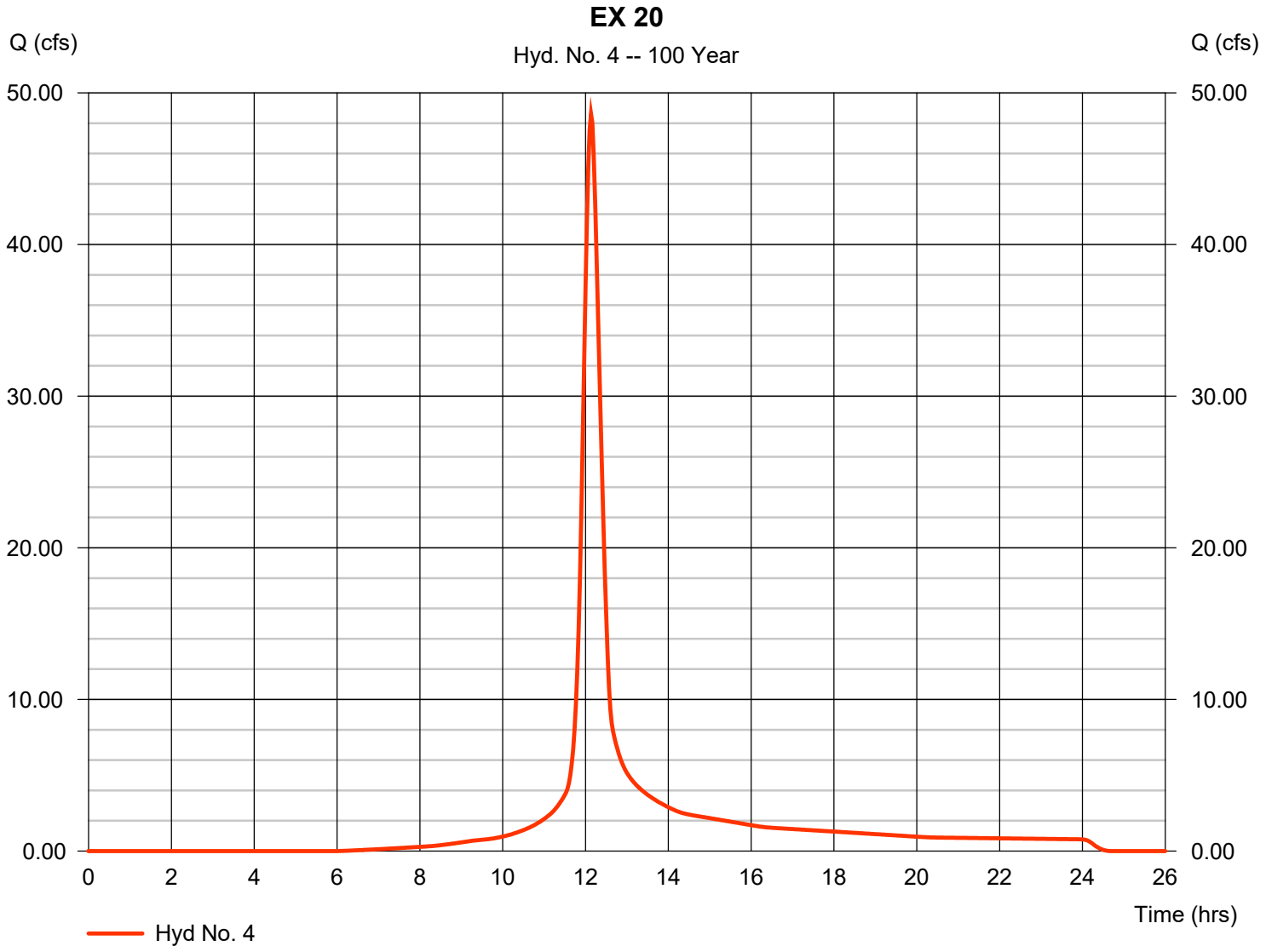
Hydrograph Report

Hyd. No. 4

EX 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	48.62 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	179,000 cuft
Drainage area	=	8.270 ac	Curve number	=	74*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.10 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.110 x 98) + (8.160 x 74)] / 8.270



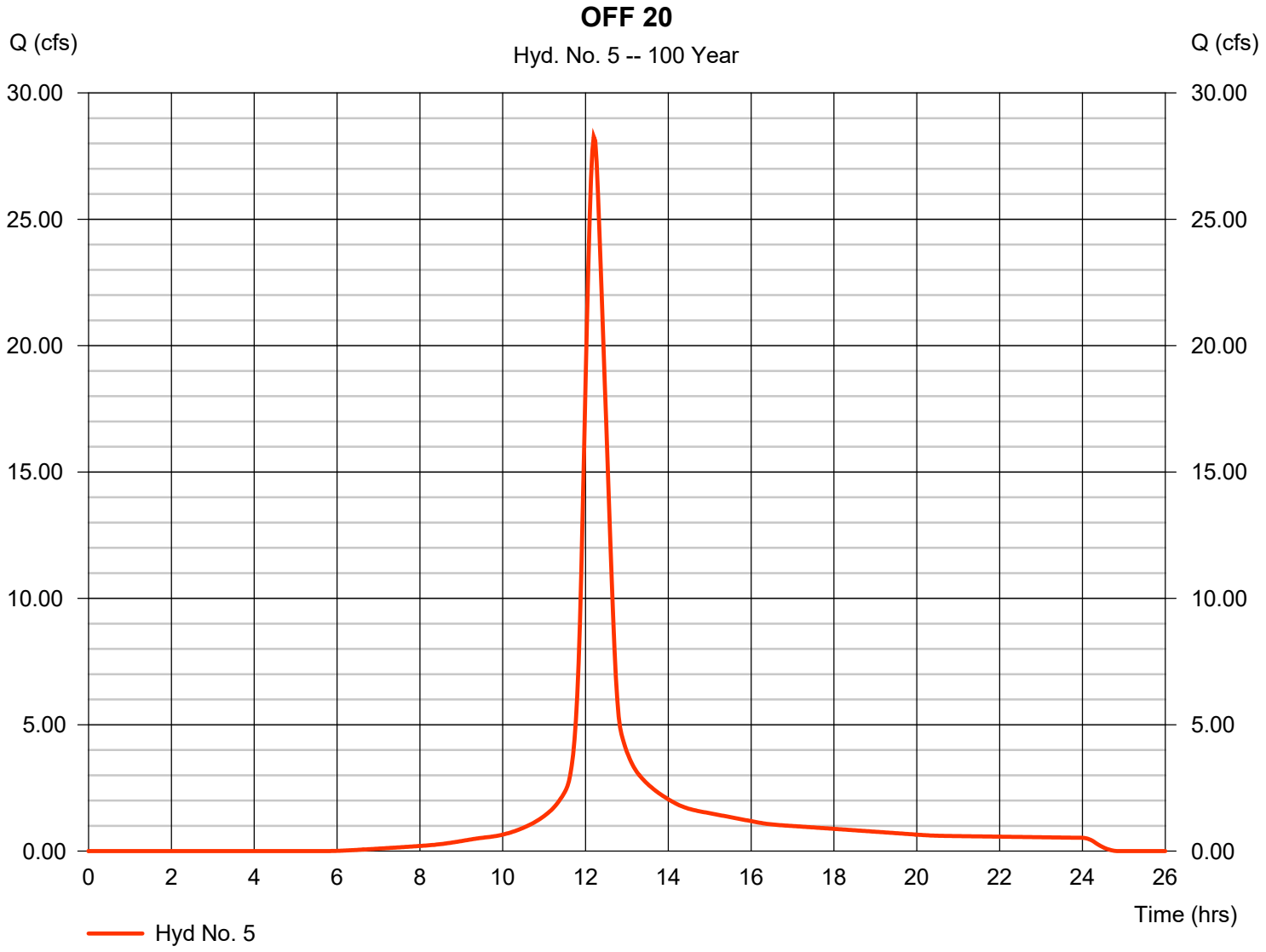
Hydrograph Report

Hyd. No. 5

OFF 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	28.27 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	122,475 cuft
Drainage area	=	5.390 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.70 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.130 x 98) + (5.260 x 74)] / 5.390

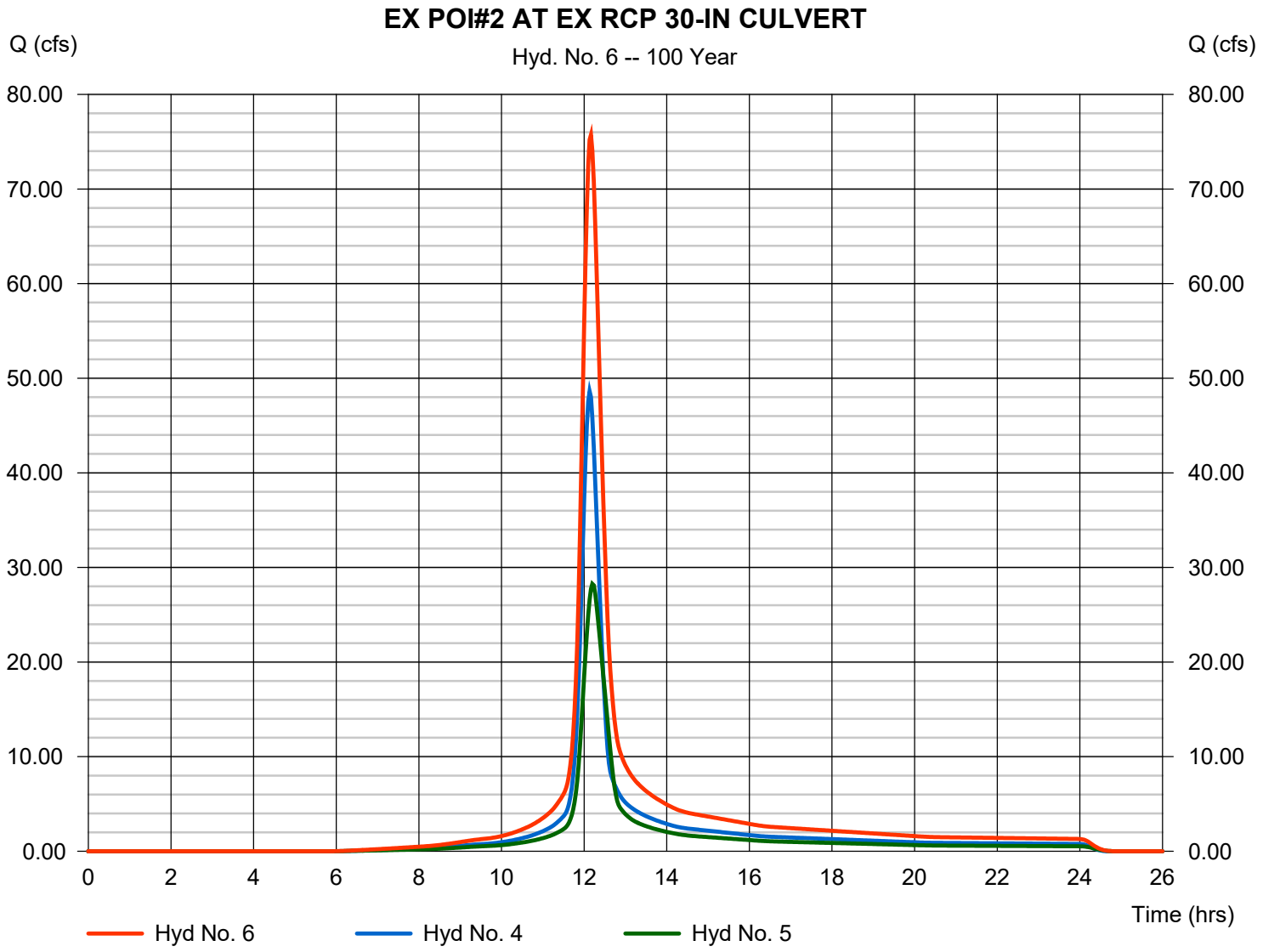


Hydrograph Report

Hyd. No. 6

EX POI#2 AT EX RCP 30-IN CULVERT

Hydrograph type	= Combine	Peak discharge	= 75.73 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 301,476 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 13.660 ac



