Micro Storm Water Study
for:

Lot 1 – Lee's Summit Town Centre
Lee's Summit, MO 64064

Prepared for:
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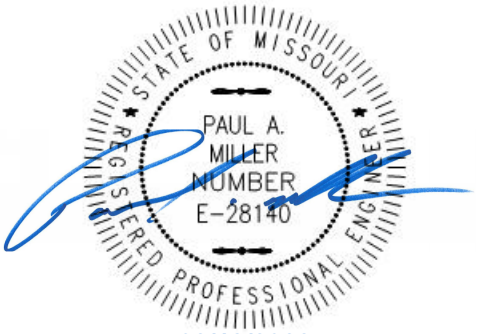

02/18/2022
February 18th, 2022

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General Information

Lot 1 of the Lee's Summit Town Centre development is located at the northeast corner of NE Town Centre Blvd. and NE Town Centre Drive in Lee's Summit, MO. The site contains 11.61 acres of undeveloped grass pasture.

The site is located in the Northwest 1/4, Sec. 29-Twp. 48N. - Range. 31W. The development will contain a large self-storage facility and a batting cage facility. Future developments to the site will include an expansion of the self-storage facility and an additional pad site. Refer to Appendix A for the site plan.

There are two different soil types represented on the project site, 10136-Sibley-Urban Land Complex and 30080-Greenton Silty Clay Loam, with 10136-Sibley-Urban Land Complex occupying the largest area at 9.50 acres. The hydrological soil group for 10136 is rated as C and the area is classified as Grass/Prairie land with 2 to 5 percent slopes. 30080- Greenton Silty Clay Loam represents 2.11 acres in the southwest corner of the site. The hydrological soil group for 30080 is rated as C/D and the area is classified as Grass/Prairie land with 5 to 9 percent slopes.

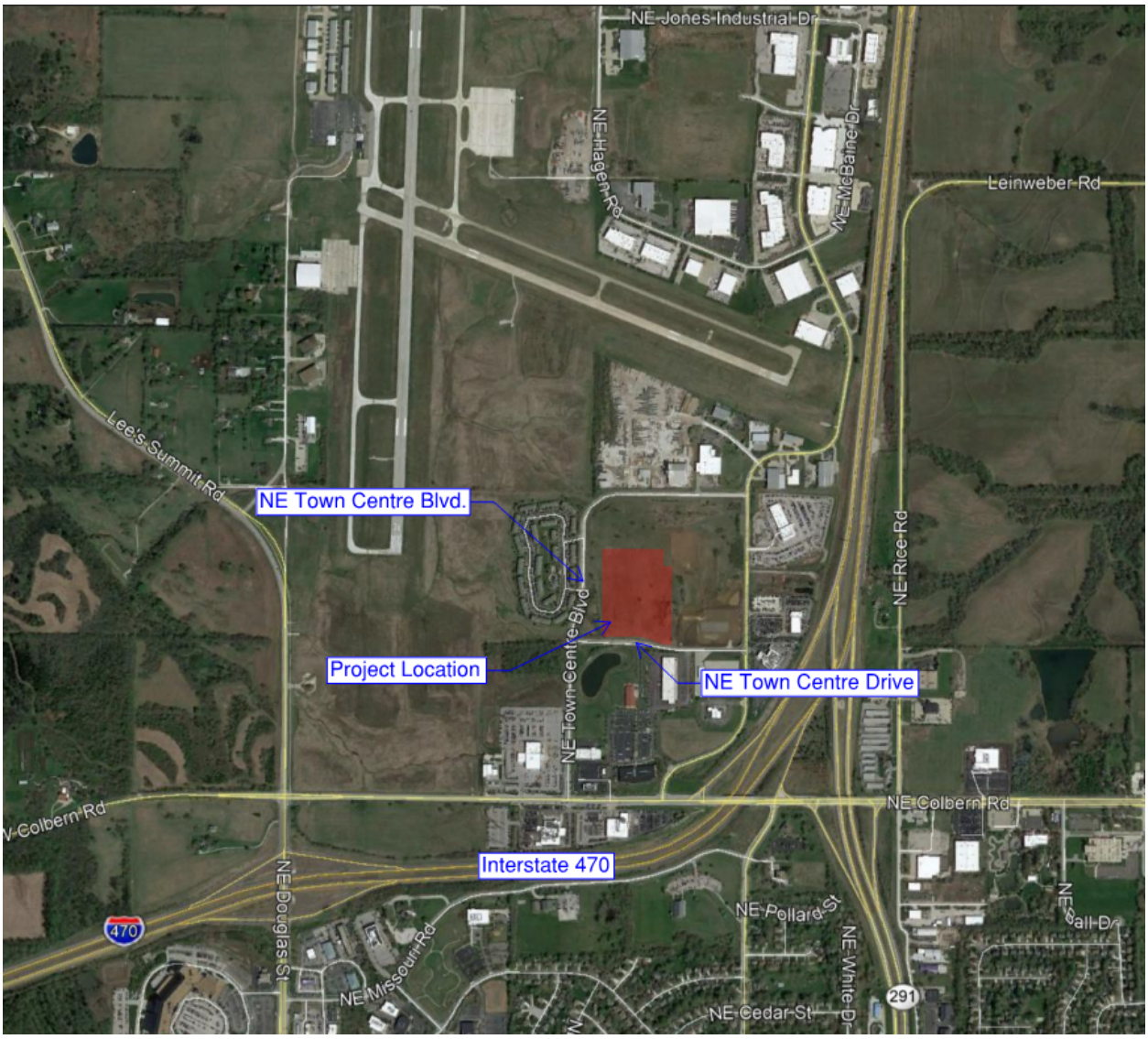

Figure 1. - Location Map (no scale)

Methodology

KCAPWA IDF curves were used to determine the rainfall intensity for the 2, 10, and 100-year storm events. Existing and proposed conditions were modeled and analyzed using Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2021 (Hydraflow). Hydrograph routing within Hydraflow used the Rational Method with depths of 3.71", 5.2", and 7.8" for the 50% (2-Yr), 10% (10-Yr), and 1% (100-Yr) storm events, respectively. This method is also used in SCS TR-55. Convolution is known as linear superpositioning, and means that each ordinate of the rainfall hyetograph is multiplied by each ordinate of the unit hydrograph, thus creating a series of hydrographs. These hydrographs are then summed to form the final runoff hydrograph. Rainfall frequencies were determined by using TECHNICAL PAPER NO.40, RAINFALL FREQUENCY ATLAS OF THE UNITED STATES, by the U.S. Department of Commerce, Weather Bureau. The October 2012 American Public Works Association BMP Manual was used for this storm study.

Existing Condition Analysis

The project site is located on the southwest corner of the Lee's Summit Town Centre development at the northeast corner of NE Town Centre Blvd. and NE Town Centre Dr. in Lee's Summit, MO. Lee's Summit Town Centre is located northwest of the Highway 291 and Interstate 470 interchange. The existing undeveloped site is 11.61 acres, with the entirety of the property being pervious.

Runoff from the site currently generally flows from the north to south and into a pond located on the east side of the property. A portion of the property in the southwest corner drains from east to west and down the sloped, moderately-wooded area into curb inlets located on NE Town Centre Dr. The site was analyzed as a greenfield site with a rational "c" value of 0.30.

Soils encountered on the site are 10136-Sibley-Urban land complex, 2 to 5 percent slopes, and 30080-Greenton Silty Clay Loam, 5 to 9 percent slopes. The Hydrologic Soil Groups of the encountered soils are C and C/D respectively (see Appendix A, Hydrologic Soil Group).

The site lies entirely outside of the 100-year floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) Map Panel No. 0430G, Map Number 29095C0430G Dated January 20, 2017, Note: This area is shown as being completely within zone X. The Flood Insurance Rate Map is included in Appendix A.

There are 3.35 acres of pervious area to the north of the property that currently drains onto the proposed site. The resulting drainage area for the site is approximately 14.96 acres of pervious area. The Existing Drainage Area Map, provided in Appendix A, depicts the existing drainage patterns for the site. Area A shown on this map currently sheet flows off the property to the west and eventually discharges into curb inlets near the intersection of NE Town Centre Dr. and NE Town Centre Blvd. Area B sheet flows across the site and discharges to the property to the east into a drainage swell that eventually discharges runoff into the existing detention basin on the neighboring property adjacent to NE Independence Ave.

The existing detention basin on the newly developed property to the east was sized to handle and detain the runoff from the site in its existing pre-developed conditions. The proposed site currently drains to a swale located just north of the neighboring property to the east, and into the existing detention basin to the east.

The existing site results in the following conditions:

Table 1 – Existing Site Runoff Hydraflow Results

Storm Event	Area A (cfs)	Area B (cfs)	Total Site Runoff (cfs)
2-Yr	1.79	14.87	16.66
10-Yr	2.50	20.76	23.26
100-Yr	3.77	31.27	35.04

Proposed Condition Analysis

The proposed development for the entire property will be constructed in multiple phases. Phase I will include the construction of 11 out of 21 proposed Mega Storage buildings and a batting cage facility and associated parking in the southeast corner of the property. Future phases of construction include the remaining 10 Mega Storage buildings and a building pad site directly west of the proposed detention basin. The construction phasing can be found on the Site Plan located in Appendix A. Phase I will increase impervious area on-site by approximately 5.18 acres. The remaining 6.43 pervious acres will be covered in grass or native vegetation that is either preserved or reestablished after land disturbance activities have been completed. The post development rational "c" values for the project site have been developed based on soil types and proposed conditions. The rational "c" values for the proposed development can be found on the Proposed Drainage Area Map located in Appendix A.

In order to mitigate the increase in peak runoff rates from the site due to the increase in impervious area created by the proposed development, a private storm network is proposed to direct runoff to the proposed on-site detention basin located on the east side of the property. The Proposed Drainage Area Map, provided in Appendix A, depicts the proposed drainage patterns for the site. Areas 1 through 4 shown on the Proposed Drainage Area Map will flow into the private storm network structures and discharge into the proposed on-site detention basin. Area 1-1 will sheet flow across the future Mega Storage development into a proposed drainage swale that discharges into the proposed detention basin. Area 5 will follow the existing drainage pattern of the site, discharging onto the neighboring property to the east. Area 6 will also follow the existing drainage pattern of the site, flowing to the southwest corner of the site and eventually discharging into the existing public storm system near the intersection of NE Town Centre Blvd. and NE Town Centre Dr.

The detention basin has been designed to effectively capture and discharge the runoff from the contributing drainage area for the entire developed site after all phases of construction have been completed, per the requirements set by APWA Section 5601.5.A.4.a. Discharge from the detention basin will be controlled by a proposed outlet structure that will maintain release rates less than pre-developed conditions, while also maintaining water quality requirements specified in APWA Section 5608.4.C.1.b. Post-development peak discharge rates shall not exceed the requirements set by APWA Section 5608.4.C.1.a that are shown below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
  - Site specific allowable release rate: 7.48 cfs
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
  - Site specific allowable release rate: 29.92 cfs
- 1% storm peak rate less than or equal to 3.0 cfs per site acre
  - Site specific allowable release rate: 44.88 cfs

Discharge from the detention basin will be controlled by an outlet structure that discharges into an outlet pipe spanning from the detention basin's outlet structure to the existing drainage swale just north of the neighboring property to the east. For water quality considerations, the outlet structure will have a perforated riser placed at the bottom elevation of the pond to control the discharge from the detention basin to meet the minimum forty-hour extended detention requirement for comprehensive control. A weir will be placed just above the water surface elevation of the 90% mean annual event and discharge into the outlet pipe. The outlet structure was designed to handle the runoff from the entire future-developed site. The runoff from the outlet pipe will continue to the east in the existing drainage swale and eventually discharge into the existing detention basin on the neighboring property. This detention basin has been sized to handle the runoff for the peak storm events from both the proposed site in its existing, pre-developed conditions and the newly developed-neighboring property.

A spillway for the proposed on-site detention basin was designed using the 100-year water surface elevation of the entire future-developed site at elevation 1003.04. Simulating clogged outlet conditions and zero available storage in the detention basin, the spillway crest elevation was set 1.06' above the 100-year water surface elevation at 1004.10. One foot of freeboard is available above the 100-year water surface elevation in the spillway to the top of the berm at 1005.60. The spillway will allow overflow to drain over the proposed private road and into the drainage swale north of the neighboring property.

Table 2 below shows the general conditions of the proposed stormwater detention basin.

Table 2 – Proposed Detention Basin Hydraflow Results		
Storm Event (yr)		Detention Basin 1
2-Yr	Discharge (cfs)	0.13
	Max. Elevation (ft)	1001.62
	Total Storage (cf)	21,066
10-Yr	Discharge (cfs)	3.09
	Max. Elevation (ft)	1002.16
	Total Storage (cf)	28,759
100-Yr	Discharge (cfs)	15.51
	Max. Elevation (ft)	1002.63
	Total Storage (cf)	36,096

Table 3 below shows the total post-developed peak discharge rates from the site with the proposed private storm network and detention basin.

Table 3 – Proposed Site Runoff Hydraflow Results – With Detention				
Storm Event	Discharge from Detention Basin 1 - **Areas 1 - 4** (cfs)	Runoff to Neighboring Property – **Area 5** (cfs)	Runoff to Offsite Public Storm System – **Area 6** (cfs)	Total Post-Development Runoff – With Detention (cfs)
2-Yr	0.13	0.77	3.90	4.71
10-Yr	3.09	1.07	5.44	6.59
100-Yr	15.51	1.62	8.19	19.91

Note: “Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results.”

Table 4 below displays the peak runoff rates for the existing pre-developed and post-developed conditions of the site.

Table 4 – Proposed Total Site Runoff Hydraflow Results			
Storm Event (yr)	Existing Site Runoff (cfs)	Total Post-Development Runoff – With Detention (cfs)	Net Reduction in Post-Developed Site Discharge (cfs)
2-Yr	16.66	4.71	11.95
10-Yr	23.26	6.59	16.67
100-Yr	35.04	19.91	15.13

Note: “Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results.”

Future Condition Analysis

Once site has been completely developed with the additional pad site and the remaining Mega Storage buildings, the total impervious area of the 11.61-acre site will increase to approximately 8.04 acres. The remaining 3.57 pervious acres will be covered in grass or native vegetation that is either preserved or reestablished after land disturbance activities have been completed. The future development rational “c” values for the project site have been developed based on soil types and future conditions. The rational “c” values for the future development can be found on the Future Conditions Drainage Area Map located in Appendix A.

In order to mitigate the increase in peak runoff rates from the site due to the additional impervious area that will be added to the site, additions to the private storm network are proposed to direct runoff to the proposed on-site detention basin. The Future Conditions Drainage Area Map, provided in Appendix A, depicts the drainage patterns for the site after all phases of construction have been completed. Drainage areas 1-5 through 1-8 shown on the Future Conditions Drainage Area Map will increase in size from their proposed conditions. Drainage areas 5-1, 5-2 & 5-3 will flow into new private storm inlets that will be installed with the future Mega Storage development and discharge into the proposed detention basin from the north. The remaining future drainage areas will follow the same drainage patterns as the site’s proposed conditions.

The proposed detention basin and outlet structure have been designed to effectively capture and discharge the runoff from the contributing drainage area for the entire fully developed site after all phases of construction have been completed. No changes or modifications to the detention basin or outlet structure shall be necessary during future phases of construction.

Table 5 below shows the general conditions of the proposed stormwater detention basin for the fully developed site.

Table 5 – Future Detention Basin Hydraflow Results

Storm Event (yr)		Detention Basin 1
2-Yr	Discharge (cfs)	0.44
	Max. Elevation (ft)	1002.03
	Total Storage (cf)	26,769
10-Yr	Discharge (cfs)	13.92
	Max. Elevation (ft)	1002.37
	Total Storage (cf)	32,093
100-Yr	Discharge (cfs)	21.86
	Max. Elevation (ft)	1003.04
	Total Storage (cf)	42,319

Table 6 below shows the total future-developed peak discharge rates from the site with the proposed private storm network and detention basin for the fully developed site.

Table 6 – Future Site Runoff Hydraflow Results – With Detention				
Storm Event	Discharge from Detention Basin 1 - **Areas 1 - 5** (cfs)	Runoff to Offsite Public Storm System – **Area 6** (cfs)	Runoff to Neighboring Property– **Area 7** (cfs)	Total Future-Development Runoff – With Detention (cfs)
2-Yr	0.44	3.94	0.77	4.79
10-Yr	13.92	5.50	1.07	16.24
100-Yr	21.86	8.28	1.62	27.04

Note: "Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results."

Table 7 below displays the peak runoff rates for the existing pre-developed and future-developed conditions of the site.