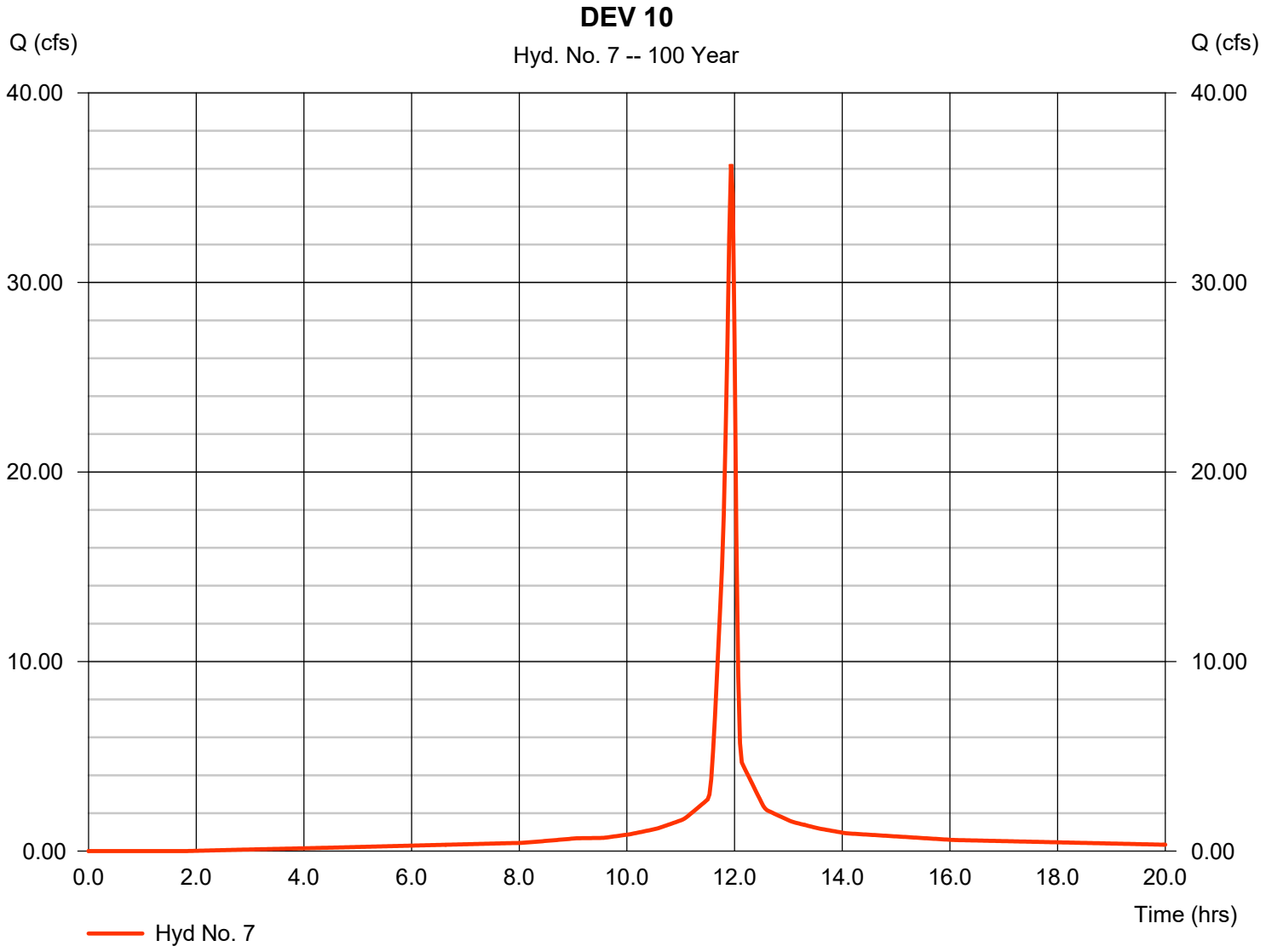
Hydrograph Report

Hyd. No. 7

DEV 10

Hydrograph type	=	SCS Runoff	Peak discharge	=	36.24 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	82,868 cuft
Drainage area	=	2.940 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.970 x 98) + (0.970 x 80)] / 2.940



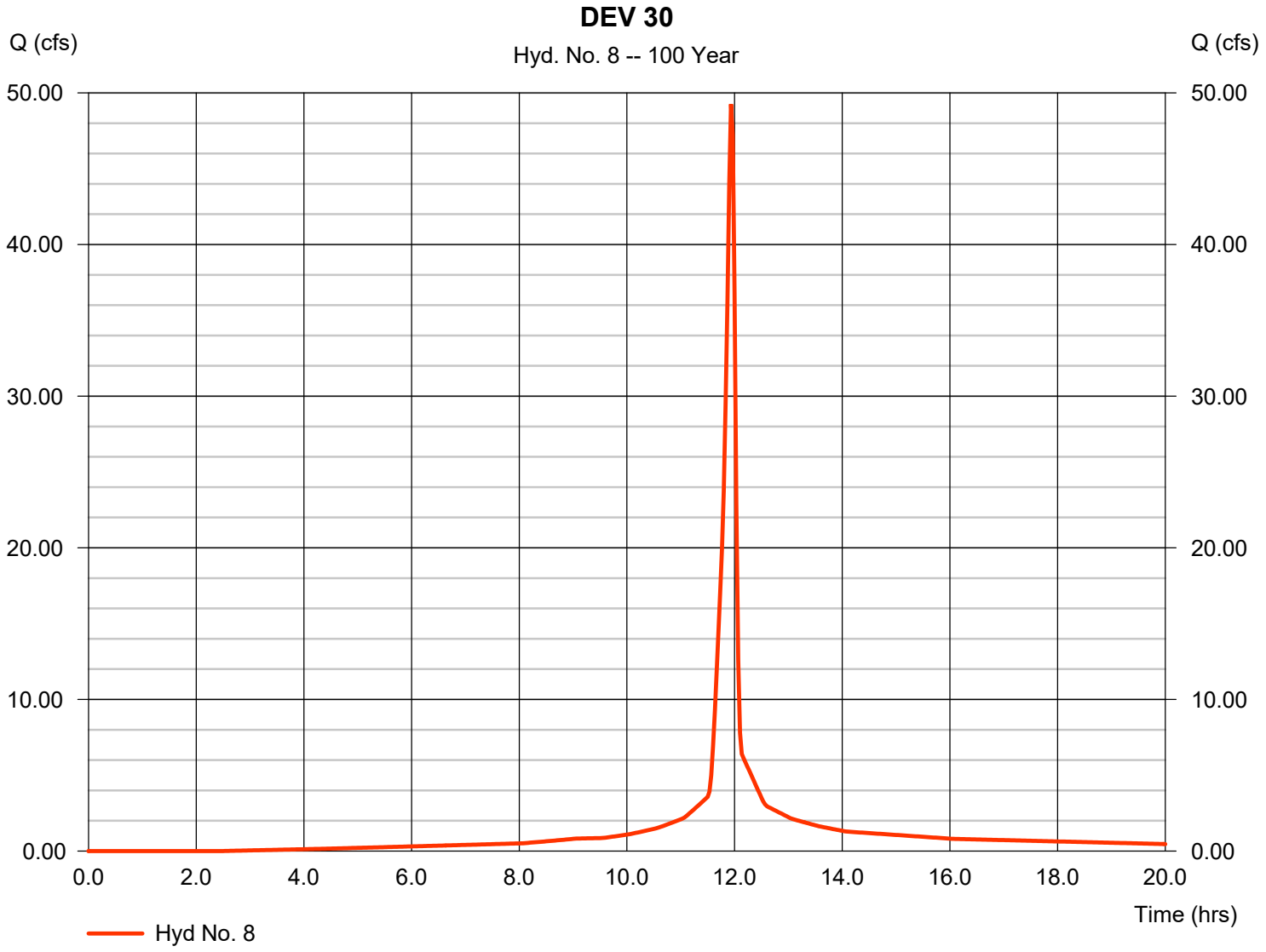
Hydrograph Report

Hyd. No. 8

DEV 30

Hydrograph type	=	SCS Runoff	Peak discharge	=	49.26 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	109,912 cuft
Drainage area	=	4.080 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.040 x 98) + (2.040 x 80)] / 4.080



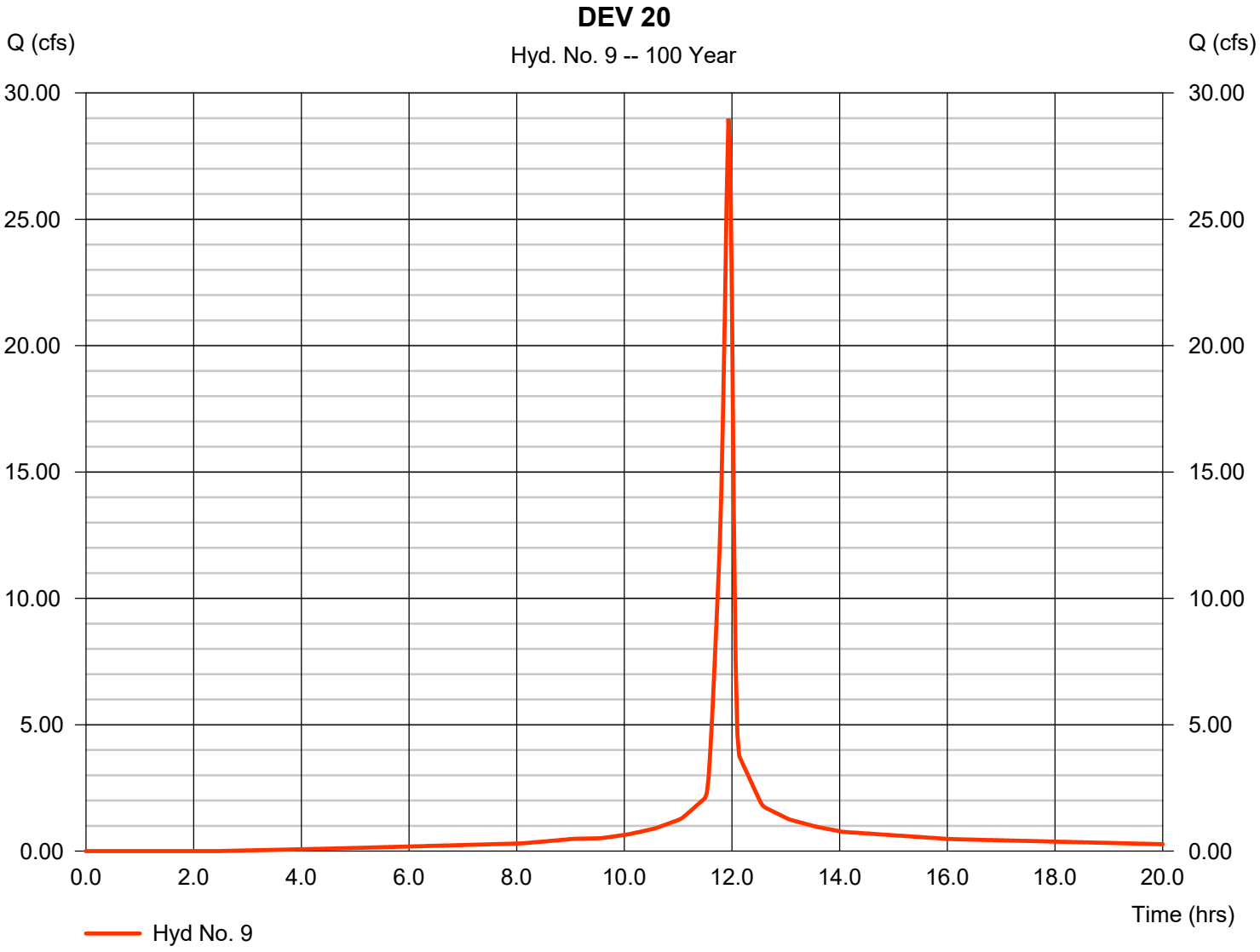
Hydrograph Report

Hyd. No. 9

DEV 20

Hydrograph type	=	SCS Runoff	Peak discharge	=	28.97 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	64,654 cuft
Drainage area	=	2.400 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.150 x 98) + (1.250 x 80)] / 2.400



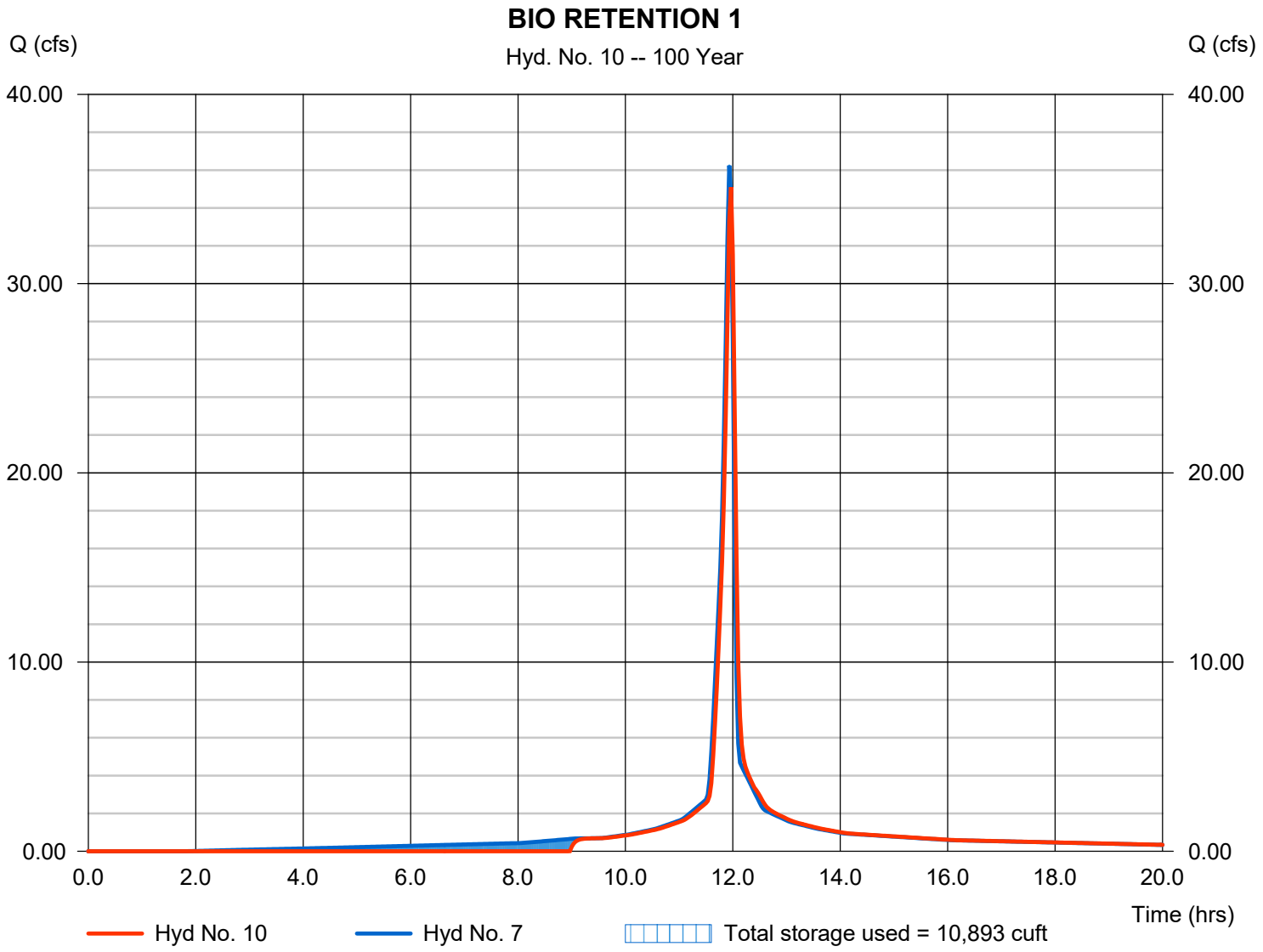
Hydrograph Report

Hyd. No. 10

BIO RETENTION 1

Hydrograph type	=	Reservoir	Peak discharge	=	35.10 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	76,250 cuft
Inflow hyd. No.	=	7 - DEV 10	Max. Elevation	=	1021.48 ft
Reservoir name	=	BIORETENTION 1	Max. Storage	=	10,893 cuft

Storage Indication method used.



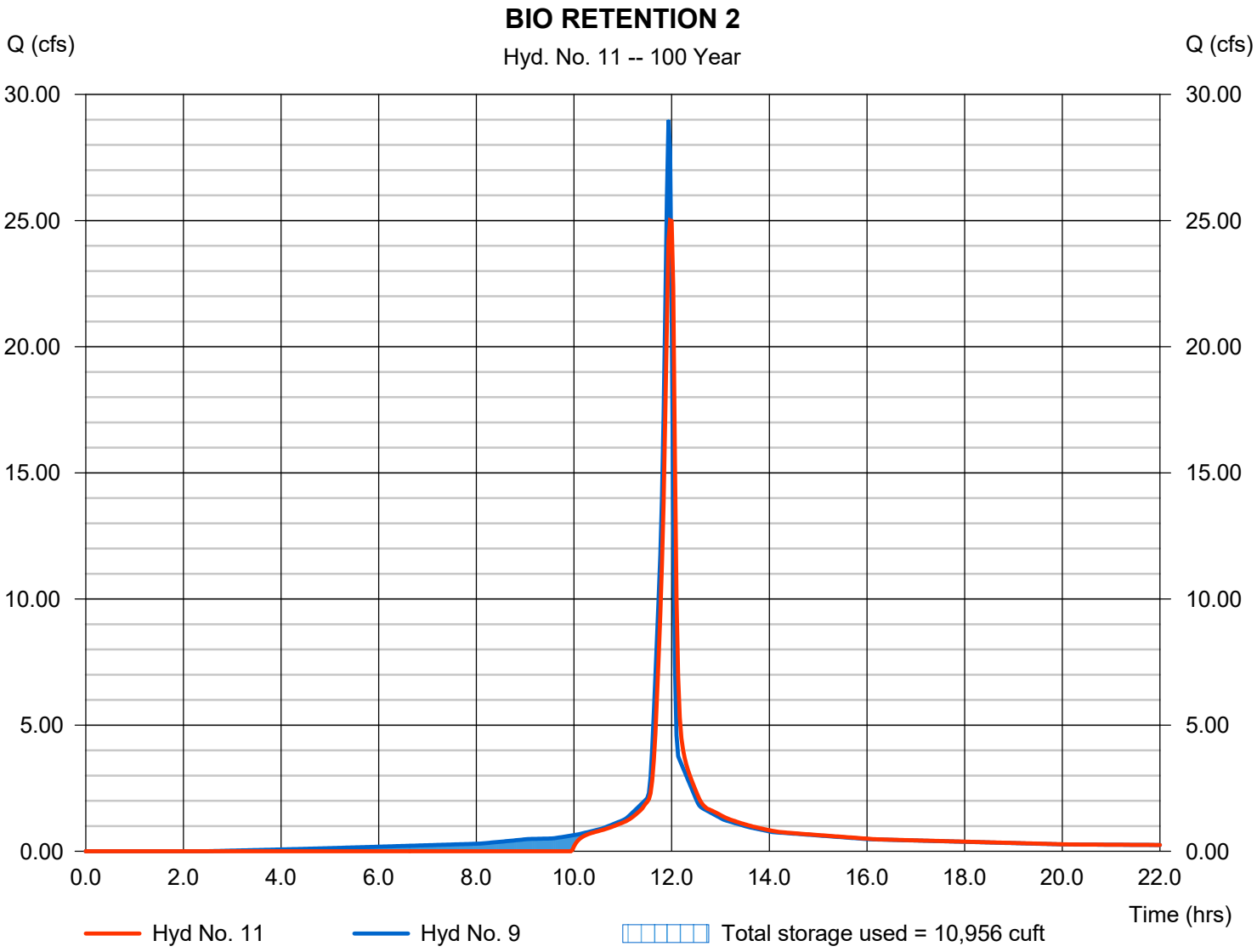
Hydrograph Report

Hyd. No. 11

BIO RETENTION 2

Hydrograph type	=	Reservoir	Peak discharge	=	25.01 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	58,651 cuft
Inflow hyd. No.	=	9 - DEV 20	Max. Elevation	=	1023.15 ft
Reservoir name	=	BIORETENTION 2	Max. Storage	=	10,956 cuft

Storage Indication method used.