Table 7 – Future Total Site Runoff Hydraflow Results			
Storm Event (yr)	Existing Site Runoff (cfs)	Total Post-Development Runoff – With Detention (cfs)	Net Reduction in Post-Developed Site Discharge (cfs)
2-Yr	16.66	4.79	11.87
10-Yr	23.26	16.24	7.02
100-Yr	35.04	27.04	8.00

Note: "Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results."

Storm Water Quality

The Mid-America Regional Council, Manual of Best Management Practices for Stormwater Quality, October 2012 requires the site to be designed to capture and treat the additional impervious runoff during the 90% mean annual storm (1.37"/24 hr) created by site improvements. The proposed outlet structure from the detention basin will control discharge from the 90% mean annual event to the minimum forty-hour extended detention requirement for comprehensive control. The outlet structure will have a perforated riser placed at the bottom elevation of the pond to control the discharge from the detention basin to meet this requirement.

Summary

Lot 1 of the Lee's Summit Town Centre development is located at the northeast corner of NE Town Centre Blvd. and NE Town Centre Dr. in Lee's Summit, MO. The existing undeveloped site is 11.61 acres, with the entirety of the property being pervious. Runoff from the site currently generally flows from the north to south and into a pond located on the east side of the property. A portion of the property in the southwest corner drains from east to west and down the sloped areas into curb inlets located near the intersection of NE Town Centre Blvd. and NE Town Centre Dr.

The proposed development for the entire property will be constructed in multiple phases. Phase I will include the construction of 11 out of 21 proposed Mega Storage buildings and a batting cage facility and associated parking in the southeast corner of the property. Future phases of construction include the remaining 10 Mega Storage buildings and a building pad site directly west of the proposed detention basin. The on-site increase in stormwater runoff will be directed to an on-site extended dry detention basin located on the east

side of the property. The proposed detention basin and outlet structure have been designed to effectively capture and discharge the runoff from the contributing drainage area for the entire fully developed site after all phases of construction have been completed.

Conclusions and Recommendations

It has been concluded that an extended dry detention basin will be added to Lot 1 of the Lee's Summit Town Centre Development to reduce site runoff from the increase in impervious area. A new private storm sewer system will be added to convey the runoff into the on-site detention basin and eventually into the detention basin on the neighboring property to the east.

The addition of the on-site detention basin will reduce runoff to the downstream system and will meet the requirements set forth in APWA Section 5601 and 5608 for water quality and peak-runoff. No waivers from the City of Lee's Summit's Design & Construction Manual (DCM) will be requested for the proposed development. No further reduction of storm water runoff or additional BMPs should be required for this project site. This project will cause no adverse impact to the downstream structures/system.

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Appendix A

Local Benchmarks:

BM–1: (Sanitary Sewer Manhole, Center of Lid)
Elevation: 1006.88'
N: 1013449.78
E: 2826933.88

BM–2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Floodplain Note:

The site lies entirely with "Zone X", areas determined to be outside the 0.2% annual chance floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) no. 29095C0430G, Revision Date: January 20, 2017.

Fire Protection Notes:

a. *Plans and specifications, in accordance with NFPA 24, for the private fire line shall be submitted for review and approval prior to installation.*
b. *Underground fire line installation including thrust blocks shall be inspected prior to being backfilled.*
c. *Hydrostatic testing and flushes shall be completed with the fire department as a witness*

Utility Legend

existing
proposed

Linetypes

sanm	*sanitary main*
sans	*sanitary service*
	storm sewer (existing)
	storm sewer (solid wall, proposed)
stm	*storm sewer (solid wall, proposed)*
	storm sewer (perforated, proposed)
wtrm	*water main*
wtrf	*water service (fire)*
wtrd	*water service (domestic)*
wtri	*water service (irrigation)*
gasm	*natural gas main*
gass	*natural gas service schematic*
elpu	*underground primary electric*
elsu	*underground secondary electric*
elpo	*overhead electric*
datu	*underground cable/phone/data*
datsu	*underground cable/phone/data service*
	fence–chainlink
	fence–wood
	fence–barbed wire
	treeline

Symbols

- *sanitary manhole*
- *service cleanout*
- *force main release valve*
- *rectangular structure*
- *circular structure*
- *fire hydrant*
- *water valve*
- *water meter*
- *backflow preventer*
- *natural gas meter*
- *service transformer (pad mount)*
- *primary switch gear*
- *light pole*
- *cable/phone/data junction box*
- *street light*
- *pedestrian street light*
- *electric pole*
- *guy wire*
- *end section*

Property Legend

- *right of way*
- *property lines*
- *easements*
- *setbacks*

Grading Legend

- *existing minor contour*
- *existing major contour*
- *proposed minor contour*
- *proposed major contour*

Construction Legend

- *concrete pavement*
- *concrete entrance per city standards*
- *concrete sidewalk*
- *standard curb & gutter*
- *standard dry curb & gutter*
- *flat curb & gutter*
- *gravel*
- *retaining wall*
- *detention basin*

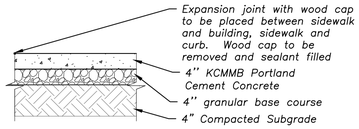
Utility Legend

sanm	*existing sanitary main*
wtrm	*existing water main*
stm	*existing storm sewer*
gasm	*existing gas main*
elpu	*existing underground electric*
elpo	*existing overhead electric*
datu	*existing underground data*
sanm	*proposed sanitary main*
sans	*proposed sanitary service*
wtrm	*proposed water main*
wtrf	*proposed fire line*
wtrd	*proposed water service*
stm	*proposed storm sewer*
gasm	*proposed gas main*
gass	*proposed gas service*
elpu	*proposed underground primary electric*
elsu	*proposed underground secondary electric*
elpo	*proposed overhead electric*
datu	*proposed underground data*

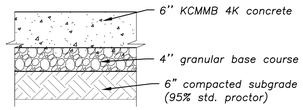
Americans with Disabilities Act (ADA) Notes:

- *The running and cross slopes for all sidewalks, accessible paths, ramps, designated parking stalls, etc., shall be in compliance with latest Federal ADA guidelines, in addition to any accessibility standards adopted by the governing municipality. Prior to installation/construction, if any discrepancies are found within the plans, the Engineer shall be notified.*
- *All ADA parking areas shall have NO slopes greater than 2% in any direction.*

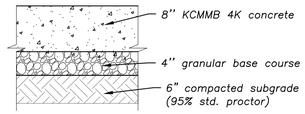
MISSOURI ONE CALL SYSTEM, INC. 1-800-344-7483 STOP-CALL BEFORE YOU DIG!



Concrete Sidewalk



Concrete Pavement Section



Concrete Commercial Entrance Pavement Section

Construction Notes:

1. *Construct type "CG–1" curb & gutter where indicated (see legend).*
2. *Construct type "CG–1 DRY" curb & gutter where indicated (see legend).*
3. *Construct flat curb & gutter where indicated (see legend and detail on C4.2).*
4. *Construct concrete pavement where indicated (see legend).*
5. *Construct temporary concrete drainage flume (see detail on C4.2).*
6. *Construct ADA accessible ramp.*
7. *Install concrete ADA stalls, signage and striping.*
8. *Construct proposed retaining wall (Design by others).*
9. *Construct 4" thick concrete sidewalk where indicated (see legend).*
10. *Install 8" fire protection water line.*
11. *Sanitary service connection location (see C1.3).*
12. *Install sanitary service line.*
13. *Install 6" fire service line.*
14. *Install 2" domestic service line.*
15. *Fire department connection location.*
16. *Install private fire hydrant, to be painted red (see C1.3).*
17. *Existing public fire hydrant.*
18. *Perimeter stone around buildings, 2" below building slab. Refer to landscape plan.*
19. *Proposed detention basin.*
20. *Construct detention basin low flow concrete channel (see detail on C4.2).*
21. *Construct concrete commercial entrance 8" thick, KCMMB–4K mix.*

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Paul A. Miller
License # E–28140

Town Centre Lot 1

a new development for

520 NE Town Centre Drive
Lee's Summit, Missouri

data
02.18.2022
drawn by
JMP
checked by
PAM
revisions

sheet number
C1.2
drawing type
FDP
project number
20231

Map Scale: 1:1,650 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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 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:
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 22, May 29, 2020

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10136	Sibley-Urban land complex, 2 to 5 percent slopes	8.3	81.8%
30080	Greenton silty clay loam, 5 to 9 percent slopes	1.9	18.2%
Totals for Area of Interest		**10.2**	**100.0%**

Jackson County, Missouri

10136—Sibley-Urban land complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql0j
Elevation: 720 to 1,080 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sibley and similar soils: 60 percent
Urban land: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sibley

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

A - 0 to 17 inches: silt loam
Bt - 17 to 65 inches: silty clay loam
C - 65 to 80 inches: silt loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Ecological site: R107BY002MO - Deep Loess Upland Prairie Amorpha canescens/Schizachyrium scoparium-Sporobolus heterolepis Leadplant/Little Bluestem-Prairie Dropseed
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Across-slope shape: Convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Data Source Information

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 22, May 29, 2020

Jackson County, Missouri

30080—Greenton silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2xjd9
Elevation: 640 to 1,120 feet
Mean annual precipitation: 35 to 41 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 209 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Greenton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
2Bt - 28 to 30 inches: silty clay
2C - 30 to 79 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 22, May 29, 2020

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the U.S.D.A Farm Service National Agriculture ImageryProgram (NAIP) dated 2014. Produced at scale of 1:24,000.

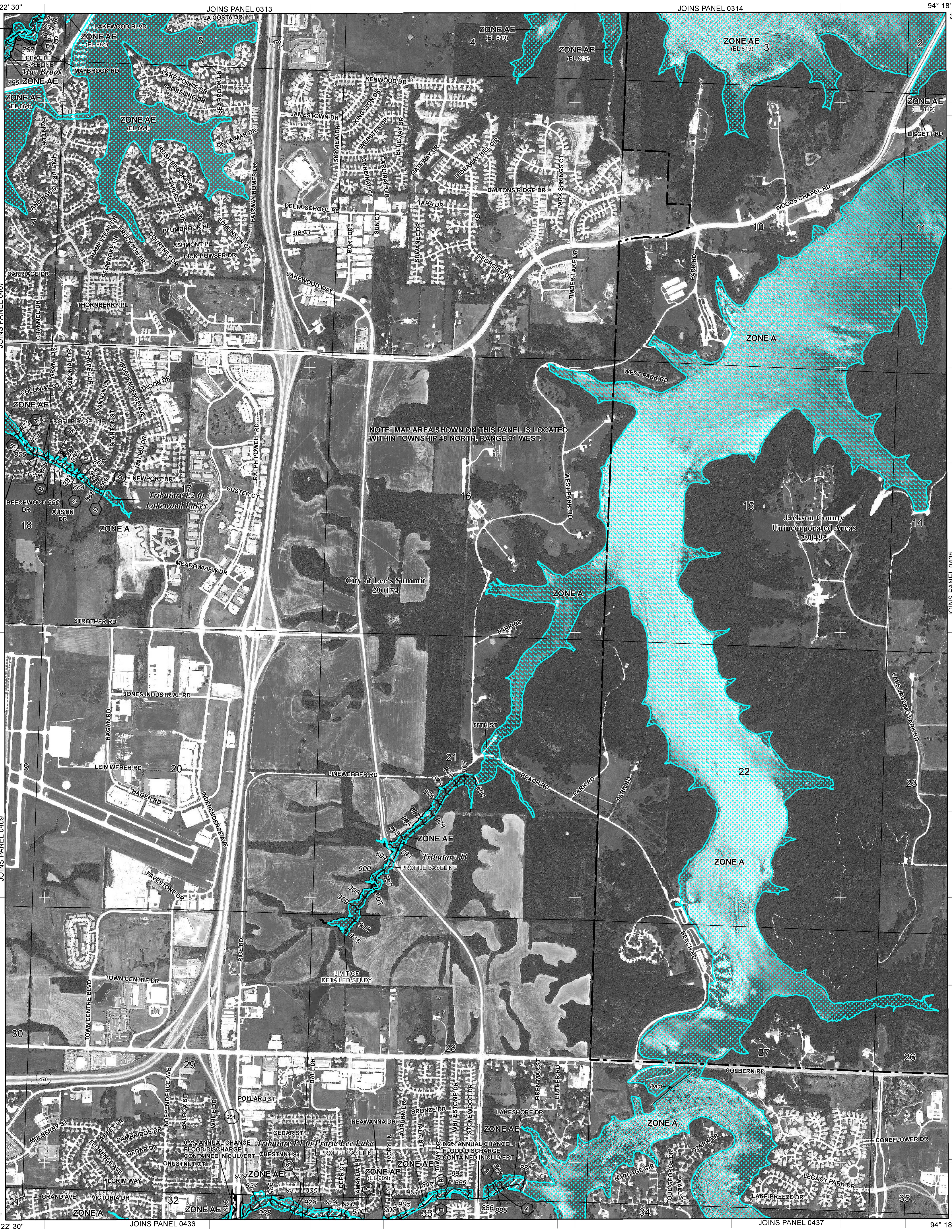
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- ~~ 513 ~~ Base Flood Elevation line and value; elevation in feet*
- (EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- (A)—(A) Cross section line
- (23)- - - -(23) Transect line
- Culvert
- Bridge
- 45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 3100000 FT 5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection
- DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)
- • M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 29, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
January 20, 2017 - to change Special Flood Hazard Areas.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
FEET: 500 0 1000 2000
METERS: 300 0 300 600

NFIP — NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0430G

FIRM
FLOOD INSURANCE RATE MAP
JACKSON COUNTY, MISSOURI
AND INCORPORATED AREAS

PANEL 430 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JACKSON COUNTY	290492	0430	G
LEE'S SUMMIT, CITY OF	290174	0430	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29095C0430G

MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency

Local Benchmarks:

BM–1: (Sanitary Sewer Manhole, Center of Lid)
Elevation: 1006.88'
N: 1013449.78
E: 2826933.88

BM–2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Drainage Legend

drainage area

Property Legend

right of way
property lines
easements
setbacks

Grading Legend

existing minor contour
existing major contour
proposed minor contour
proposed major contour

Utility Legend

existing
proposed

Linetypes

sanm — sanitary main
sans — sanitary service
storm sewer (existing)
storm sewer (solid wall, proposed)
stm — storm sewer (solid wall, proposed)
storm sewer (perforated, proposed)
wtrm — water main
wtrf — water service (fire)
wtrd — water service (domestic)
wtri — water service (irrigation)

gasm — natural gas main
gass — natural gas service schematic

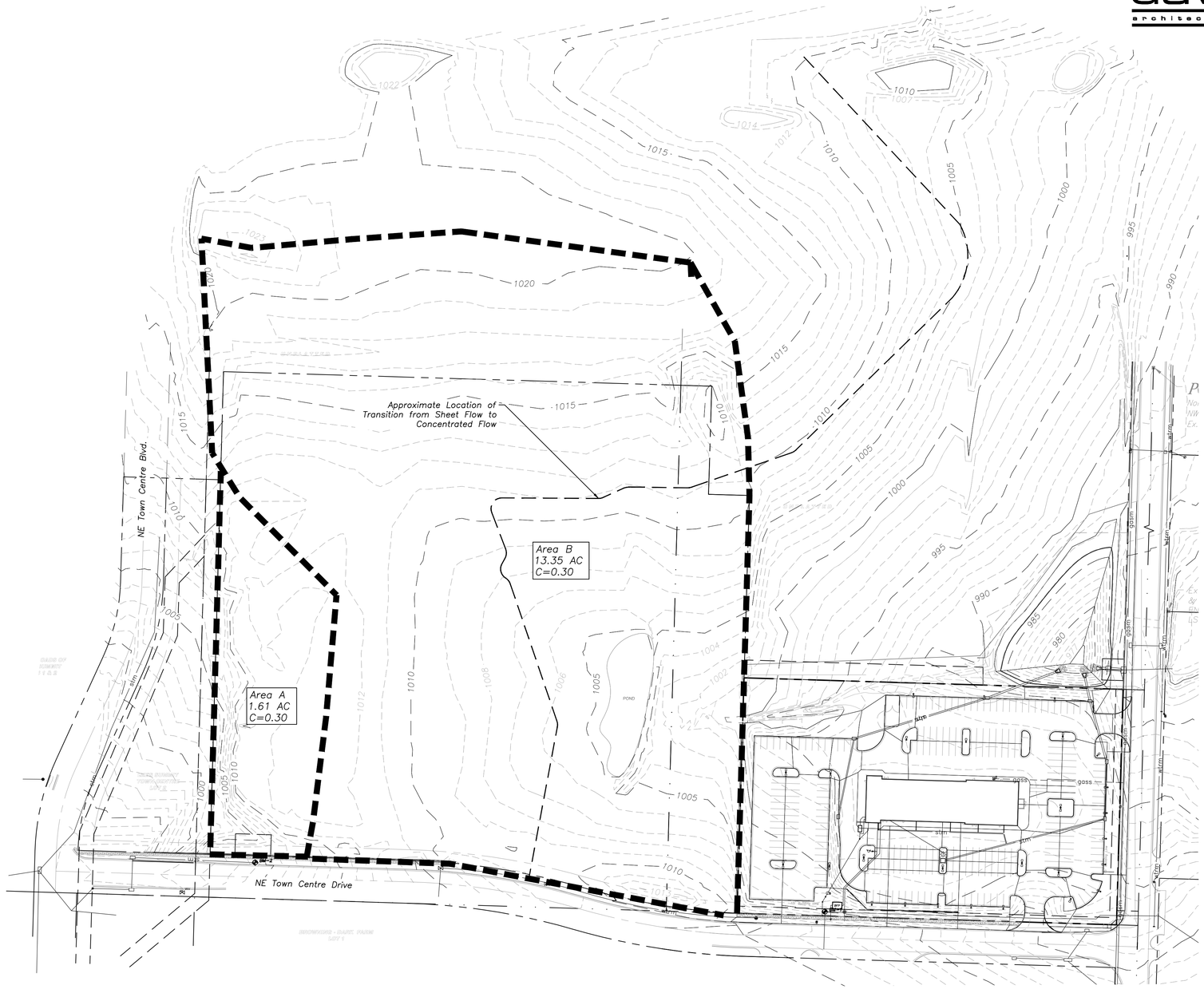
elpu — underground primary electric
elsu — underground secondary electric
elpo — overhead electric

datu — underground cable/phone/data
datsu — underground cable/phone/data service

fence–chainlink
fence–wood
fence–barbed wire
treeline

Symbols

sanitary manhole
co — service cleanout
fmv — force main release valve
rectangular structure
circular structure
fire hydrant
wv — water valve
water meter
BFP — backflow preventer
g — natural gas meter
T — service transformer (pad mount)
S — primary switch gear
light pole
C — cable/phone/data junction box
street light
pedestrian street light
electric pole
guy wire
end section