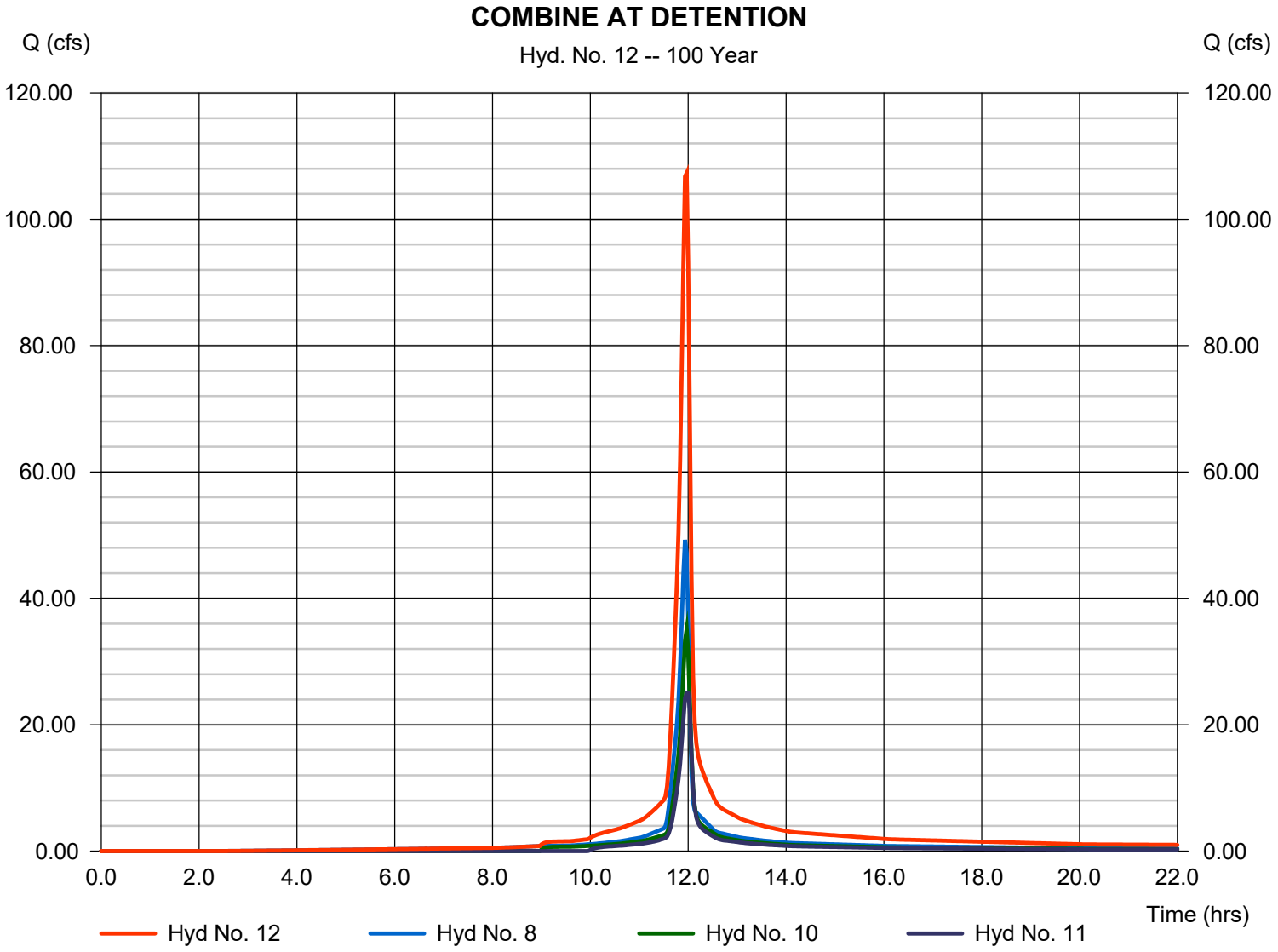


Hydrograph Report

Hyd. No. 12

COMBINE AT DETENTION

Hydrograph type	=	Combine	Peak discharge	=	107.32 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	244,813 cuft
Inflow hyds.	=	8, 10, 11	Contrib. drain. area	=	4.080 ac



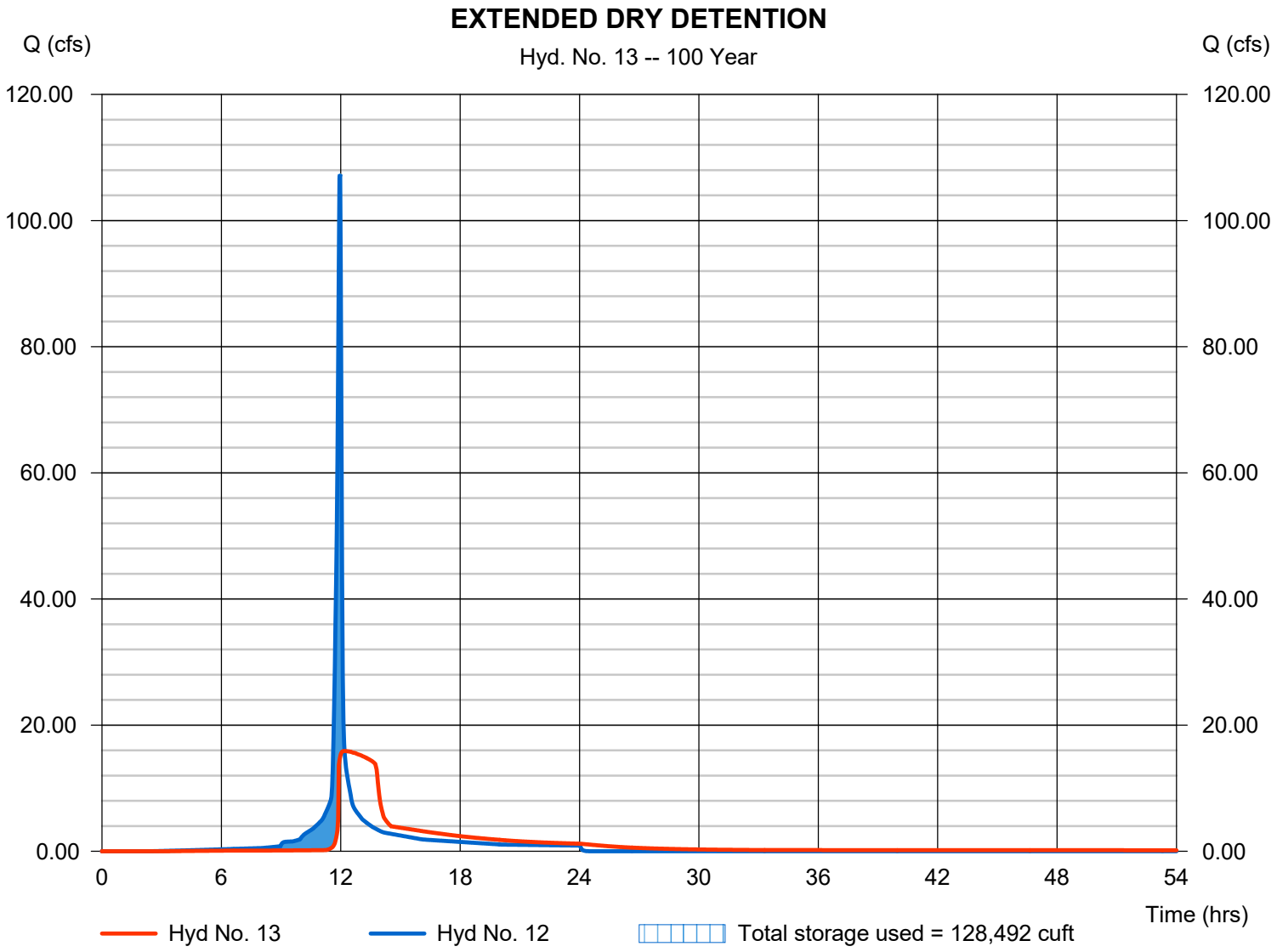
Hydrograph Report

Hyd. No. 13

EXTENDED DRY DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	15.89 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	244,803 cuft
Inflow hyd. No.	=	12 - COMBINE AT DETENTION	Max. Elevation	=	1020.77 ft
Reservoir name	=	DRY DETENTION 1	Max. Storage	=	128,492 cuft

Storage Indication method used.



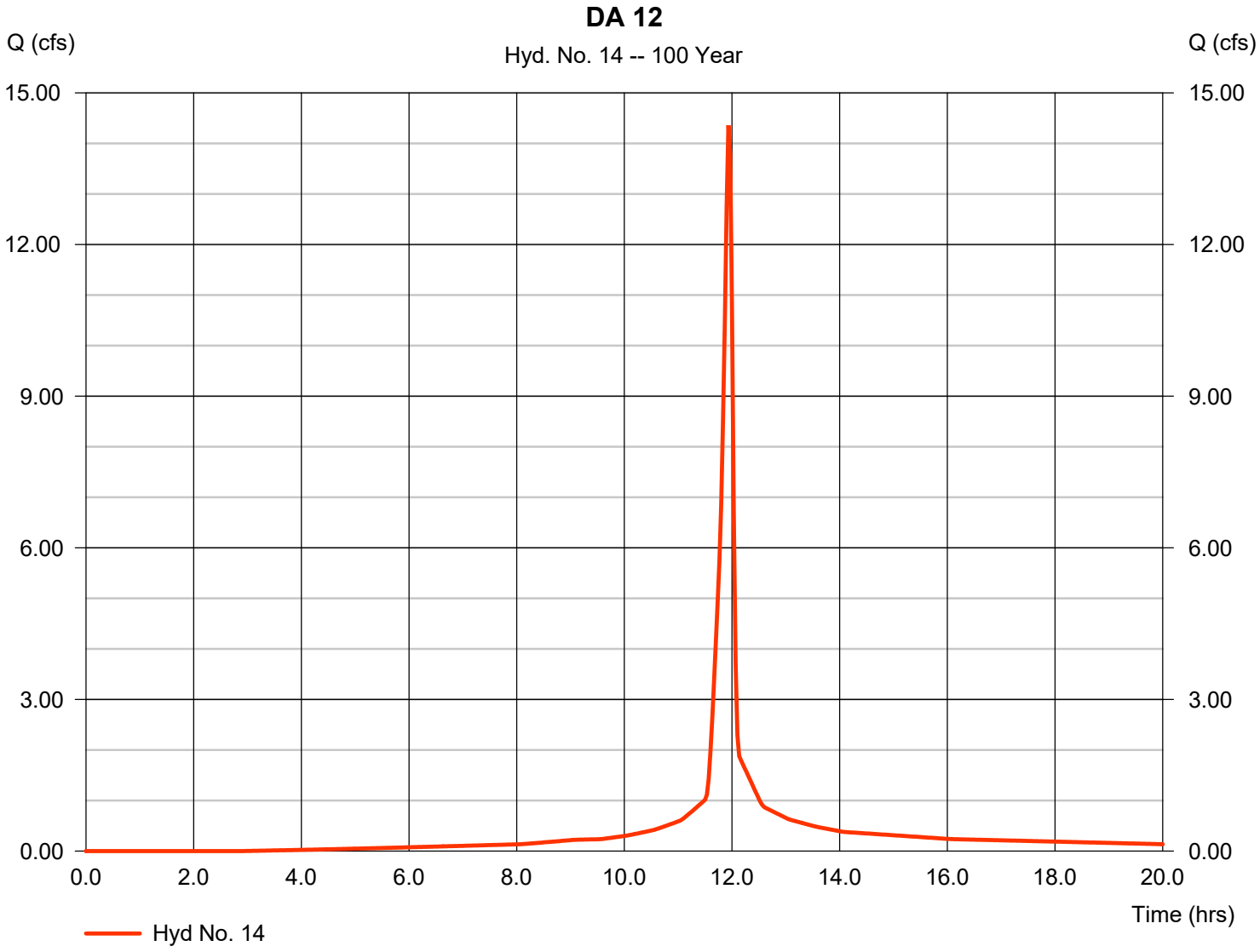
Hydrograph Report

Hyd. No. 14

DA 12

Hydrograph type	=	SCS Runoff	Peak discharge	=	14.36 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	31,586 cuft
Drainage area	=	1.210 ac	Curve number	=	87*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.460 x 98) + (0.750 x 80)] / 1.210

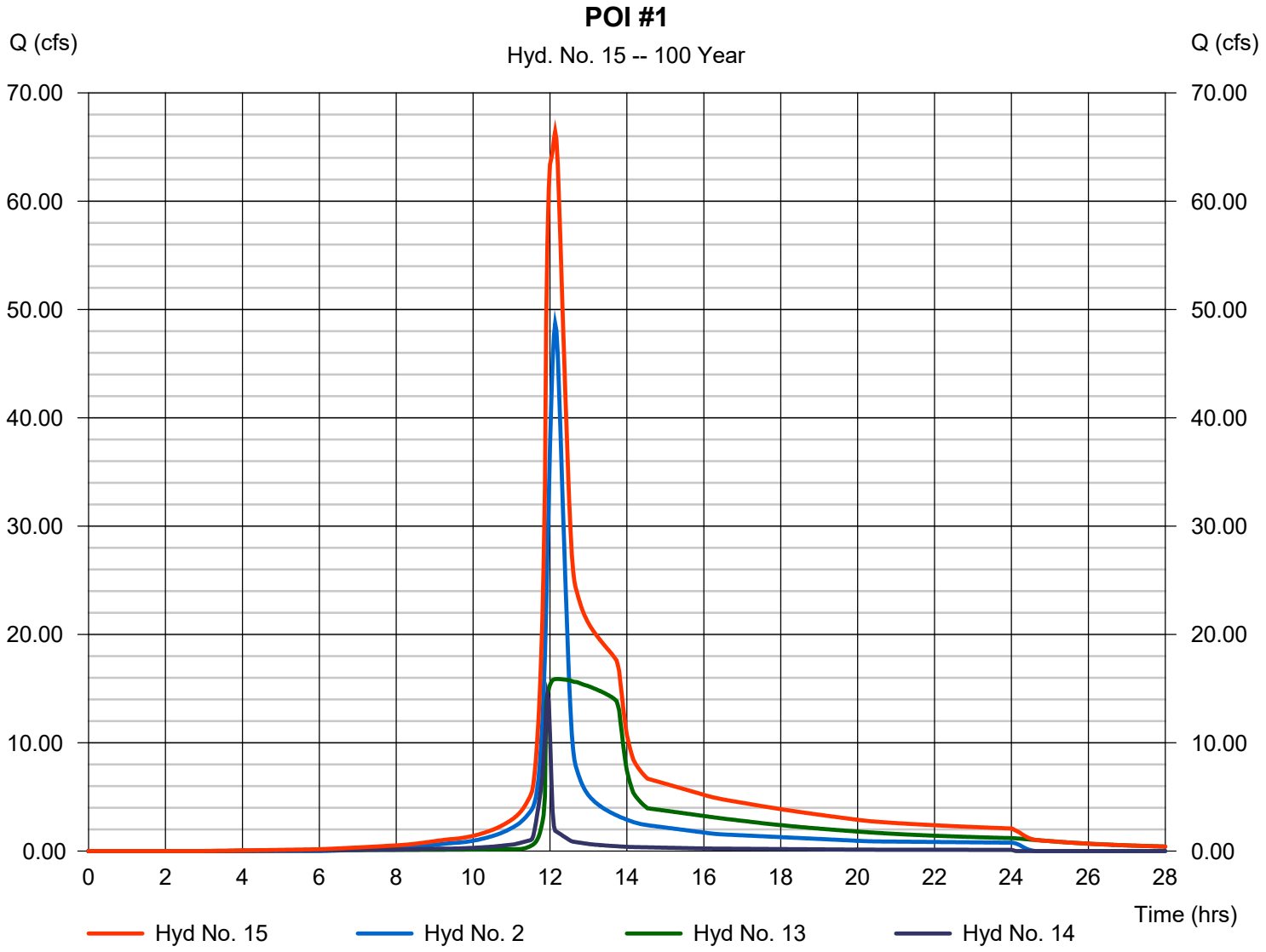


Hydrograph Report

Hyd. No. 15

POI #1

Hydrograph type	=	Combine	Peak discharge	=	66.43 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	455,605 cuft
Inflow hyds.	=	2, 13, 14	Contrib. drain. area	=	9.490 ac



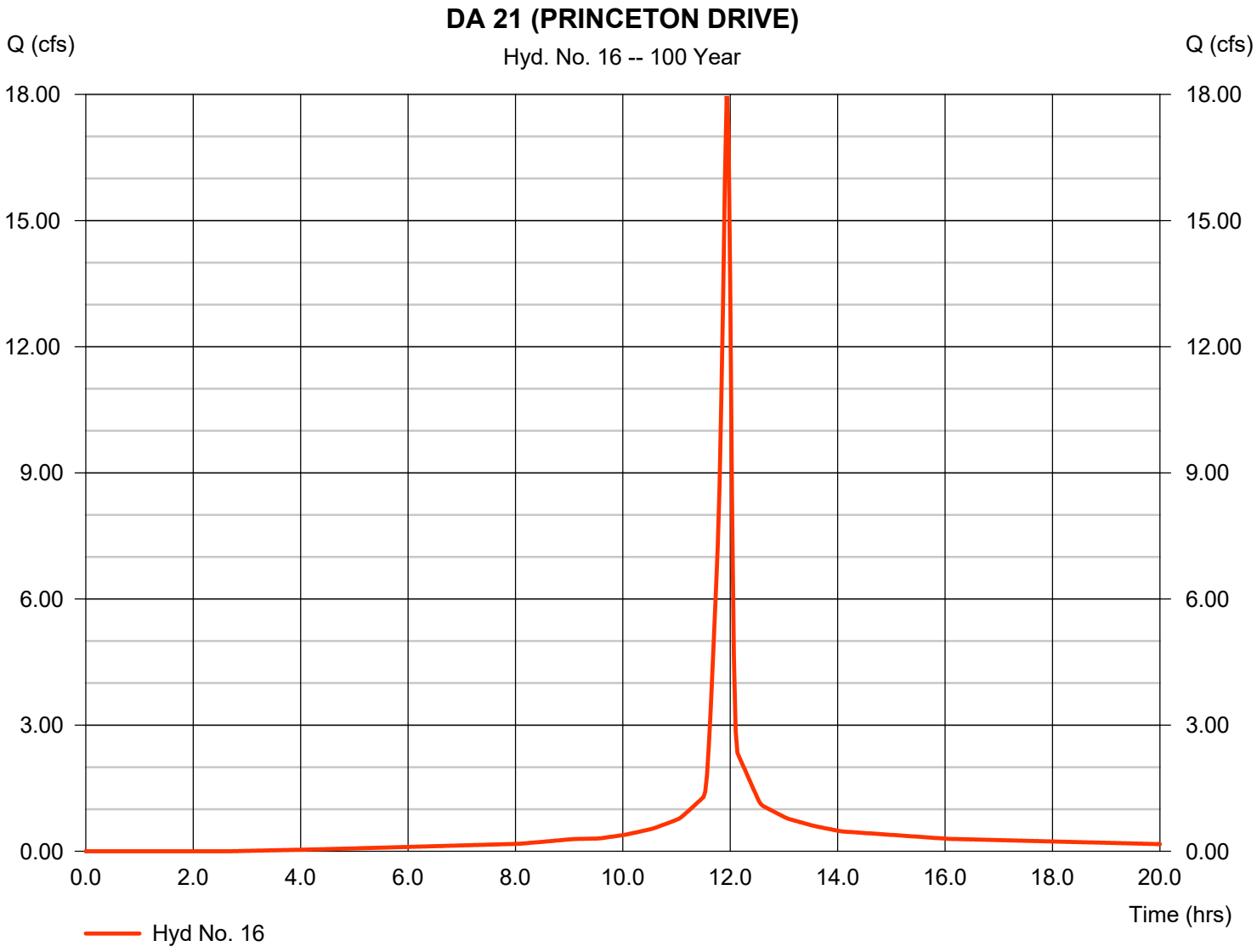
Hydrograph Report

Hyd. No. 16

DA 21 (PRINCETON DRIVE)

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.96 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	39,783 cuft
Drainage area	=	1.500 ac	Curve number	=	88*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.630 x 98) + (0.870 x 80)] / 1.500