Pre–Construction Impervious Area Calculations

	Square Feet	Acres
Area of Site	505,732	11.61
Impervious Area	0	0
Pervious Area	505,732	11.61

Q: 10 year 23.26 cfs
100 year 35.04 cfs

1 Existing Drainage Area Map
scale: 1"=80'

davidson
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4301 Indian Creek Parkway
Overland Park, KS 66207
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fax: 913.451.9381
www.davidsonae.com

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License # 2010029713

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REGISTERED PROFESSIONAL ENGINEER

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License # E-28140

Town Centre Lot 1

a new development for

520 NE Town Centre Drive
Lee's Summit, Missouri

date
02.18.2022
drawn by
JMP
checked by
PAM
revisions

MISSOURI ONE CALL SYSTEM, INC. 1-800-344-7483 STOP-CALL BEFORE YOU DIG!

sheet number
C3.1
drawing type
FDP
project number
20231

Local Benchmarks:

BM–1: (Sanitary Sewer Manhole, Center of Lid)
Elevation: 1006.88'
N: 1013449.78
E: 2826933.88

BM–2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Drainage Legend

drainage area

Property Legend

right of way
property lines
easements
setbacks

Grading Legend

existing minor contour
existing major contour
proposed minor contour
proposed major contour

Utility Legend

existing
proposed

Linetypes

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	fence–wood
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Symbols

- sanitary manhole
- service cleanout
- force main release valve
- rectangular structure
- circular structure
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- water valve
- water meter
- BFP — backflow preventer
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- T — service transformer (pad mount)
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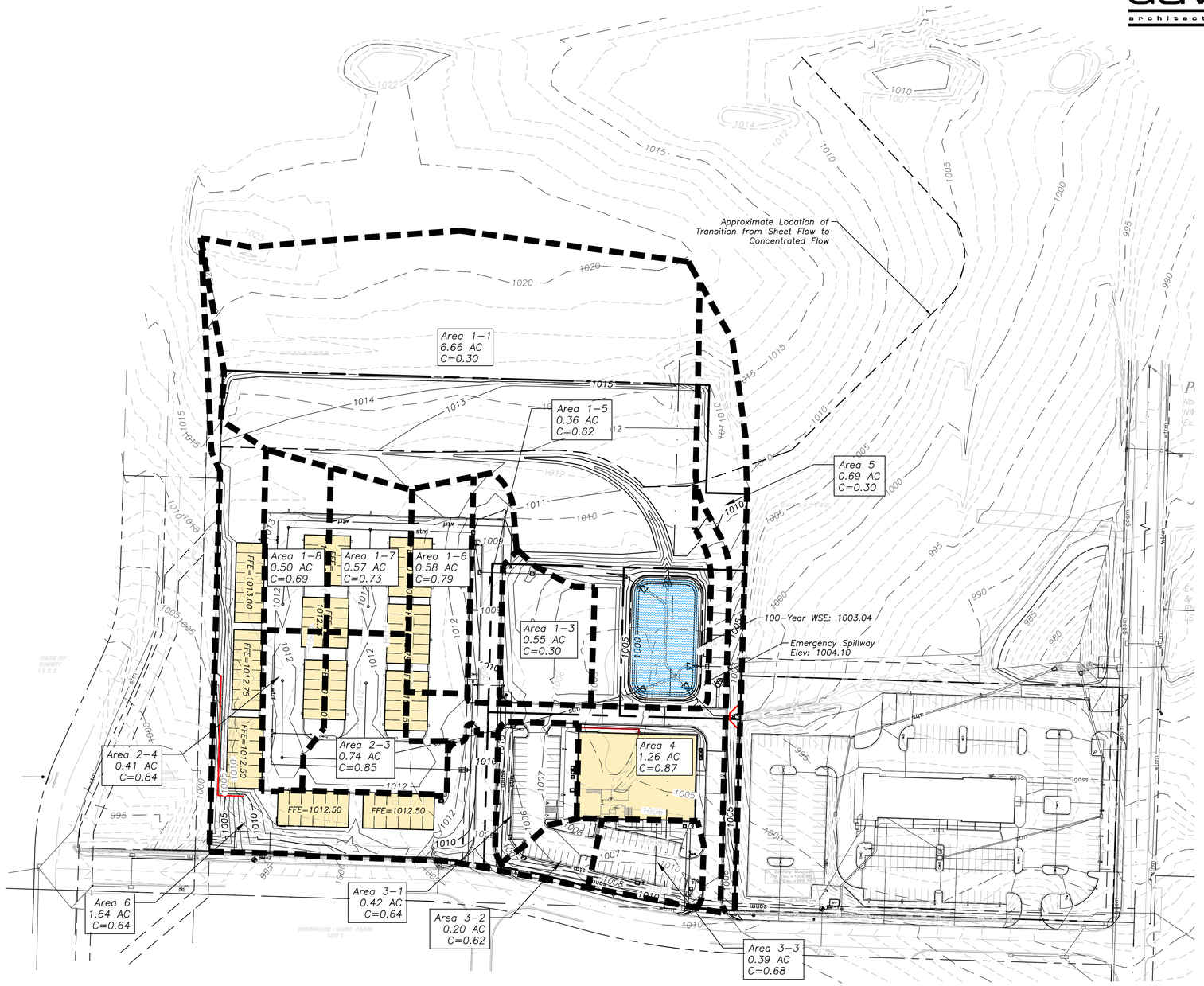
- end section



Post–Construction Impervious Area Calculations

		Square Feet	Acres
Area of Site		505,723	11.61
Impervious Area		255,706	5.18
Pervious Area		280,017	6.43
Q: 10 year	6.59 cfs		
100 year	19.91 cfs		

north

1 Proposed Drainage Area Map
scale: 1"=80'
0 40 80 160

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a new development for

520 NE Town Centre Drive
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date
02.18.2022
drawn by
JMP
checked by
PAM
revisions

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C3.2
drawing type
FDP
project number
20231

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E: 2826136.03

Drainage Legend

drainage area

Property Legend

right of way
property lines
easements
setbacks

Grading Legend

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Utility Legend

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	fence–wood
	fence–barbed wire
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Symbols

- sanitary manhole
- co — service cleanout
- fmv — force main release valve
- rectangular structure
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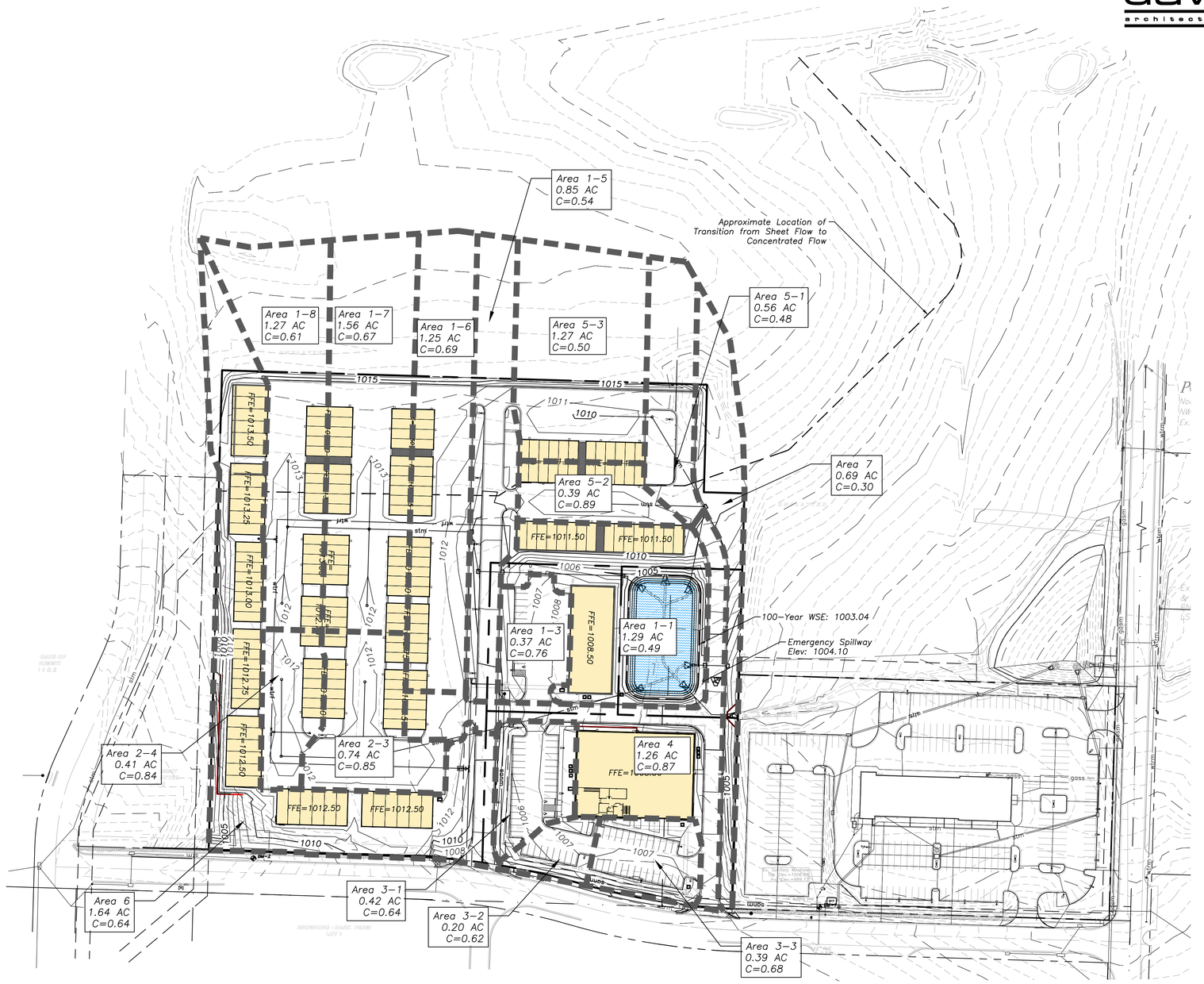

Post–Construction Impervious Area Calculations

	Square Feet	Acres
Area of Site	505,723	11.61
Impervious Area	350,108	8.04
Pervious Area	155,615	3.57
Q: 10 year	16.24 cfs	
100 year	27.04 cfs	

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drawing type
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BM–2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Grading Legend

- existing minor contour
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Utility Legend

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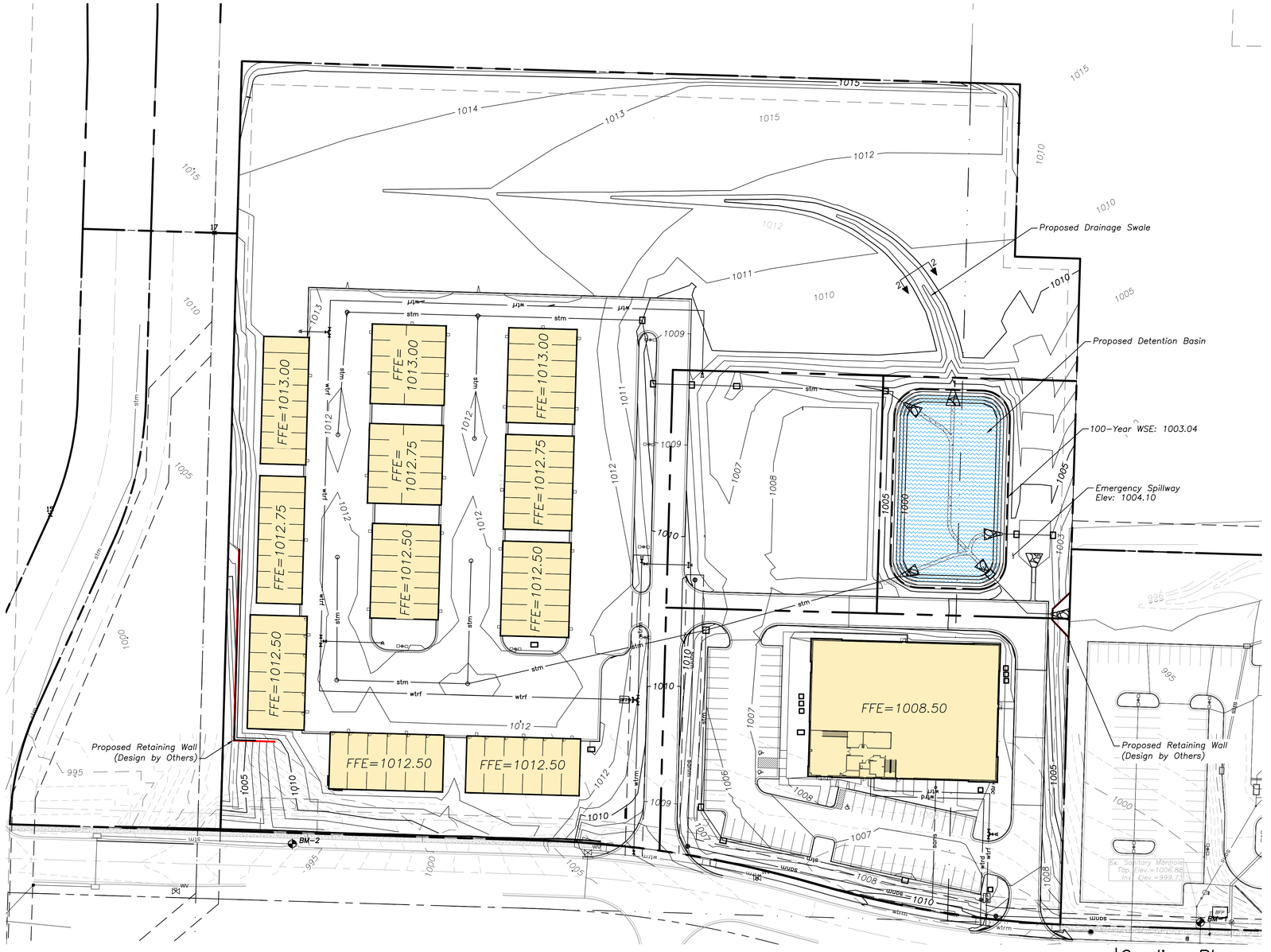
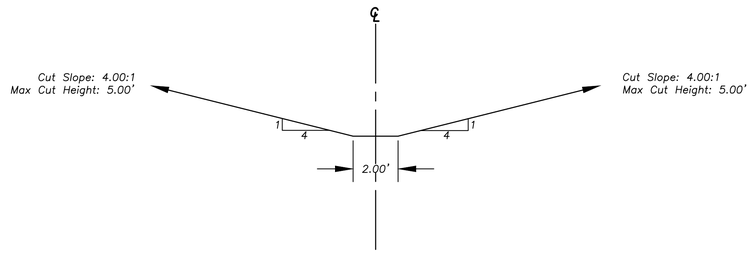