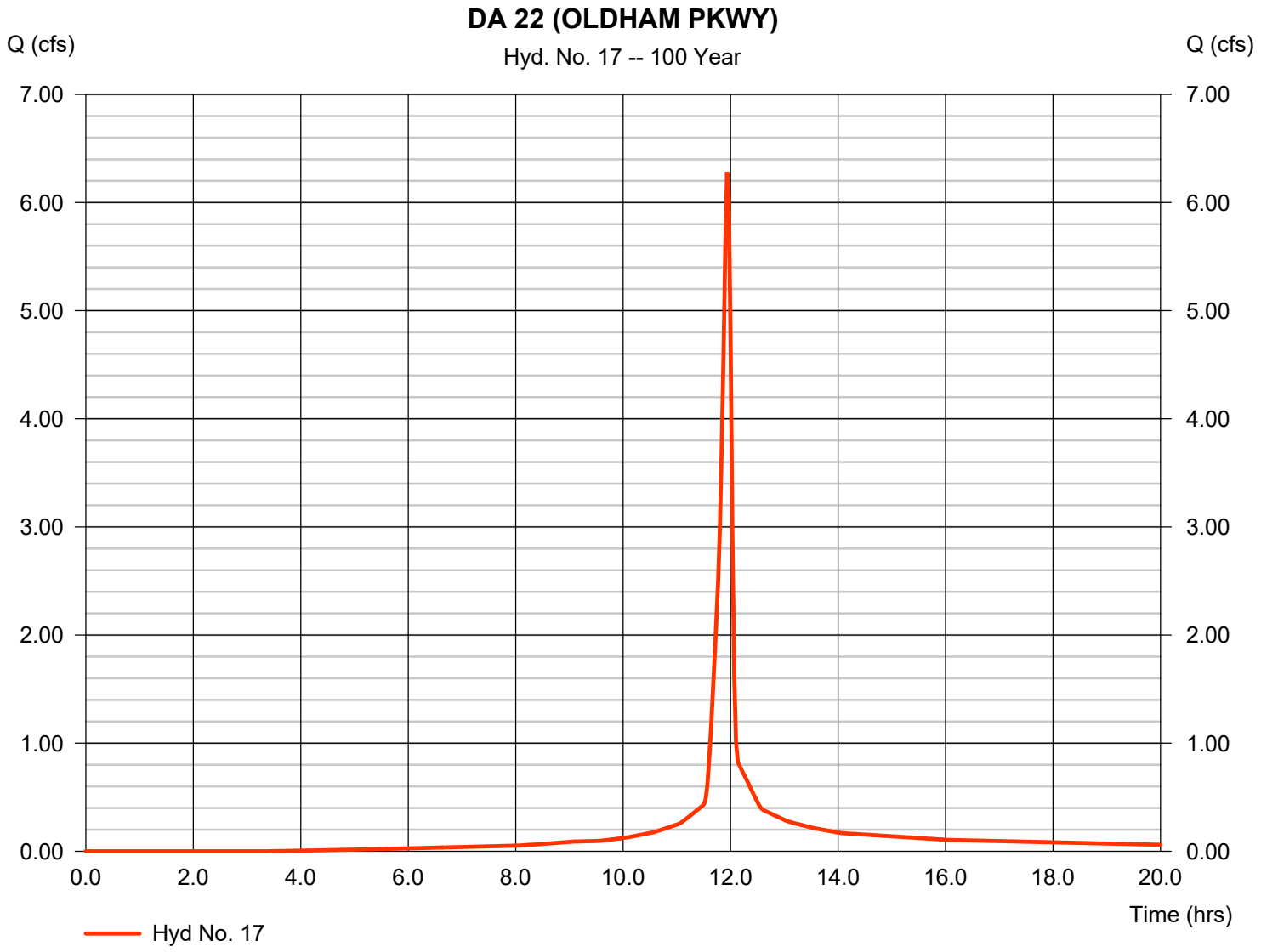
Hydrograph Report

Hyd. No. 17

DA 22 (OLDHAM PKWY)

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.284 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	13,644 cuft
Drainage area	=	0.540 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.150 x 98) + (0.390 x 80)] / 0.540



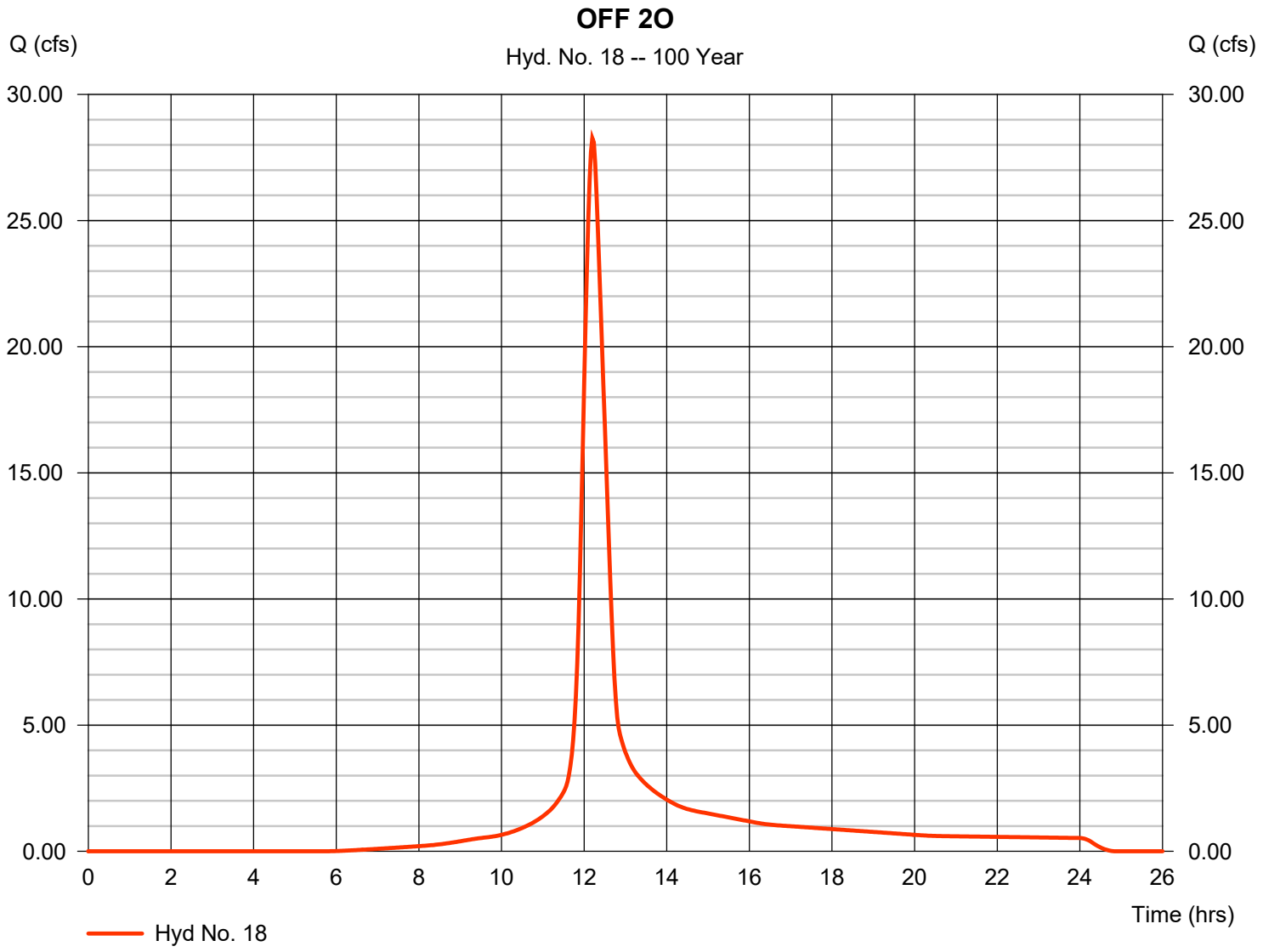
Hydrograph Report

Hyd. No. 18

OFF 2O

Hydrograph type	=	SCS Runoff	Peak discharge	=	28.27 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	122,475 cuft
Drainage area	=	5.390 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.70 min
Total precip.	=	9.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.240 x 98) + (5.150 x 74)] / 5.390

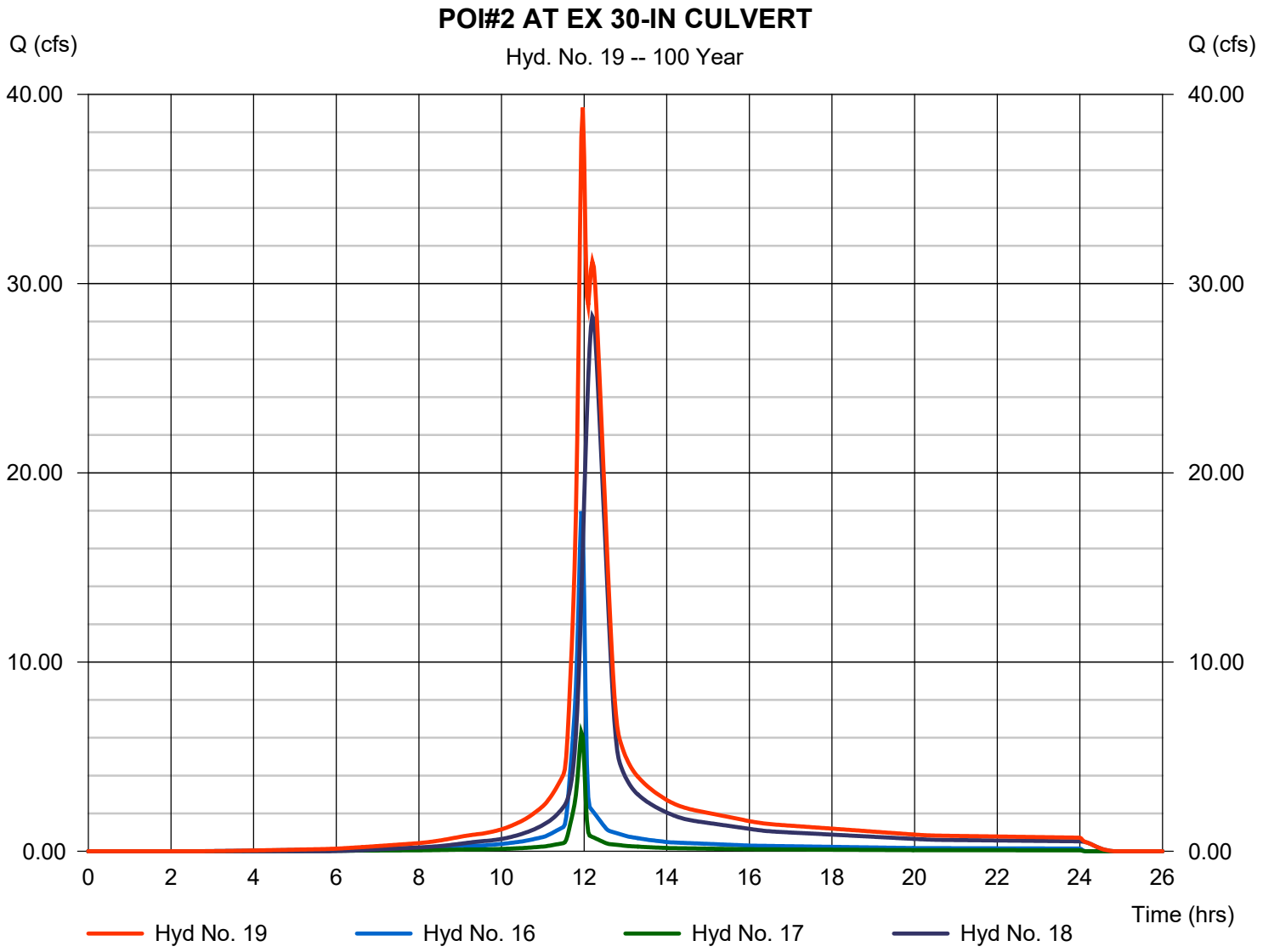


Hydrograph Report

Hyd. No. 19

POI#2 AT EX 30-IN CULVERT

Hydrograph type	=	Combine	Peak discharge	=	39.30 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	175,902 cuft
Inflow hyds.	=	16, 17, 18	Contrib. drain. area	=	7.430 ac



Hydraflow Table of Contents

81450_24-HR ANALYSIS.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Saturday, 07 / 20 / 2019

100 - Year

NOAA Atlas 14, Volume 8, Version 2
Location name: Lees Summit, Missouri, USA*
Latitude: 38.9004°, Longitude: -94.3314°
Elevation: 1024.15 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

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	0.415 (0.324-0.529)	0.484 (0.378-0.618)	0.599 (0.466-0.767)	0.696 (0.539-0.894)	0.832 (0.625-1.10)	0.938 (0.691-1.25)	1.05 (0.748-1.43)	1.16 (0.798-1.62)	1.31 (0.871-1.87)	1.42 (0.926-2.07)
10-min	0.607 (0.474-0.775)	0.709 (0.553-0.905)	0.877 (0.682-1.12)	1.02 (0.789-1.31)	1.22 (0.916-1.61)	1.37 (1.01-1.84)	1.53 (1.10-2.09)	1.70 (1.17-2.37)	1.92 (1.27-2.75)	2.08 (1.36-3.03)
15-min	0.740 (0.578-0.945)	0.864 (0.674-1.10)	1.07 (0.832-1.37)	1.24 (0.962-1.60)	1.49 (1.12-1.96)	1.68 (1.23-2.24)	1.87 (1.34-2.55)	2.07 (1.43-2.89)	2.34 (1.56-3.35)	2.54 (1.65-3.69)
30-min	1.02 (0.800-1.31)	1.20 (0.939-1.54)	1.50 (1.17-1.92)	1.75 (1.35-2.24)	2.09 (1.57-2.76)	2.36 (1.74-3.15)	2.63 (1.88-3.59)	2.91 (2.00-4.07)	3.28 (2.18-4.70)	3.57 (2.32-5.18)
60-min	1.34 (1.05-1.71)	1.57 (1.23-2.01)	1.97 (1.53-2.52)	2.30 (1.78-2.95)	2.76 (2.08-3.66)	3.13 (2.31-4.20)	3.51 (2.51-4.80)	3.90 (2.69-5.46)	4.43 (2.95-6.35)	4.83 (3.14-7.02)
2-hr	1.66 (1.30-2.10)	1.95 (1.53-2.47)	2.43 (1.91-3.09)	2.85 (2.22-3.63)	3.44 (2.61-4.53)	3.91 (2.90-5.20)	4.39 (3.16-5.97)	4.89 (3.40-6.81)	5.57 (3.74-7.94)	6.10 (4.00-8.80)
3-hr	1.87 (1.48-2.36)	2.20 (1.74-2.78)	2.76 (2.17-3.49)	3.24 (2.54-4.11)	3.93 (3.00-5.16)	4.48 (3.35-5.95)	5.06 (3.67-6.86)	5.66 (3.95-7.85)	6.48 (4.38-9.22)	7.13 (4.70-10.3)
6-hr	2.26 (1.80-2.82)	2.66 (2.12-3.34)	3.37 (2.67-4.22)	3.98 (3.14-5.01)	4.88 (3.76-6.37)	5.60 (4.22-7.39)	6.36 (4.65-8.57)	7.16 (5.05-9.89)	8.27 (5.63-11.7)	9.15 (6.07-13.1)
12-hr	2.66 (2.13-3.30)	3.16 (2.54-3.93)	4.04 (3.23-5.03)	4.81 (3.83-6.02)	5.94 (4.62-7.72)	6.86 (5.21-9.00)	7.83 (5.77-10.5)	8.86 (6.30-12.2)	10.3 (7.06-14.5)	11.4 (7.64-16.2)
24-hr	3.11 (2.51-3.82)	3.71 (2.99-4.57)	4.74 (3.82-5.86)	5.66 (4.54-7.02)	7.00 (5.48-9.03)	8.10 (6.20-10.5)	9.25 (6.88-12.3)	10.5 (7.51-14.3)	12.2 (8.44-17.0)	13.5 (9.14-19.1)
2-day	3.66 (2.98-4.47)	4.31 (3.50-5.26)	5.43 (4.41-6.66)	6.43 (5.19-7.91)	7.90 (6.24-10.1)	9.10 (7.03-11.8)	10.4 (7.77-13.7)	11.7 (8.47-15.9)	13.6 (9.50-18.9)	15.1 (10.3-21.2)
3-day	4.06 (3.33-4.94)	4.71 (3.85-5.73)	5.84 (4.76-7.12)	6.85 (5.55-8.38)	8.33 (6.61-10.6)	9.55 (7.41-12.3)	10.8 (8.16-14.3)	12.2 (8.87-16.5)	14.1 (9.92-19.5)	15.7 (10.7-21.9)
4-day	4.40 (3.61-5.33)	5.05 (4.14-6.12)	6.17 (5.05-7.50)	7.18 (5.84-8.76)	8.65 (6.89-11.0)	9.87 (7.68-12.7)	11.1 (8.42-14.6)	12.5 (9.12-16.8)	14.4 (10.2-19.9)	16.0 (10.9-22.2)
7-day	5.21 (4.30-6.27)	5.89 (4.86-7.10)	7.07 (5.82-8.53)	8.09 (6.62-9.80)	9.56 (7.64-12.0)	10.8 (8.41-13.7)	12.0 (9.11-15.6)	13.3 (9.74-17.7)	15.1 (10.7-20.6)	16.5 (11.4-22.9)
10-day	5.90 (4.89-7.07)	6.66 (5.52-7.99)	7.93 (6.55-9.53)	9.00 (7.40-10.9)	10.5 (8.43-13.1)	11.7 (9.20-14.8)	13.0 (9.87-16.7)	14.2 (10.5-18.9)	16.0 (11.3-21.7)	17.3 (12.0-23.9)
20-day	7.87 (6.58-9.35)	8.89 (7.43-10.6)	10.5 (8.78-12.6)	11.9 (9.85-14.2)	13.7 (11.0-16.8)	15.1 (11.9-18.7)	16.4 (12.5-20.9)	17.7 (13.1-23.2)	19.4 (13.9-26.1)	20.7 (14.5-28.3)
30-day	9.51 (7.99-11.3)	10.8 (9.03-12.7)	12.7 (10.7-15.1)	14.3 (11.9-17.1)	16.4 (13.2-19.9)	17.9 (14.1-22.1)	19.3 (14.9-24.5)	20.8 (15.4-27.0)	22.5 (16.1-30.1)	23.7 (16.7-32.4)
45-day	11.6 (9.80-13.7)	13.1 (11.1-15.5)	15.5 (13.0-18.3)	17.3 (14.5-20.6)	19.7 (15.9-23.8)	21.4 (17.0-26.3)	23.0 (17.7-28.9)	24.5 (18.2-31.6)	26.3 (18.9-34.9)	27.5 (19.4-37.3)
60-day	13.4 (11.4-15.7)	15.1 (12.8-17.8)	17.8 (15.0-21.0)	19.9 (16.7-23.5)	22.5 (18.2-27.0)	24.3 (19.3-29.7)	26.0 (20.1-32.5)	27.5 (20.5-35.4)	29.3 (21.1-38.7)	30.5 (21.6-41.3)

[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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Hydrologic Soil Group—Jackson County, Missouri
(Drainage Area)

Map Scale: 1:3,370 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 45 90 180 270

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 19, Sep 13, 2018

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

Date(s) aerial images were photographed: Jun 11, 2017—Sep 22, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	21.1	79.1%
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	4.9	18.4%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	0.7	2.5%
Totals for Area of Interest			**26.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

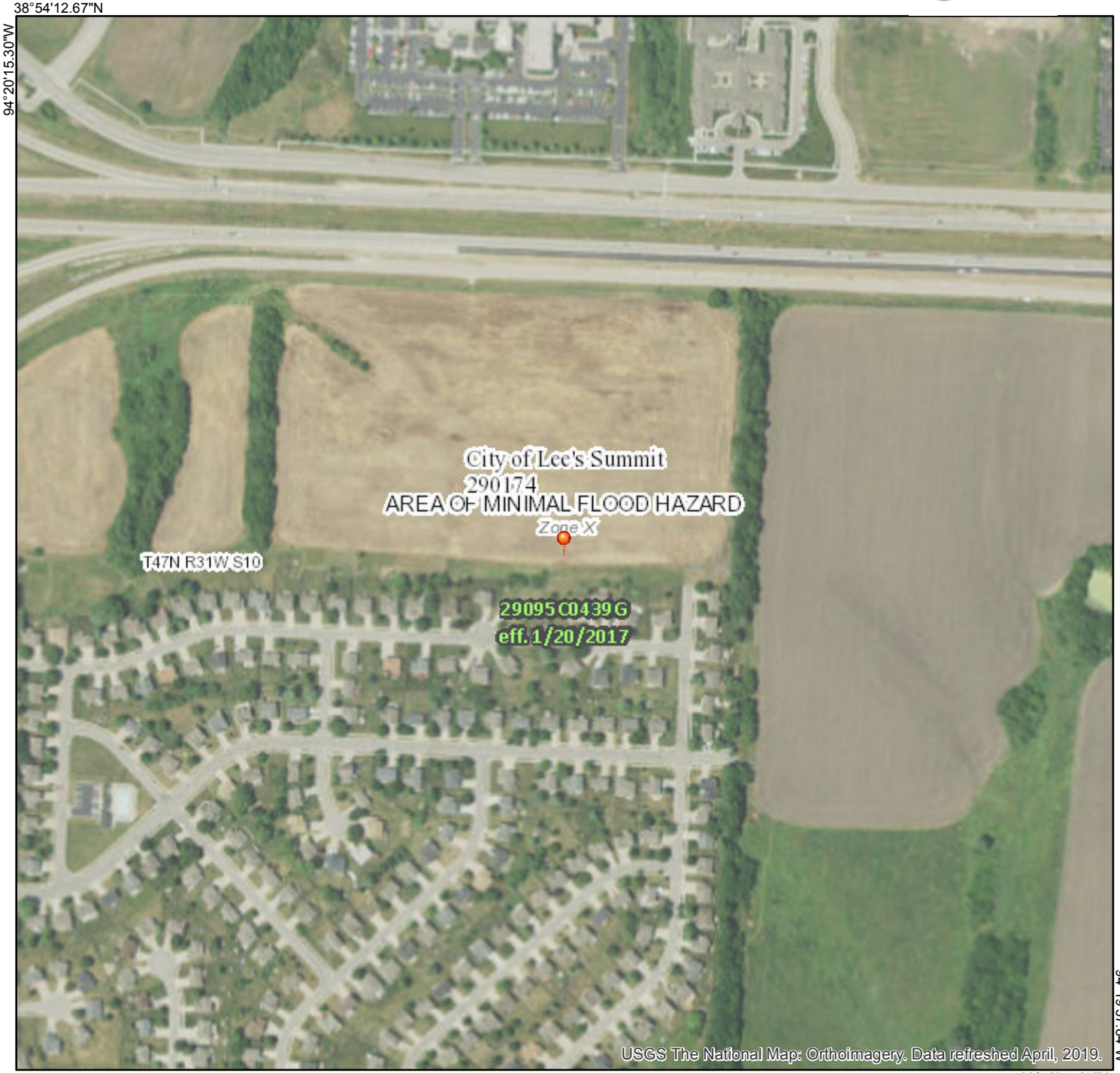
FEMA Firmette

National Flood Hazard Layer FIRMette

FEMA

38°54'12.67"N

94°20'15.30"W



94°19'37.84"W

38°53'44.67"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/3/2019 at 9:52:30 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX C

APWA\MARC BMP Level of Service & Water Quality Calculations

WORKSHEET 1: REQUIRED LEVEL OF SERVICE - UNDEVELOPED SITE

Project: By: Date:
Location: Checked: Date:

1. Runoff Curve Number

A. Predevelopment CN

Cover Description	Soil HSG	CN from Table 1	Area (ac.)	Product of CN x Area
Pasture (GOOD)	C	74	9.42	
		Totals:		

Area-Weighted CN = total product/total area = 74 (Round to integer)

B. Postdevelopment CN

Cover Description	Soil HSG[1]	CN from Table 1	Area (ac.)	Product of CN x Area
PAVEMENT/ROOFS	NA	98	5.16	505.68
OPEN SPACE (TURF,GOOD)	D	80	4.26	340.8
		Totals:	9.42	846.48

[1] Postdevelopment CN is one HSG higher for all cover types except preserved vegetation, absent documentation showing how postdevelopment soil structure will be preserved.