1 Grading Plan
scale: 1"–50'



2 Drainage Swale Cross–Section
not to scale

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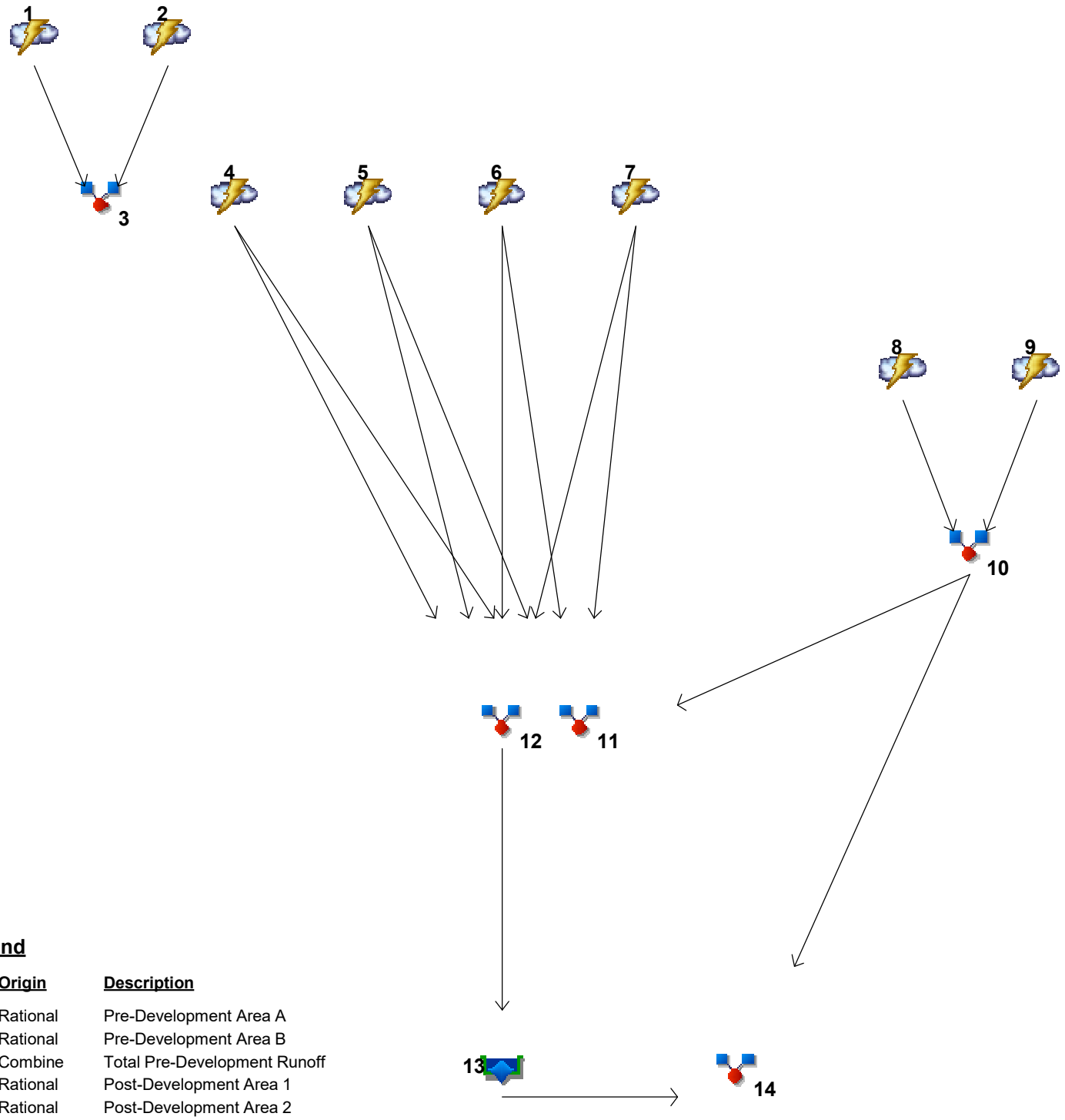
drawing type
FDP
project number
20231

Appendix B

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Rational	Pre-Development Area A
2	Rational	Pre-Development Area B
3	Combine	Total Pre-Development Runoff
4	Rational	Post-Development Area 1
5	Rational	Post-Development Area 2
6	Rational	Post-Development Area 3
7	Rational	Post-Development Area 4
8	Rational	Post-Development Area 5
9	Rational	Post-Development Area 6
10	Combine	Total Post-Development Offsite Runoff
11	Combine	Total Post-Development Runoff - No Detention
12	Combine	Post-Development Runoff to Detention
13	Reservoir	Detention Basin 1
14	Combine	Total Post-Development Runoff w/ Detention

Hydraflow Table of Contents

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	1.410	1.793	-------	2.205	2.503	2.982	3.234	3.771	Pre-Development Area A
2	Rational	------	11.69	14.87	-------	18.28	20.76	24.73	26.82	31.27	Pre-Development Area B
3	Combine	1, 2	13.10	16.66	-------	20.49	23.26	27.71	30.05	35.04	Total Pre-Development Runoff
4	Rational	------	10.50	13.35	-------	16.41	18.64	22.20	24.08	28.07	Post-Development Area 1
5	Rational	------	2.888	3.671	-------	4.515	5.126	6.106	6.623	7.721	Post-Development Area 2
6	Rational	------	1.917	2.437	-------	2.997	3.402	4.053	4.396	5.125	Post-Development Area 3
7	Rational	------	3.201	4.069	-------	5.004	5.681	6.768	7.341	8.558	Post-Development Area 4
8	Rational	------	0.604	0.768	-------	0.945	1.073	1.278	1.386	1.616	Post-Development Area 5
9	Rational	------	3.065	3.896	-------	4.791	5.440	6.480	7.028	8.194	Post-Development Area 6
10	Combine	8, 9	3.669	4.664	-------	5.736	6.512	7.758	8.415	9.810	Total Post-Development Offsite Runof
11	Combine	4, 5, 6, 7, 10	22.17	28.19	-------	34.67	39.36	46.89	50.85	59.29	Total Post-Development Runoff - No
12	Combine	4, 5, 6, 7,	18.51	23.52	-------	28.93	32.84	39.13	42.44	49.48	Post-Development Runoff to Detentio
13	Reservoir	12	0.095	0.133	-------	0.178	3.093	10.40	12.55	15.51	Detention Basin 1
14	Combine	10, 13	3.704	4.714	-------	5.804	6.593	12.93	15.71	19.91	Total Post-Development Runoff w/ De

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	1.793	1	15	1,614	------	------	------	Pre-Development Area A
2	Rational	14.87	1	15	13,379	------	------	------	Pre-Development Area B
3	Combine	16.66	1	15	14,993	1, 2	------	------	Total Pre-Development Runoff
4	Rational	13.35	1	15	12,012	------	------	------	Post-Development Area 1
5	Rational	3.671	1	15	3,304	------	------	------	Post-Development Area 2
6	Rational	2.437	1	15	2,193	------	------	------	Post-Development Area 3
7	Rational	4.069	1	15	3,662	------	------	------	Post-Development Area 4
8	Rational	0.768	1	15	692	------	------	------	Post-Development Area 5
9	Rational	3.896	1	15	3,506	------	------	------	Post-Development Area 6
10	Combine	4.664	1	15	4,198	8, 9	------	------	Total Post-Development Offsite Runof
11	Combine	28.19	1	15	25,369	4, 5, 6, 7, 10	------	------	Total Post-Development Runoff - No
12	Combine	23.52	1	15	21,171	4, 5, 6, 7,	------	------	Post-Development Runoff to Detentio
13	Reservoir	0.133	1	30	12,543	12	1001.62	21,066	Detention Basin 1
14	Combine	4.714	1	15	16,741	10, 13	------	------	Total Post-Development Runoff w/ De

Hydrograph Report

Hyd. No. 1

Pre-Development Area A

Hydrograph type	=	Rational	Peak discharge	=	1.793 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	1,614 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.3
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 2

Pre-Development Area B

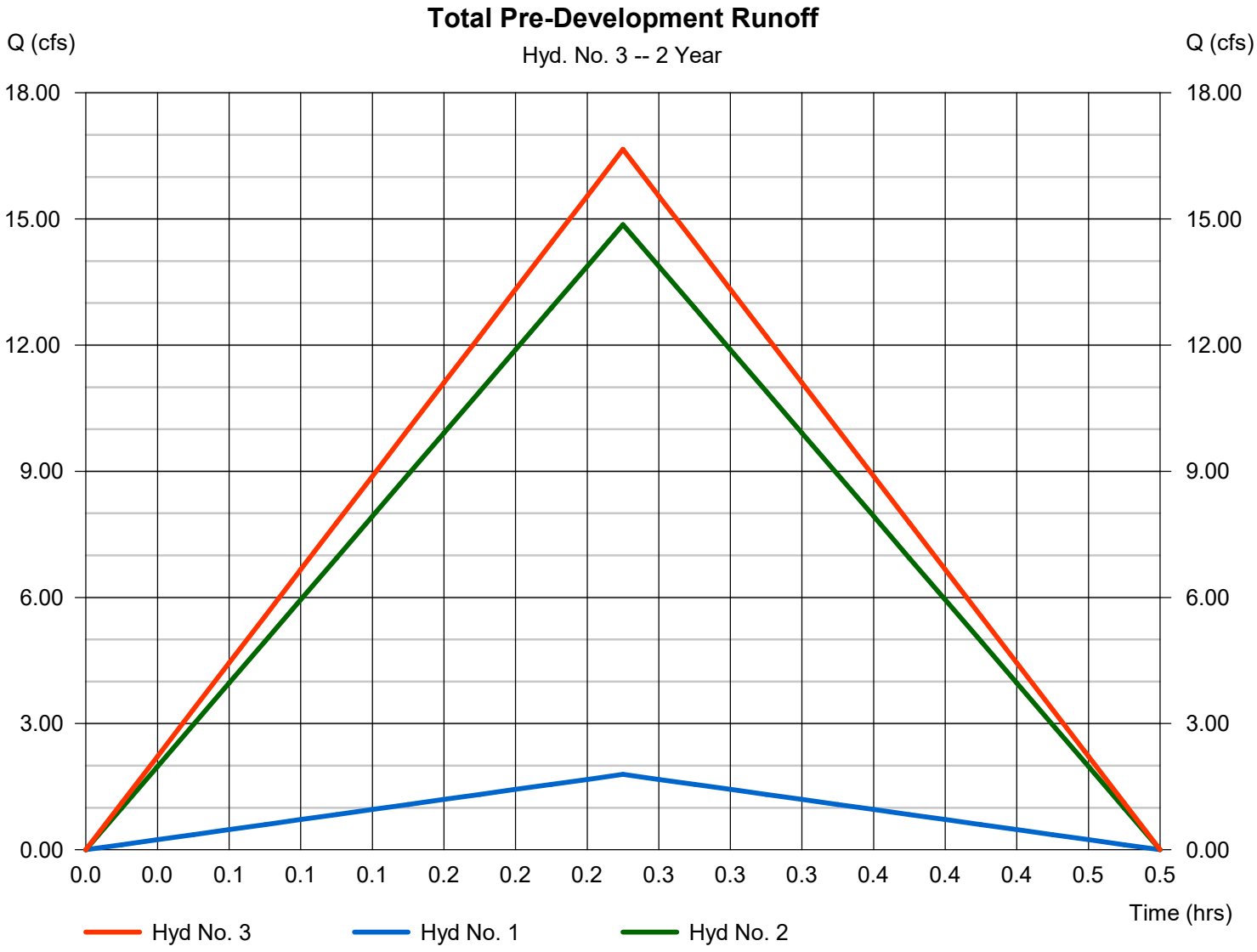
Hydrograph type	=	Rational	Peak discharge	=	14.87 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	13,379 cuft
Drainage area	=	13.350 ac	Runoff coeff.	=	0.3
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type	= Combine	Peak discharge	= 16.66 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 14,993 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.960 ac

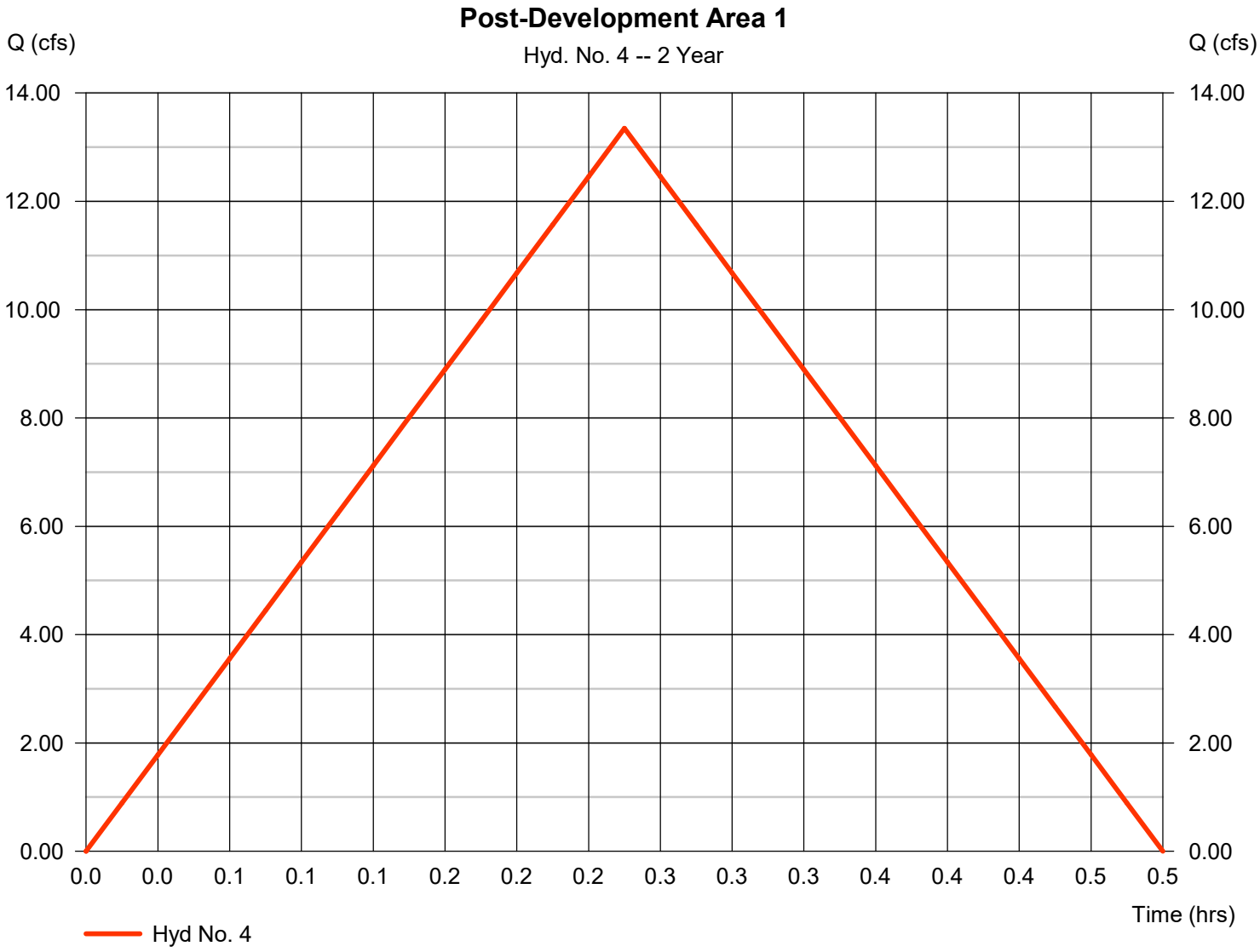


Hydrograph Report

Hyd. No. 4

Post-Development Area 1

Hydrograph type	= Rational	Peak discharge	= 13.35 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 12,012 cuft
Drainage area	= 9.220 ac	Runoff coeff.	= 0.39
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

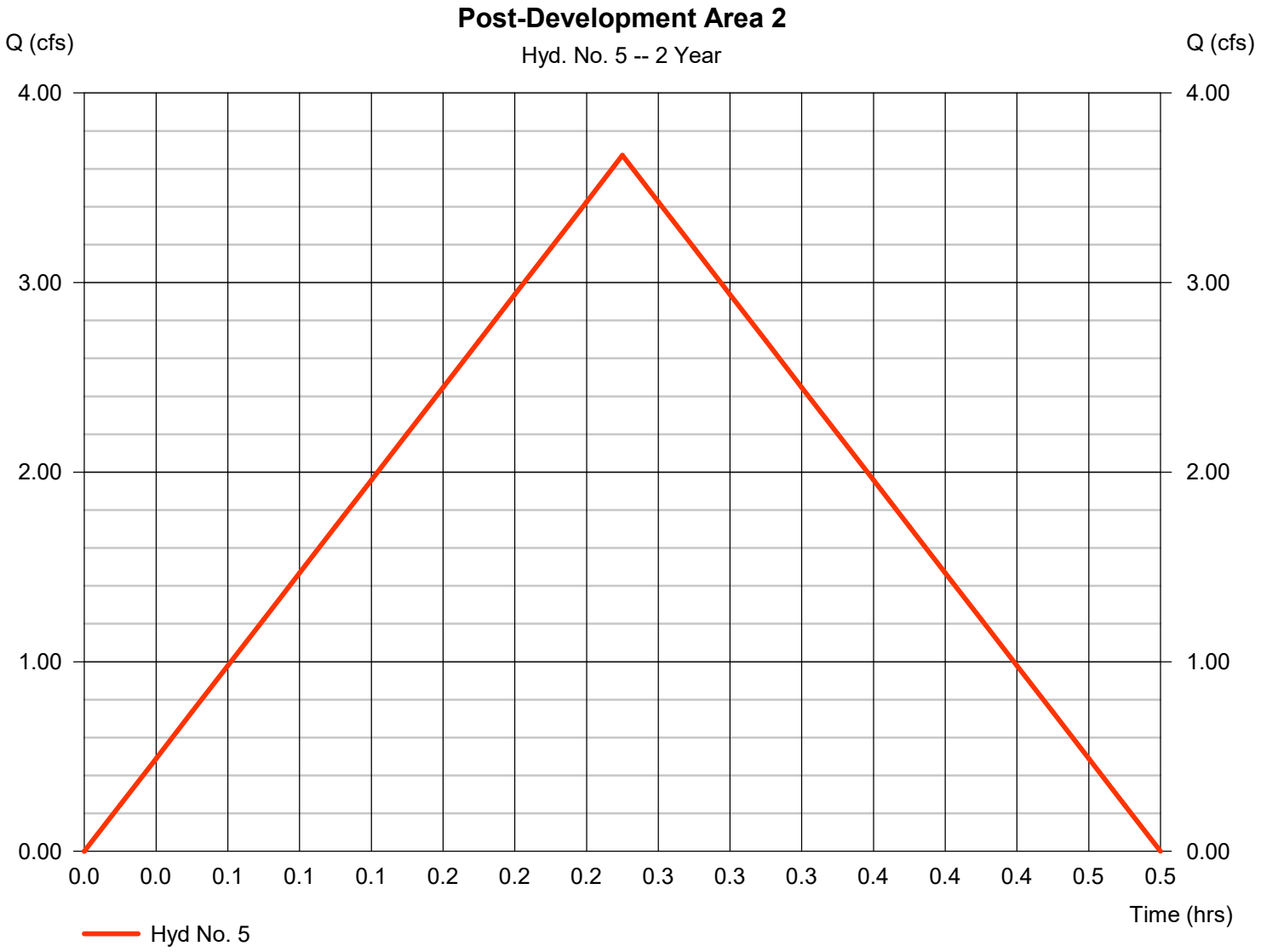


Hydrograph Report

Hyd. No. 5

Post-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	3.671 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	3,304 cuft
Drainage area	=	1.150 ac	Runoff coeff.	=	0.86
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

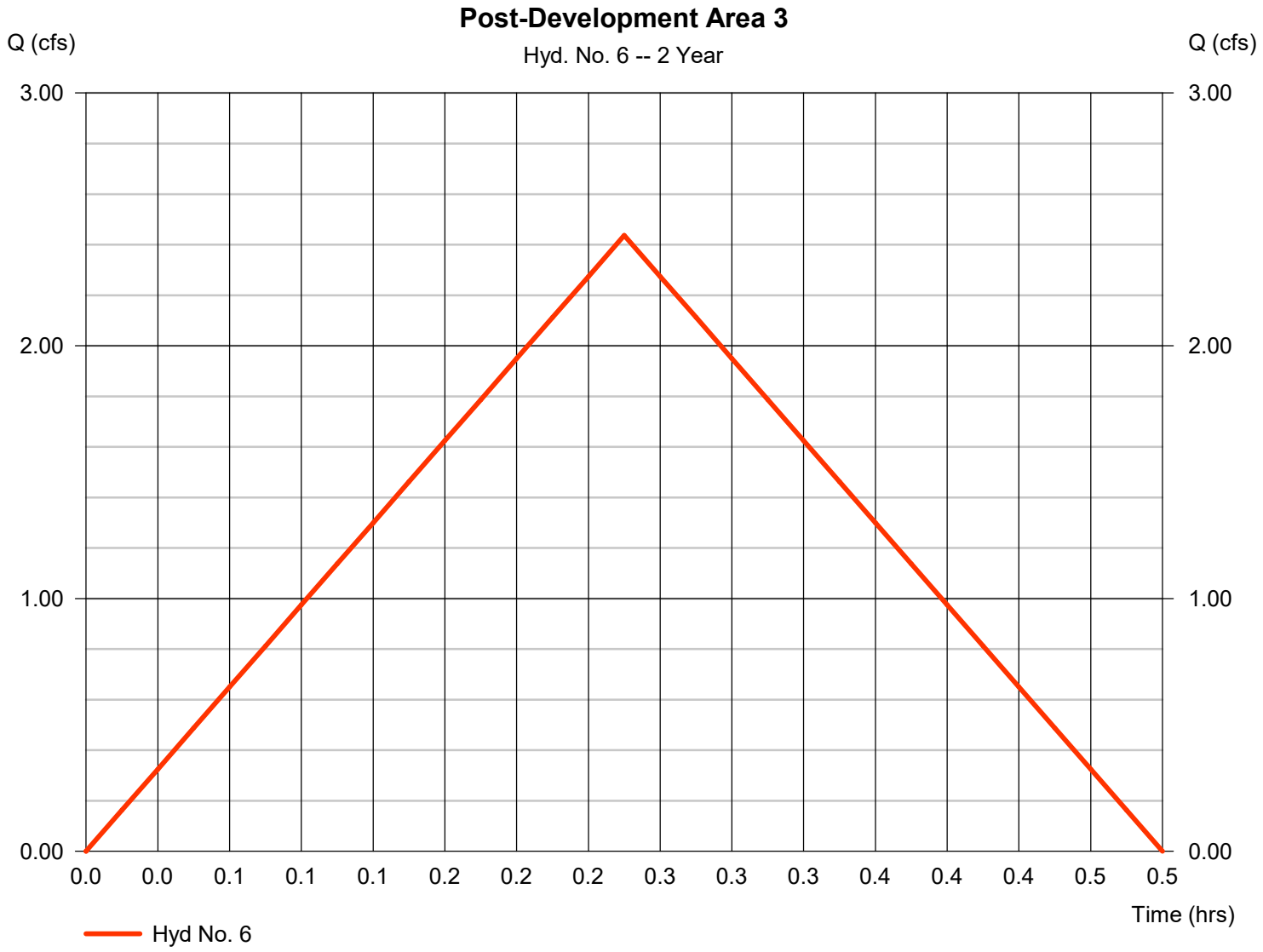


Hydrograph Report

Hyd. No. 6

Post-Development Area 3

Hydrograph type	= Rational	Peak discharge	= 2.437 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 2,193 cuft
Drainage area	= 1.010 ac	Runoff coeff.	= 0.65
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

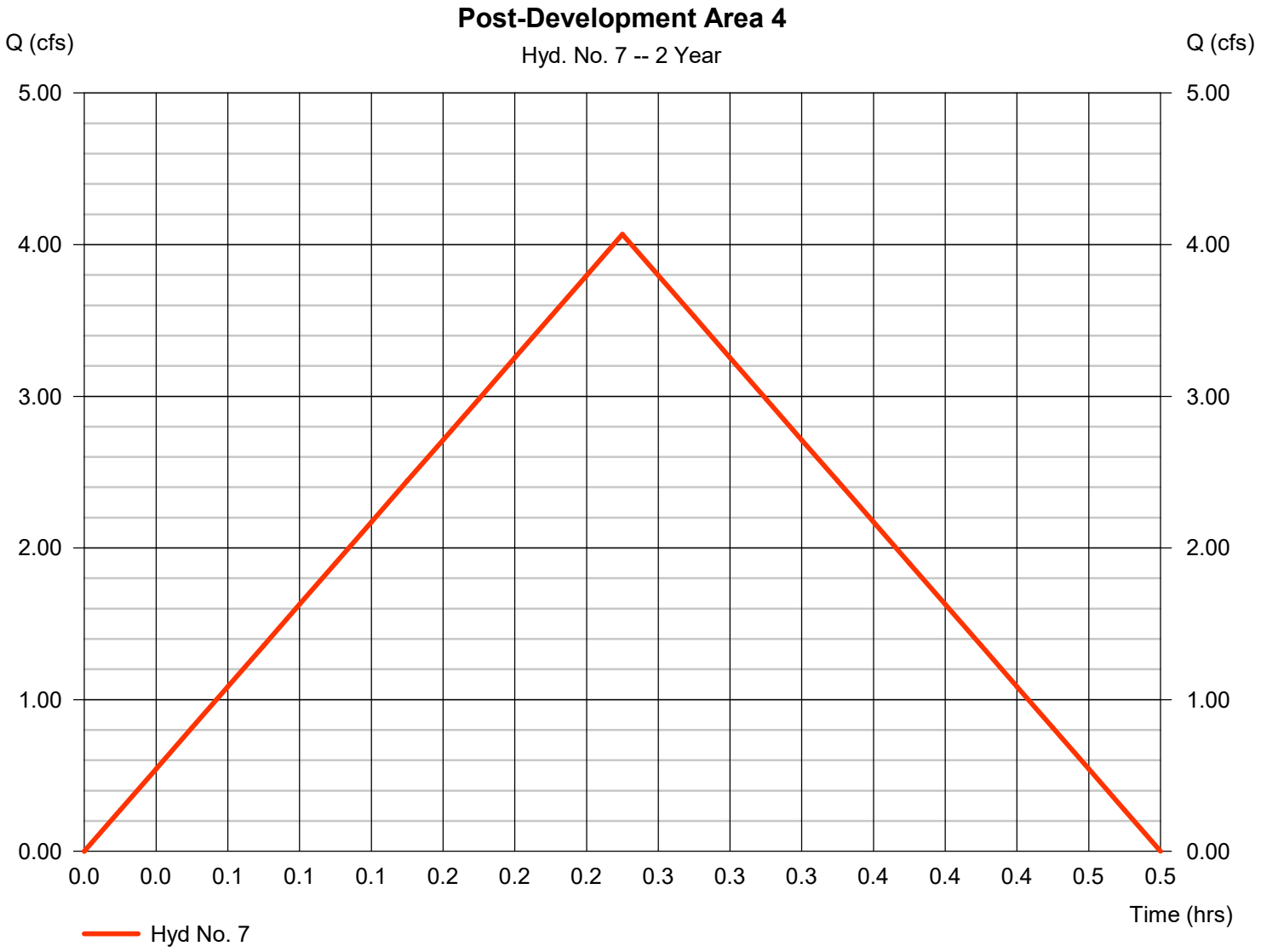


Hydrograph Report

Hyd. No. 7

Post-Development Area 4

Hydrograph type	= Rational	Peak discharge	= 4.069 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 3,662 cuft
Drainage area	= 1.260 ac	Runoff coeff.	= 0.87
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

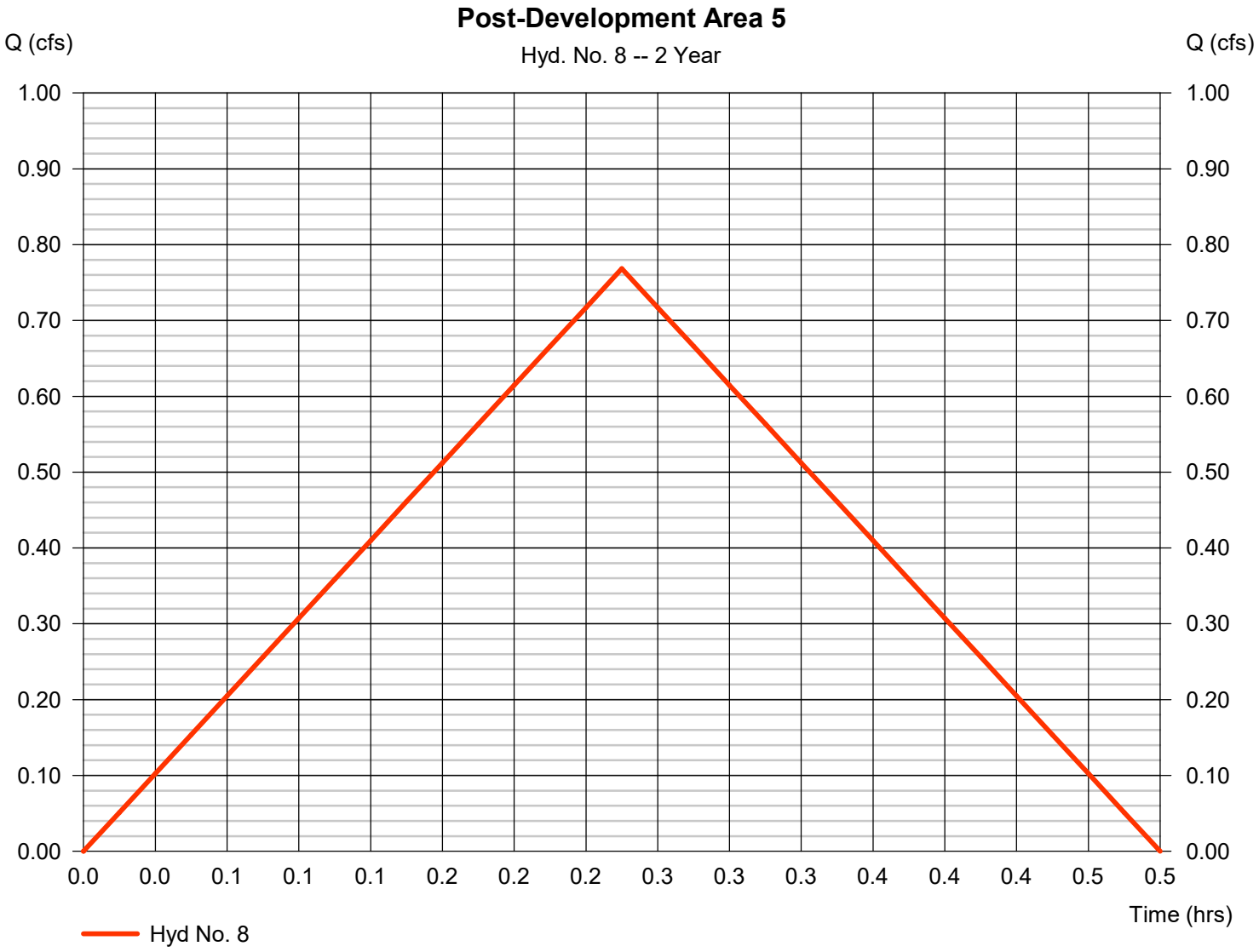


Hydrograph Report

Hyd. No. 8

Post-Development Area 5

Hydrograph type	= Rational	Peak discharge	= 0.768 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 692 cuft
Drainage area	= 0.690 ac	Runoff coeff.	= 0.3
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