Area-Weighted CN = total product/total area = 90 (Round to integer)

C. Level of Service (LS) Calculation

Predevelopment CN: 74
Postdevelopment CN: 90
Difference: 16
LS Required (see scale at right): 7

Change in CN	LS
17+	8
7 to 16	7
4 to 6	6
1 to 3	5
0	4
-7 to -1	3
-8 to -17	2
-18 to -21	1
-22 -	0

WORKSHEET 2: DEVELOP MITIGATION PACKAGE(S) THAT MEET THE REQUIRED LS

Project: By: Date:
Location: Checked: Date:
Sheet __ of __

1. **Required LS (New Development, Wksht 1) or Total VR (Redevelopment, Wksht 1A):** 7

   Note: Various BMPs may alter CN of proposed development, and LS; recalculate both if applicable.

2. **Proposed BMP Option Package No. ___**

Cover/BMP Description	Treatment Area	VR from Table 4.4 or 4.6[1]	Product of VR x Area
Extended Dry Detention Area	3.33	4.0	16.32
Bioretention 1 DA10	2.94	8.5	24.99
Bioretention 2 DA 20	2.4	8.5	20.4
Native Vegetation	0.75	9.5	7.12
Total[2]:	9.42	**Total:**	68.83
		***Weighted VR:**	7.3

= total product/total a

[1] VR calculated for final BMP only in Treatment Train.
[2] Total treatment area cannot exceed 100 percent of the actual site area.
* Blank In Redevelopment

Meets required LS (Yes/No)? YES (If No, or if additional options are being tested, proceed below.)

3. **Proposed BMP Option Package No. ___**

Cover/BMP Description	Treatment Area	VR from Table 4.4 or 4.6[1]	Product of VR x Area
Total[2]:		**Total:**	
		***Weighted VR:**	

= total product/total a

[1] VR calculated for final BMP only in Treatment Train.
[2] Total treatment area cannot exceed 100 percent of the actual site area.
* Blank In Redevelopment

Meets required LS (Yes/No)? (If No, or if additional options are being tested, move to next sheet.)

Bioretention 1 - Water Quality Volume Calculation Worksheet
Short Cut Method (Claytor and Schueler, 1996)
Date: 01/10/2019

Project Name: Lee's Summit Senior Living Facility
Description: DEV 10 Water Quality Volume
Drainage Areas to Pond 1

$$WQV\ (ft^3) = (P/12)(R_v)(A*43{,}560)$$

Where

P = rainfall depth = 1 inch
R_v = volumetric runoff coefficient = 0.05 + 0.009I
I = percent impervious cover (in percent, e.g. 80% = 80)
A = total site area in acres

P=	1.37 inch
A=	2.94 acres
Impervious Area=	1.97 acres
I=	67 %
Rv=	0.653

WQV=	**9547 cubic feet**
	0.219 ac-ft

Bioretention 2 - Water Quality Volume Calculation Worksheet
Short Cut Method (Claytor and Schueler, 1996)
Date:

Project Name:
Description: DEV 20 Water Quality Volume

$$WQV\ (ft^3) = (P/12)(R_v)(A*43{,}560)$$

Where

P = rainfall depth = 1 inch
R_v = volumetric runoff coefficient = 0.05 + 0.009I
I = percent impervious cover (in percent, e.g. 80% = 80)
A = total site area in acres

P=	1.37 inch
A=	2.4 acres
Impervious Area=	1.15 acres
I=	48 %
Rv=	0.482

WQV=	**5753 cubic feet**
	0.132 ac-ft

Pond 4 - Water Quality Volume Calculation Worksheet
Short Cut Method (Claytor and Schueler, 1996)
Date:

Project Name:
Description: Dry Detention Water Quality Volume

$$WQV\ (ft^3) = (P/12)(R_v)(A*43{,}560)$$

Where

P = rainfall depth = 1 inch
R_v = volumetric runoff coefficient = 0.05 + 0.009I
I = percent impervious cover (in percent, e.g. 80% = 80)
A = total site area in acres

P=	1.37 inch
A=	9.42 acres
Impervious Area=	5.16 acres
I=	55 %
Rv=	0.545

WQV=	**25531 cubic feet**
	0.586 ac-ft

Designer Ryan Jeppson
Checked By: Ryan Jeppson
Company: Olsson
Date: 7/19/2019
Project: Lee's Summit Senior Living Community
Location: Bioretention 1

WQv= 9547

III.Planting Soil Bed and Ponding Area

Step 1)	Planting bed soil depth, df(ft) (Df should be between 2.5 feet and 4 feet)	df(ft)=	2.5
Step 2)	Coefficient of permeability for planting soil bed, k (ft/day) (k should be at least 1 ft/day)	k(ft/day)=	1
Step 3)	Maximum ponding depth, hmax(ft) (hmax should be between 0.25 ft and 1.0 ft)	hmax (ft)=	1
Step 4)	Avergae height of water above bioretention bed, havg(ft) havg= hmax/2	havg(ft)=	0.5
Step 5)	Time required for WQv to filter through planting soil bed, tf(days) (tf of 1 to 3 days recommended)	tf(days)=	2
Step 6)	Required filter bed surface area, A_f (sf) Af=(WQv*df)/[k*tf*(havg+df)]	A_f(sf)=	3978
Step 7)	Approximate filter bed length, Lf (ft), assuming a length to width ratio of 2:1 (Lf, should be at least 40-ft)	Lf(ft)=	265
Step 8)	Approximate filter bed width, Wf (ft), assuming a length to with ratio of 2:1 (Wf should be at least 15 feet, and optimally half of Lf)	Wf(ft)	15
Step 9)	Required Ponding Area, Ap (sf) Ap= WQV/Hmax	Ap(sf)=	9547

Designer Ryan Jeppson
Checked By: Ryan Jeppson
Company: Olsson
Date: 7/19/2019
Project: Lee's Summit Senior Living Community
Location: Bioretention 2

WQv= 5753

III.Planting Soil Bed and Ponding Area

Step 1)	Planting bed soil depth, df(ft) (Df should be between 2.5 feet and 4 feet)	df(ft)=	2.5
Step 2)	Coefficient of permeability for planting soil bed, k (ft/day) (k should be at least 1 ft/day)	k(ft/day)=	1
Step 3)	Maximum ponding depth, hmax(ft) (hmax should be between 0.25 ft and 1.0 ft)	hmax (ft)=	1
Step 4)	Avergae height of water above bioretention bed, havg(ft) havg= hmax/2	havg(ft)=	0.5
Step 5)	Time required for WQv to filter through planting soil bed, tf(days) (tf of 1 to 3 days recommended)	tf(days)=	2
Step 6)	Required filter bed surface area, A_f (sf) Af=(WQv*df)/[k*tf*(havg+df)]	A_f(sf)=	2397
Step 7)	Approximate filter bed length, Lf (ft), assuming a length to width ratio of 2:1 (Lf, should be at least 40-ft)	Lf(ft)=	160
Step 8)	Approximate filter bed width, Wf (ft), assuming a length to with ratio of 2:1 (Wf should be at least 15 feet, and optimally half of Lf)	Wf(ft)	15
Step 9)	Required Ponding Area, Ap (sf) Ap= WQV/Hmax	Ap(sf)=	5753

OUTLET STRUCTURE DISCHARGE COMPUTATIONS
FOR EXTENDED DETENTION BASINS

****ENTER THE FOLLOWING INFORMATION*****

PROJECT: THE PRINCETON - EXTENDED DRY DETENTION BASIN
Date Printed: 20-Jul-19

PERFORATION DIA: 2 INCHES
HOLES PER ROW: 1
ORIFICE AREA: 3.1400 SQ. IN.
(TOTAL FOR ROW)
ROW SPACING: 6 INCHES
NUMBER OF ROWS: 2

FLOWLINE ELEVATION
AT BOTTOM OF BASIN: 1013.00

MAXIMUM PONDING
ELEV. FOR WQCV
EXTENDED DETENTION: 1016.25 25531

****

IN COLUMN A, ENTER WATER ELEVATIONS AT 3" INCREMENTS BEGINNING WITH THE ELEVATION
ENTERED ABOVE FOR MAXIMUM PONDING ELEVATION FOR EXTENDED DETENTION
AND PROCEEDING DOWNWARD TO THE FLOWLINE ELEVATION AT THE BOTTOM OF THE BASIN

IN COLUMN B ENTER THE AREA CORRESPONDING TO THE ELEVATION IN COLUMN A

ENTER THE ELEVATION OF EACH ROW OF HOLES BELOW THE ROW NUMBER
ENTER ELEVATION 9999.0 FOR ROWS NOT USED (ROW 1 to be the bottom row)

RESULT IS DISPLAYED AT THE BOTTOM OF COLUMN K

WATER ELEVATION	AVERAGE AREA (SF)	AVERAGE VOL (CF)	OUTFLOW RATE (CFS)											COMBINED OUTFLOW	DRAIN TIME (HOURS)	CUMULATIVE VOLUME CF	CUMULATIVE DRAIN TIME HR
			ROW 1 1013.00	ROW 2 9999.00	ROW 3 9999.00	ROW 4 9999.00	ROW 5 9999.00	ROW 6 9999.00	ROW 7 9999.00	ROW 8 9999.00	ROW 9 9999.00	ROW 10 9999.00	ROW 11 9999.00				
1016.25	15780	3857	0.189	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.189	5.661	27489.5	51.1
1016.00	15079	3658	0.182	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.182	5.587	23632.1	45.5
1015.75	14184	3434	0.174	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.174	5.479	19974.3	39.9
1015.50	13289	3210	0.166	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.166	5.372	16540.1	34.4
1015.25	12394	2987	0.157	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.157	5.268	13329.8	29.0
1015.00	11499	2659	0.148	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.148	4.974	10343.1	23.8
1014.75	9773	2227	0.139	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.139	4.455	7684.2	18.8
1014.50	8047	1796	0.129	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.129	3.879	5456.8	14.3
1014.25	6320	1364	0.117	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.117	3.228	3660.9	10.4
1014.00	4594	1005	0.105	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.105	2.658	2296.6	7.2
1013.75	3445	718	0.091	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.091	2.192	1291.8	4.6
1013.50	2297	431	0.074	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.074	1.611	574.2	2.4
1013.25	1149	144	0.052	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.760	143.6	0.8
1013.00	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
		27489											TOTAL DRAIN TIME		51.1	hours	
													MAX. OUTFLOW RATE =		0.19	CFS	

WQv PROVIDED

DRAIN TIME GRATER THAN 40-HRS

LEE'S SUMMIT SENIOR LIVING COMMUNITY

Lee's Summit, MO - 2019

July 2019

Olsson Project No. 018-1450