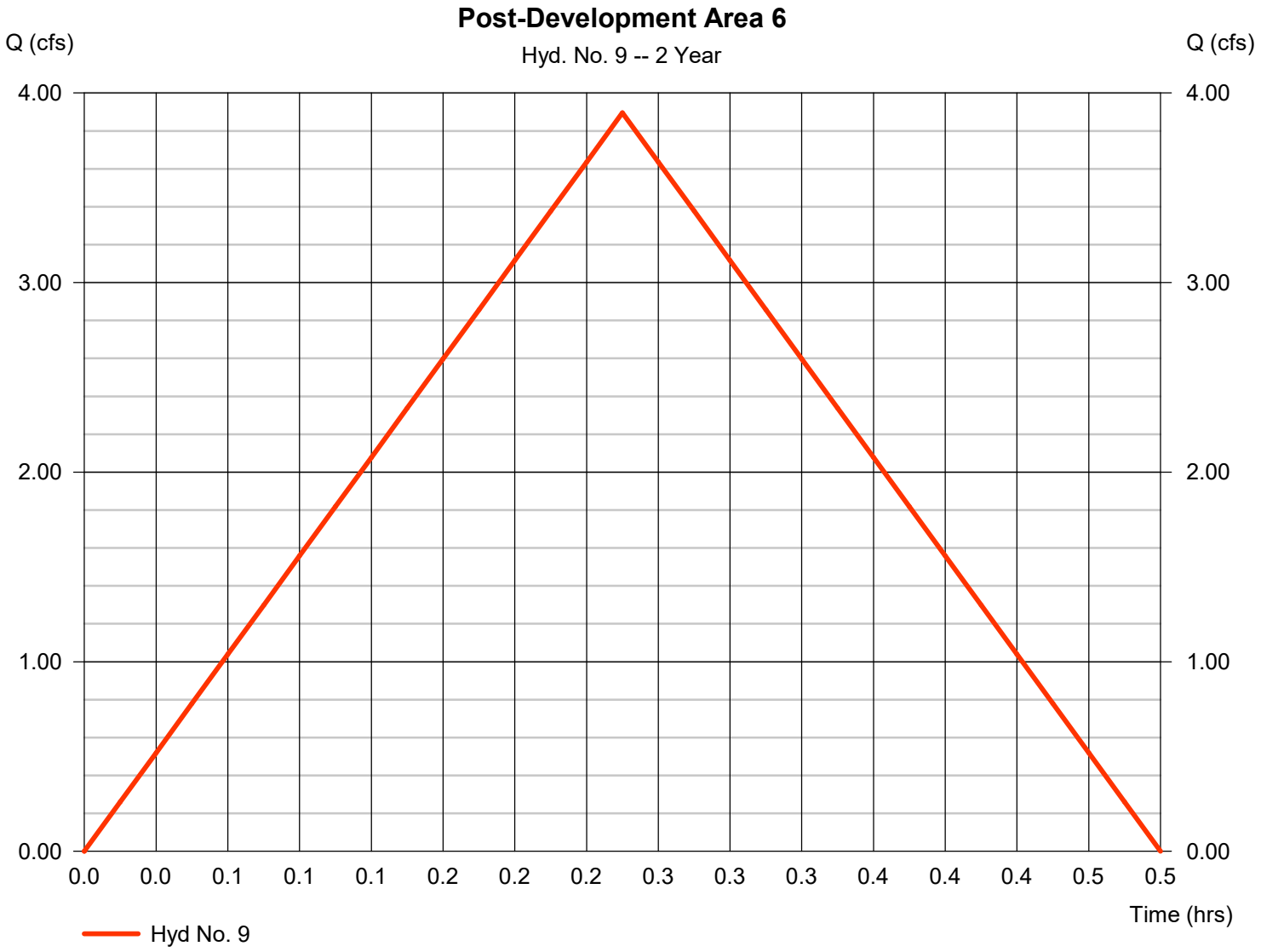


Hydrograph Report

Hyd. No. 9

Post-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	3.896 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	3,506 cuft
Drainage area	=	1.640 ac	Runoff coeff.	=	0.64
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

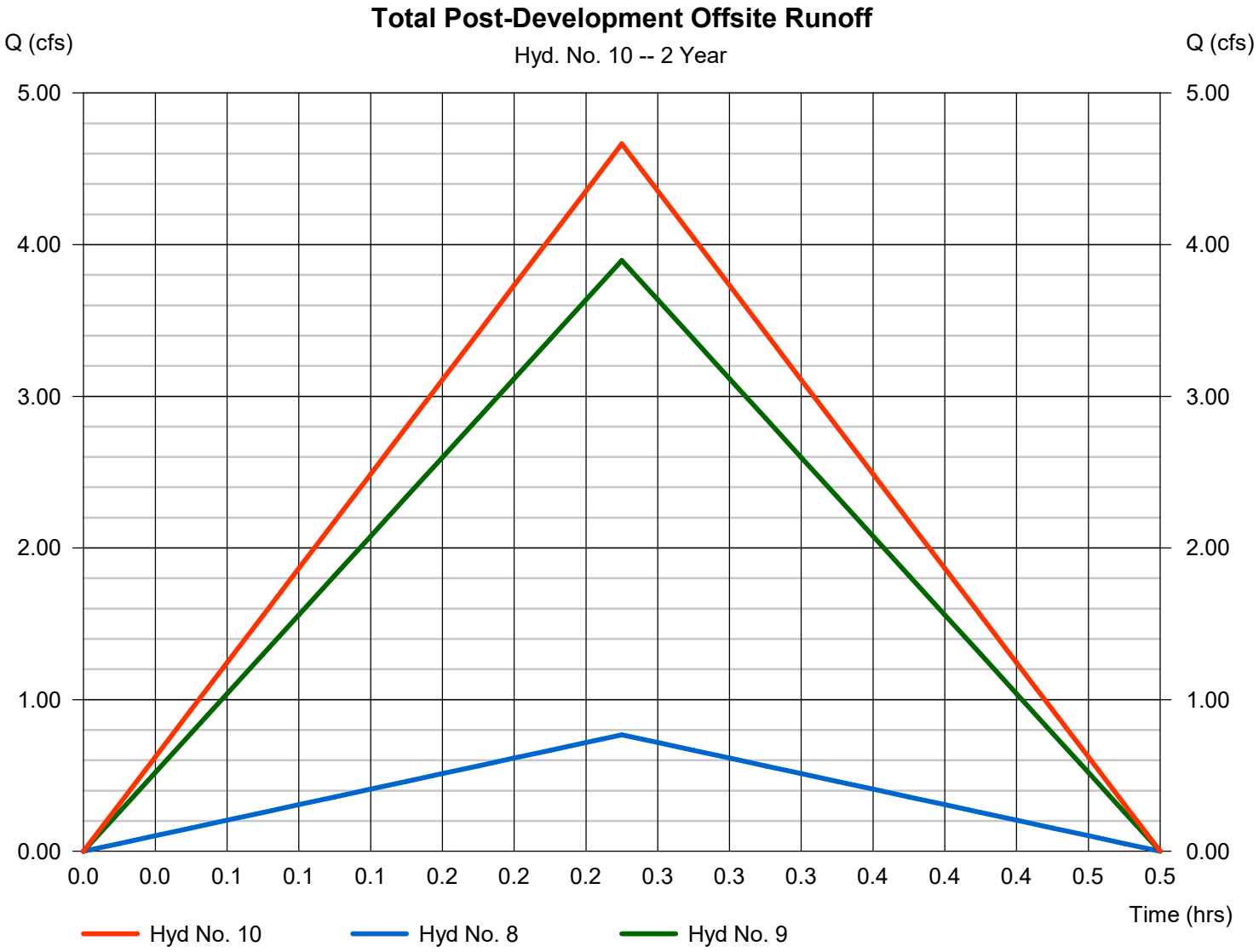


Hydrograph Report

Hyd. No. 10

Total Post-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 4.664 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 4,198 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 2.330 ac

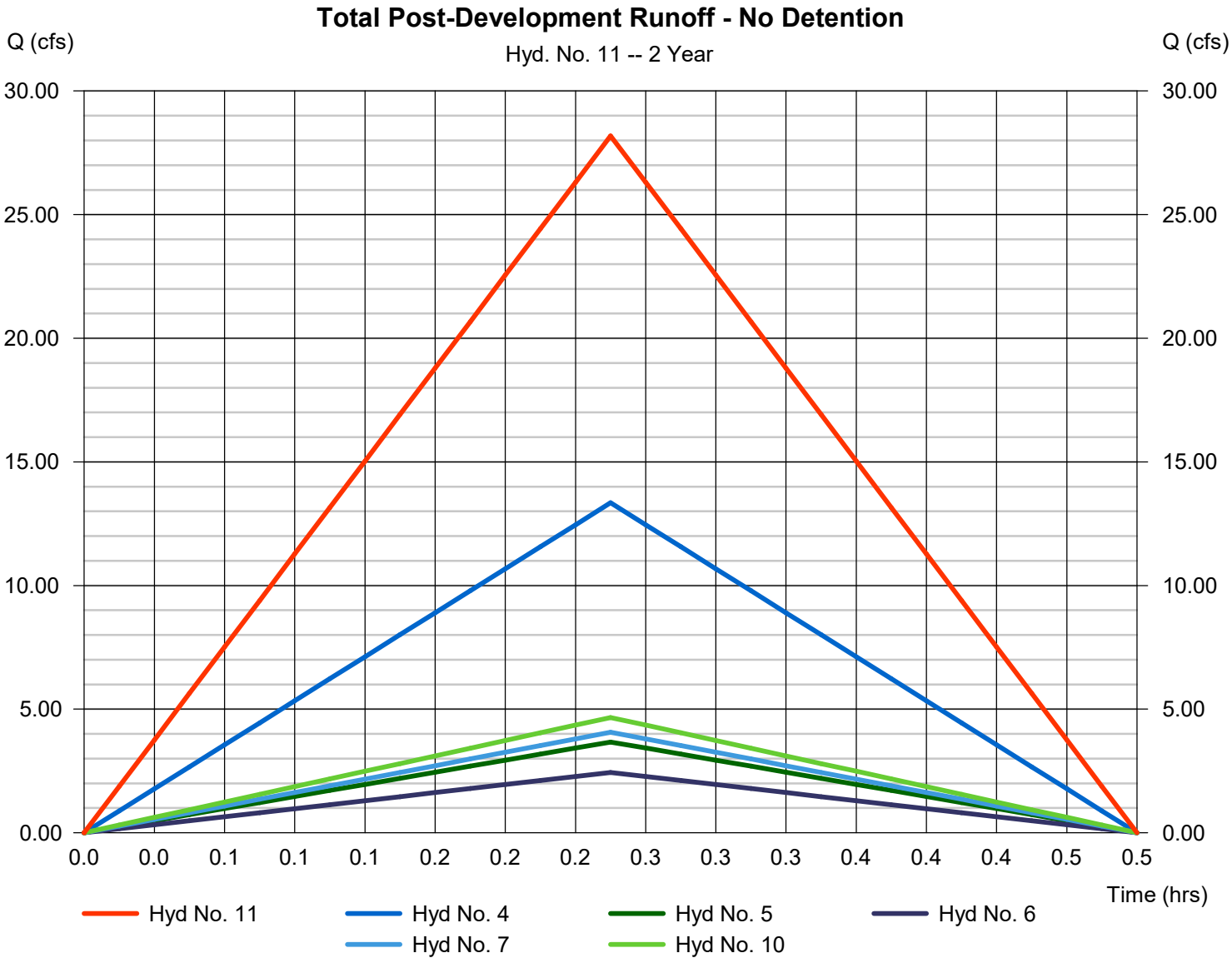


Hydrograph Report

Hyd. No. 11

Total Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 28.19 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 25,369 cuft
Inflow hyds.	= 4, 5, 6, 7, 10	Contrib. drain. area	= 12.640 ac

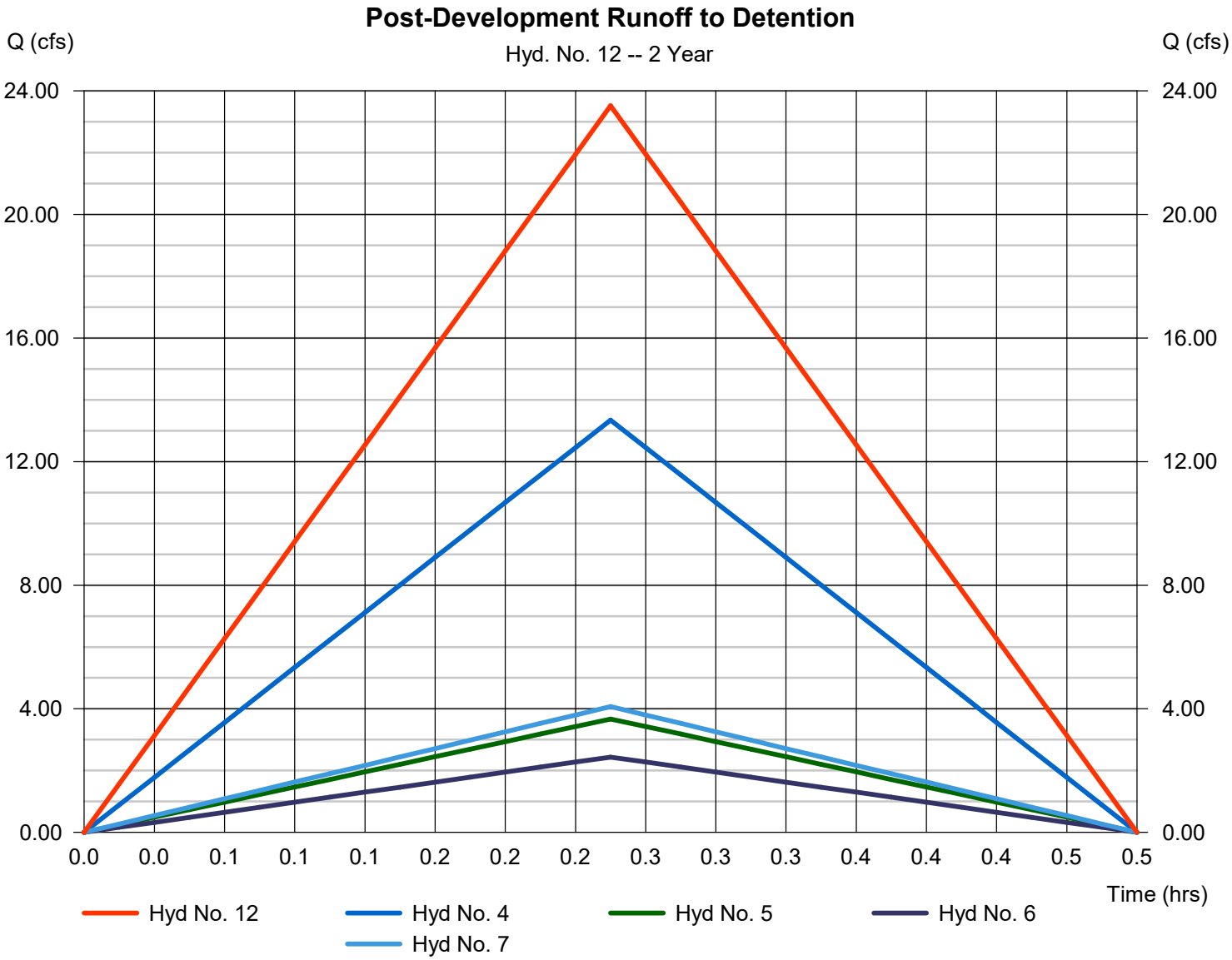


Hydrograph Report

Hyd. No. 12

Post-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 23.52 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 21,171 cuft
Inflow hyds.	= 4, 5, 6, 7	Contrib. drain. area	= 12.640 ac



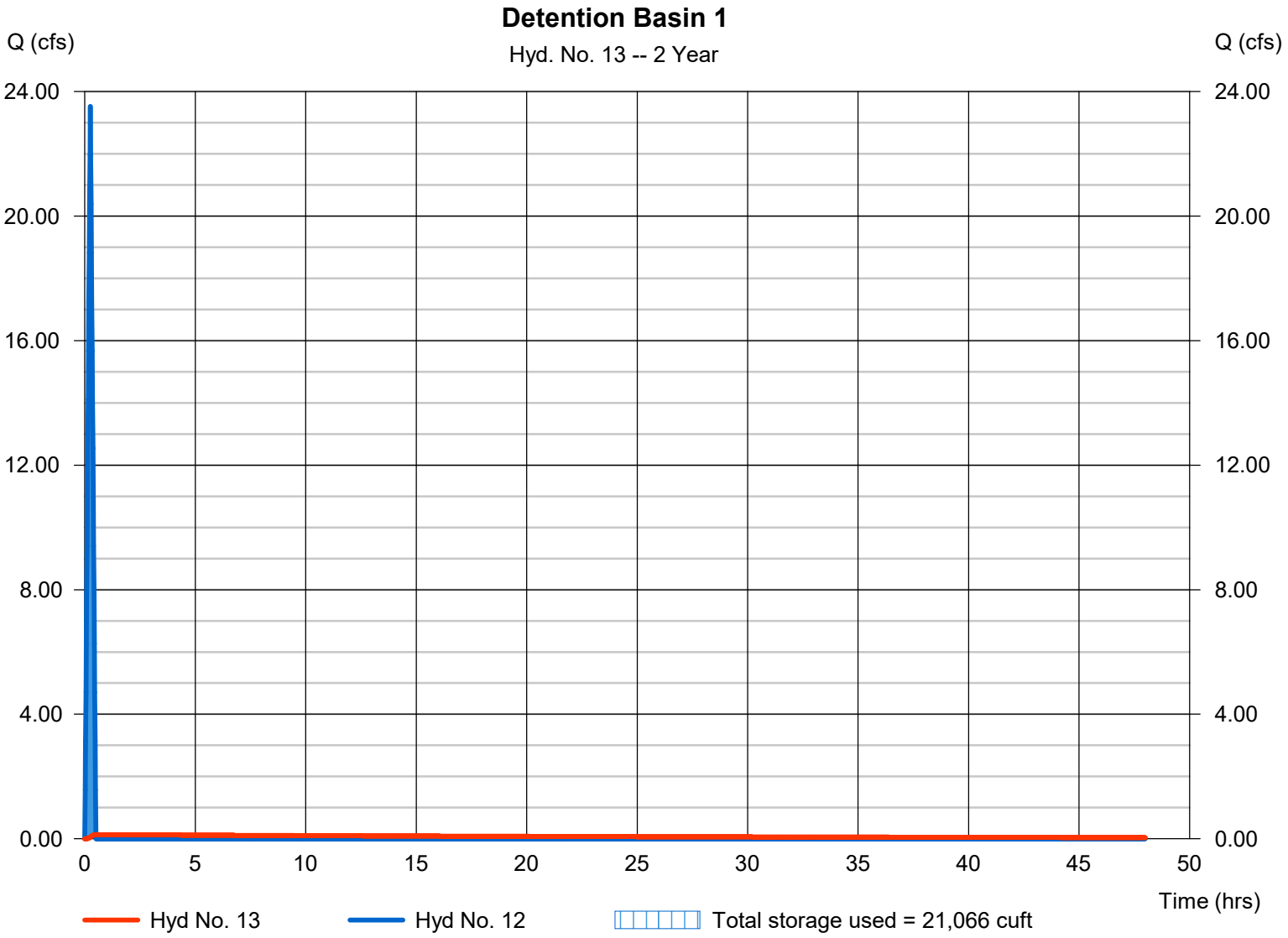
Hydrograph Report

Hyd. No. 13

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	0.133 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.50 hrs
Time interval	=	1 min	Hyd. volume	=	12,543 cuft
Inflow hyd. No.	=	12 - Post-Development Runoff to Detention	Max. Elevation	=	1001.62 ft
Reservoir name	=	Detention Basin	Max. Storage	=	21,066 cuft

Storage Indication method used.



Pond No. 1 - Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1000.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1000.00	11,836	0	0
1.00	1001.00	13,183	12,502	12,502
2.00	1002.00	14,586	13,877	26,379
3.00	1003.00	16,045	15,308	41,688
4.00	1004.00	17,561	16,796	58,483

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	1.50
Span (in)	= 24.00	2.50	0.00	1.50
No. Barrels	= 1	1	0	6
Invert El. (ft)	= 999.98	1000.00	0.00	1000.00
Length (ft)	= 58.75	0.10	0.00	3.25
Slope (%)	= 0.40	0.01	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	Yes

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 24.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 1002.05	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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1000.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.10	1,250	1000.10	0.00 oc	0.00	---	0.00	0.00	---	---	---	---	---	0.002
0.20	2,500	1000.20	0.01 oc	0.00	---	0.01	0.00	---	---	---	---	---	0.006
0.30	3,751	1000.30	0.01 oc	0.00	---	0.01	0.00	---	---	---	---	---	0.011
0.40	5,001	1000.40	0.02 ic	0.00	---	0.02	0.00	---	---	---	---	---	0.016
0.50	6,251	1000.50	0.03 ic	0.00	---	0.02	0.00	---	---	---	---	---	0.023
0.60	7,501	1000.60	0.03 ic	0.00	---	0.03	0.00	---	---	---	---	---	0.030
0.70	8,752	1000.70	0.04 ic	0.00	---	0.04	0.00	---	---	---	---	---	0.038
0.80	10,002	1000.80	0.05 ic	0.00	---	0.05	0.00	---	---	---	---	---	0.046
0.90	11,252	1000.90	0.06 ic	0.00	---	0.06	0.00	---	---	---	---	---	0.055
1.00	12,502	1001.00	0.06 ic	0.00	---	0.06	0.00	---	---	---	---	---	0.064
1.10	13,890	1001.10	0.07 ic	0.00	---	0.07	0.00	---	---	---	---	---	0.074
1.20	15,278	1001.20	0.08 ic	0.00	---	0.08	0.00	---	---	---	---	---	0.085
1.30	16,665	1001.30	0.10 ic	0.00	---	0.10	0.00	---	---	---	---	---	0.095
1.40	18,053	1001.40	0.11 ic	0.00	---	0.11	0.00	---	---	---	---	---	0.107
1.50	19,441	1001.50	0.12 ic	0.00	---	0.12	0.00	---	---	---	---	---	0.119
1.60	20,829	1001.60	0.13 ic	0.00	---	0.13	0.00	---	---	---	---	---	0.131
1.70	22,216	1001.70	0.15 ic	0.00	---	0.14	0.00	---	---	---	---	---	0.143
1.80	23,604	1001.80	0.16 ic	0.00	---	0.16	0.00	---	---	---	---	---	0.156
1.90	24,992	1001.90	0.18 ic	0.00	---	0.17	0.00	---	---	---	---	---	0.169
2.00	26,379	1002.00	0.18 ic	0.00	---	0.18	0.00	---	---	---	---	---	0.183
2.10	27,910	1002.10	1.10 oc	0.00	---	0.16	0.89	---	---	---	---	---	1.054
2.20	29,441	1002.20	4.73 oc	0.00	---	0.09	4.64	---	---	---	---	---	4.731
2.30	30,972	1002.30	9.82 oc	0.00	---	0.01	9.81 s	---	---	---	---	---	9.816
2.40	32,503	1002.40	12.36 oc	0.00	---	0.00	12.36 s	---	---	---	---	---	12.36
2.50	34,033	1002.50	13.94 oc	0.00	---	0.00	13.93 s	---	---	---	---	---	13.93
2.60	35,564	1002.60	15.15 oc	0.00	---	0.00	15.15 s	---	---	---	---	---	15.15
2.70	37,095	1002.70	16.19 oc	0.00	---	0.00	16.19 s	---	---	---	---	---	16.19
2.80	38,626	1002.80	17.13 oc	0.00	---	0.00	17.11 s	---	---	---	---	---	17.11
2.90	40,157	1002.90	17.99 oc	0.00	---	0.00	17.96 s	---	---	---	---	---	17.97
3.00	41,688	1003.00	18.80 oc	0.00	---	0.00	18.77 s	---	---	---	---	---	18.77
3.10	43,367	1003.10	19.57 oc	0.00	---	0.00	19.53 s	---	---	---	---	---	19.53
3.20	45,047	1003.20	20.30 oc	0.00	---	0.00	20.25 s	---	---	---	---	---	20.25
3.30	46,726	1003.30	21.01 oc	0.00	---	0.00	20.94 s	---	---	---	---	---	20.94
3.40	48,406	1003.40	21.68 oc	0.00	---	0.00	21.61 s	---	---	---	---	---	21.61
3.50	50,085	1003.50	22.34 oc	0.00	---	0.00	22.30 s	---	---	---	---	---	22.30
3.60	51,765	1003.60	22.98 oc	0.00	---	0.00	22.97 s	---	---	---	---	---	22.98
3.70	53,445	1003.70	23.60 oc	0.00	---	0.00	23.55 s	---	---	---	---	---	23.55

Continues on next page...

Detention Basin

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.80	55,124	1003.80	24.20 oc	0.00	---	0.00	24.11 s	---	---	---	---	---	24.11
3.90	56,804	1003.90	24.78 oc	0.00	---	0.00	24.76 s	---	---	---	---	---	24.76
4.00	58,483	1004.00	25.36 oc	0.00	---	0.00	25.29 s	---	---	---	---	---	25.29

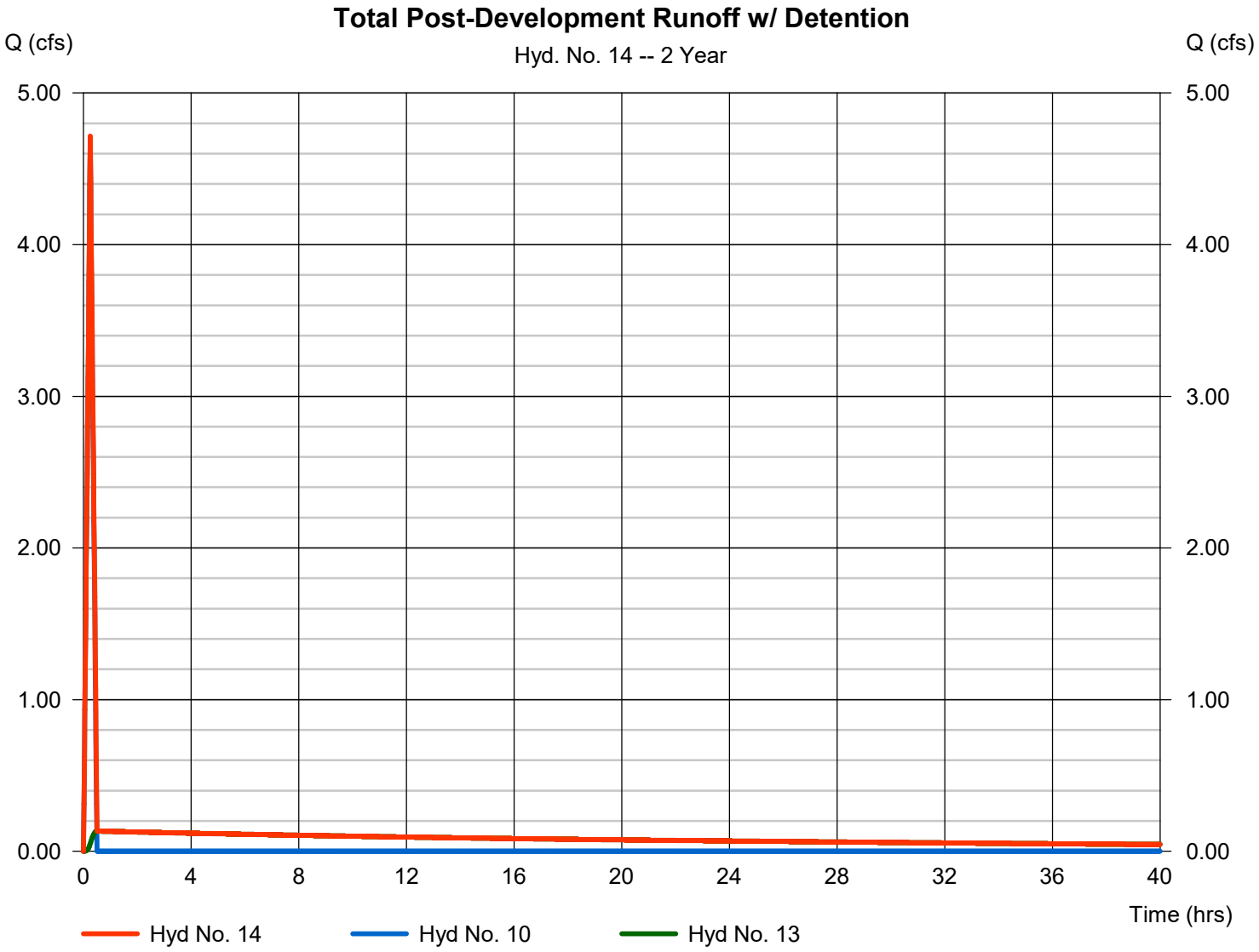
...End

Hydrograph Report

Hyd. No. 14

Total Post-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 4.714 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 16,741 cuft
Inflow hyds.	= 10, 13	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	2.503	1	15	2,253	------	------	------	Pre-Development Area A
2	Rational	20.76	1	15	18,681	------	------	------	Pre-Development Area B
3	Combine	23.26	1	15	20,934	1, 2	------	------	Total Pre-Development Runoff
4	Rational	18.64	1	15	16,772	------	------	------	Post-Development Area 1
5	Rational	5.126	1	15	4,613	------	------	------	Post-Development Area 2
6	Rational	3.402	1	15	3,062	------	------	------	Post-Development Area 3
7	Rational	5.681	1	15	5,113	------	------	------	Post-Development Area 4
8	Rational	1.073	1	15	966	------	------	------	Post-Development Area 5
9	Rational	5.440	1	15	4,896	------	------	------	Post-Development Area 6
10	Combine	6.512	1	15	5,861	8, 9	------	------	Total Post-Development Offsite Runof
11	Combine	39.36	1	15	35,421	4, 5, 6, 7, 10	------	------	Total Post-Development Runoff - No
12	Combine	32.84	1	15	29,560	4, 5, 6, 7,	------	------	Post-Development Runoff to Detentio
13	Reservoir	3.093	1	29	19,363	12	1002.16	28,759	Detention Basin 1
14	Combine	6.593	1	15	25,224	10, 13	------	------	Total Post-Development Runoff w/ De

Hydrograph Report

Hyd. No. 1

Pre-Development Area A

Hydrograph type	=	Rational	Peak discharge	=	2.503 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	2,253 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.3
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 2

Pre-Development Area B

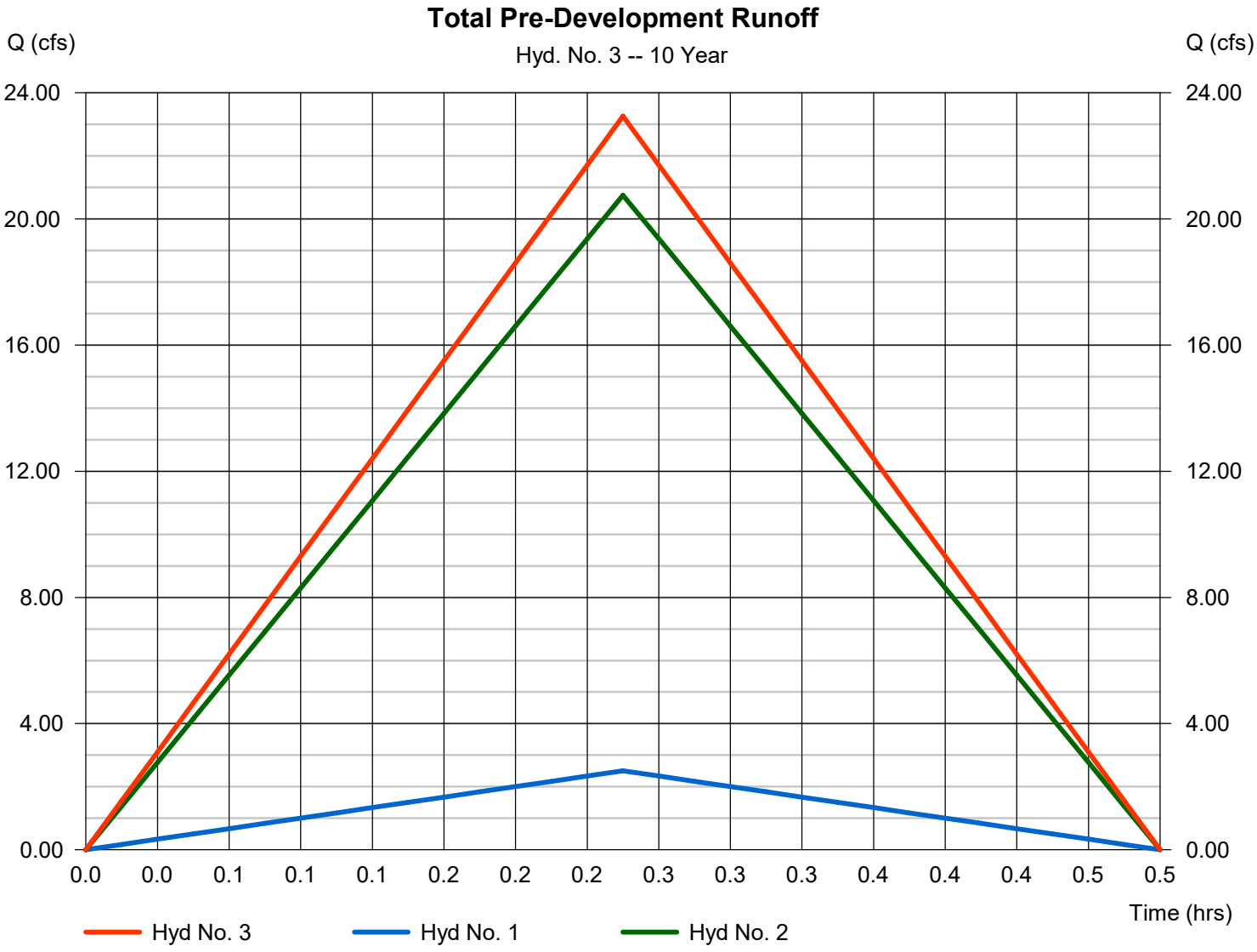
Hydrograph type	=	Rational	Peak discharge	=	20.76 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	18,681 cuft
Drainage area	=	13.350 ac	Runoff coeff.	=	0.3
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type	= Combine	Peak discharge	= 23.26 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 20,934 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.960 ac

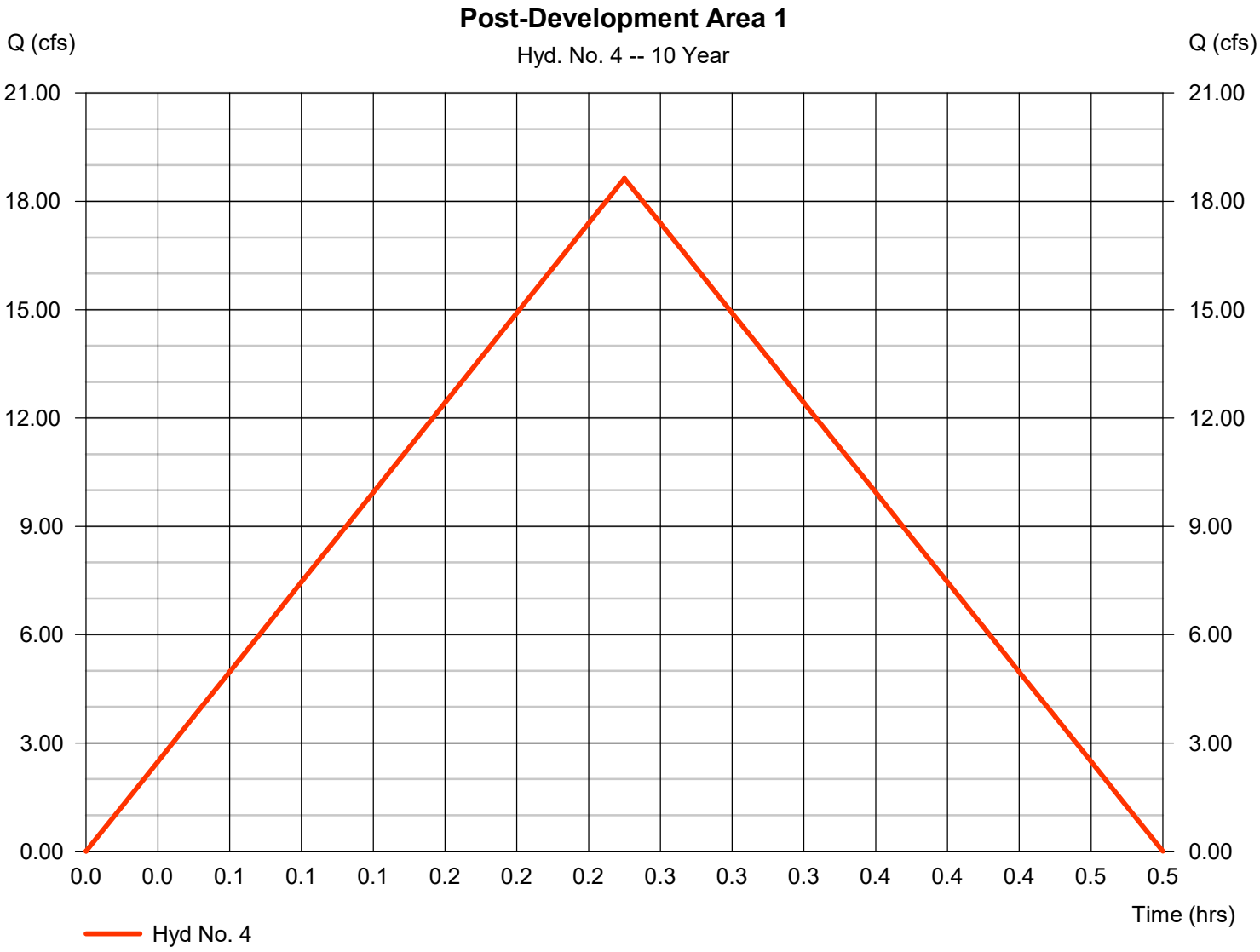


Hydrograph Report

Hyd. No. 4

Post-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	18.64 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	16,772 cuft
Drainage area	=	9.220 ac	Runoff coeff.	=	0.39
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

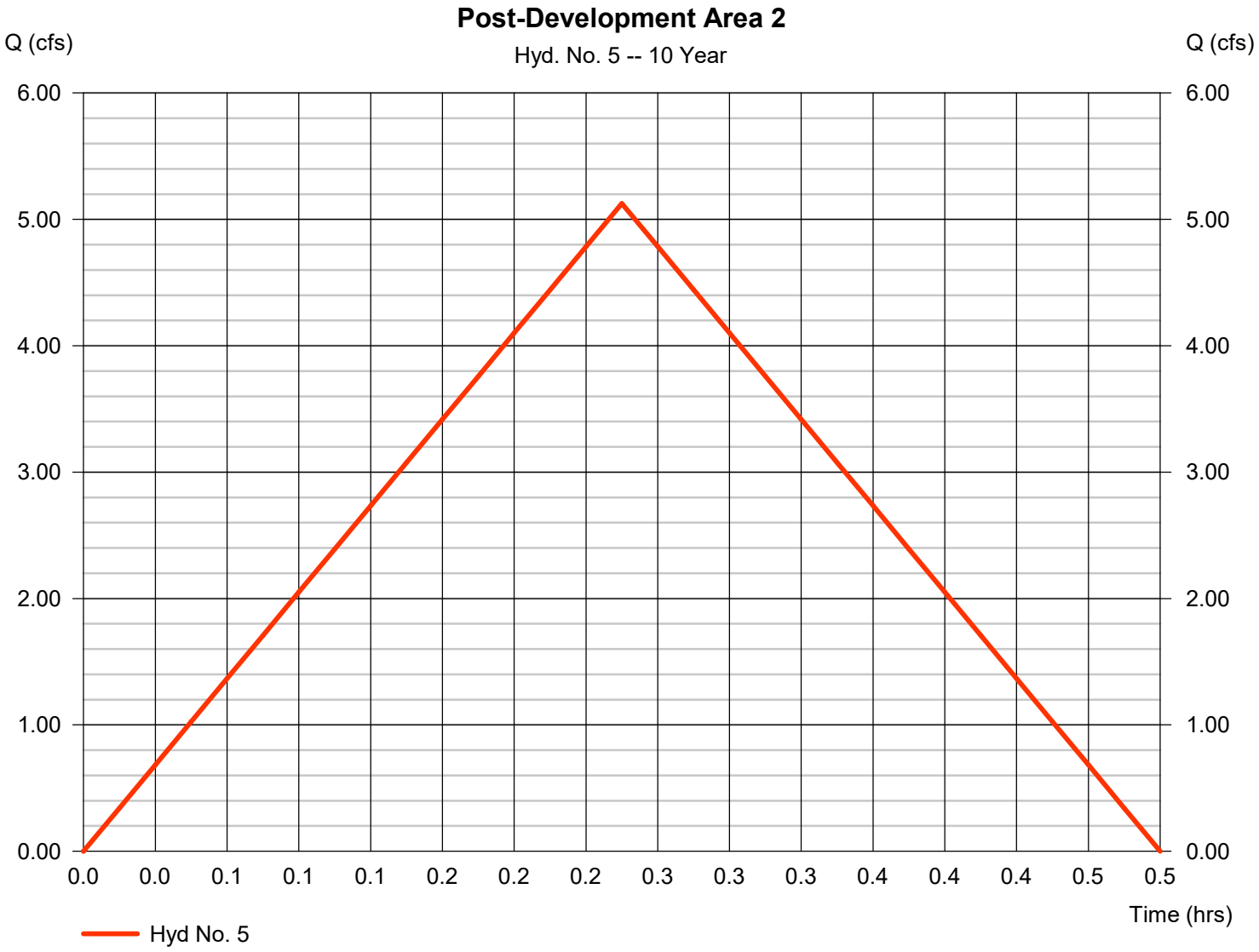


Hydrograph Report

Hyd. No. 5

Post-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	5.126 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	4,613 cuft
Drainage area	=	1.150 ac	Runoff coeff.	=	0.86
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 6

Post-Development Area 3

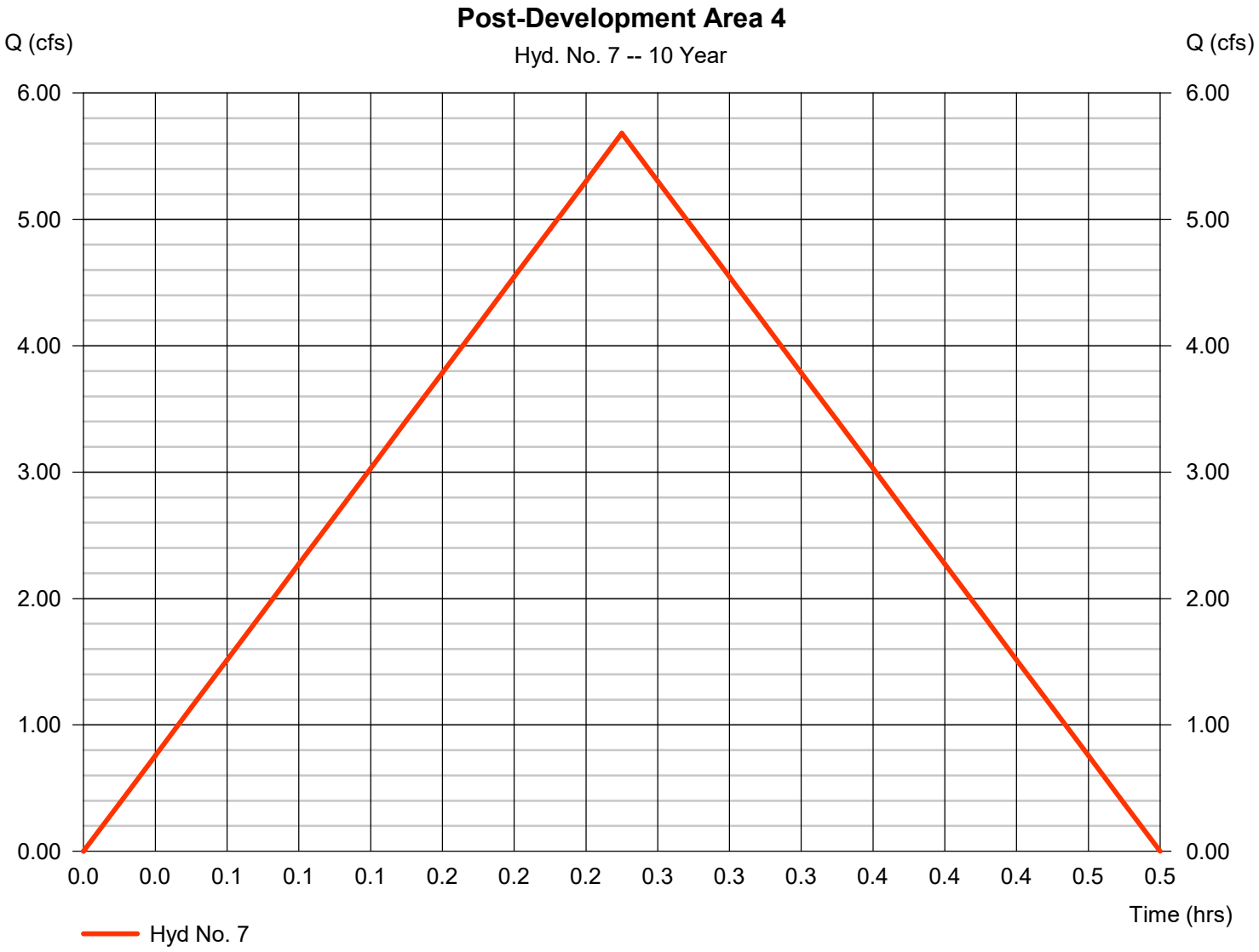
Hydrograph type	=	Rational	Peak discharge	=	3.402 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	3,062 cuft
Drainage area	=	1.010 ac	Runoff coeff.	=	0.65
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 7

Post-Development Area 4

Hydrograph type	=	Rational	Peak discharge	=	5.681 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	5,113 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.87
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

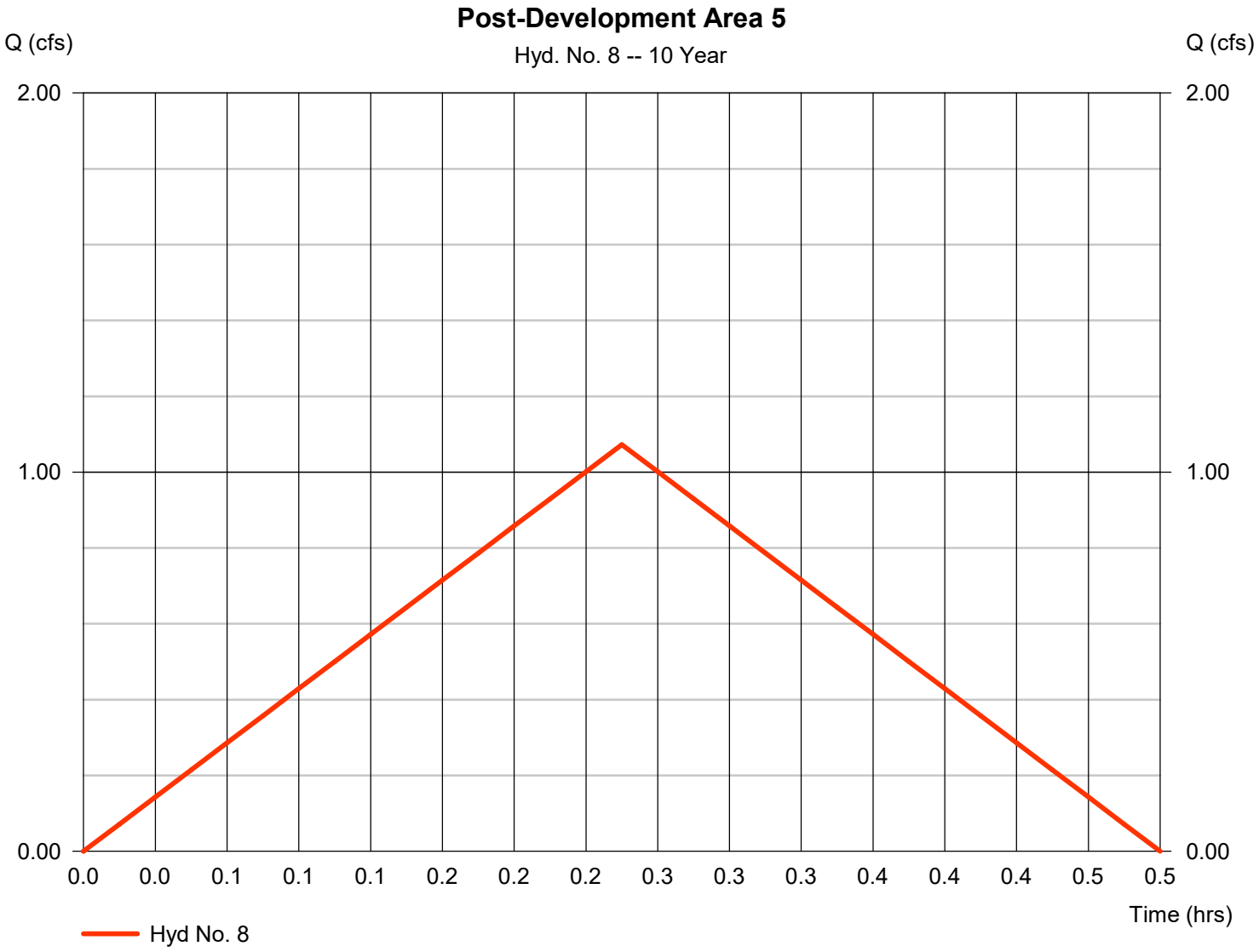


Hydrograph Report

Hyd. No. 8

Post-Development Area 5

Hydrograph type	=	Rational	Peak discharge	=	1.073 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	966 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

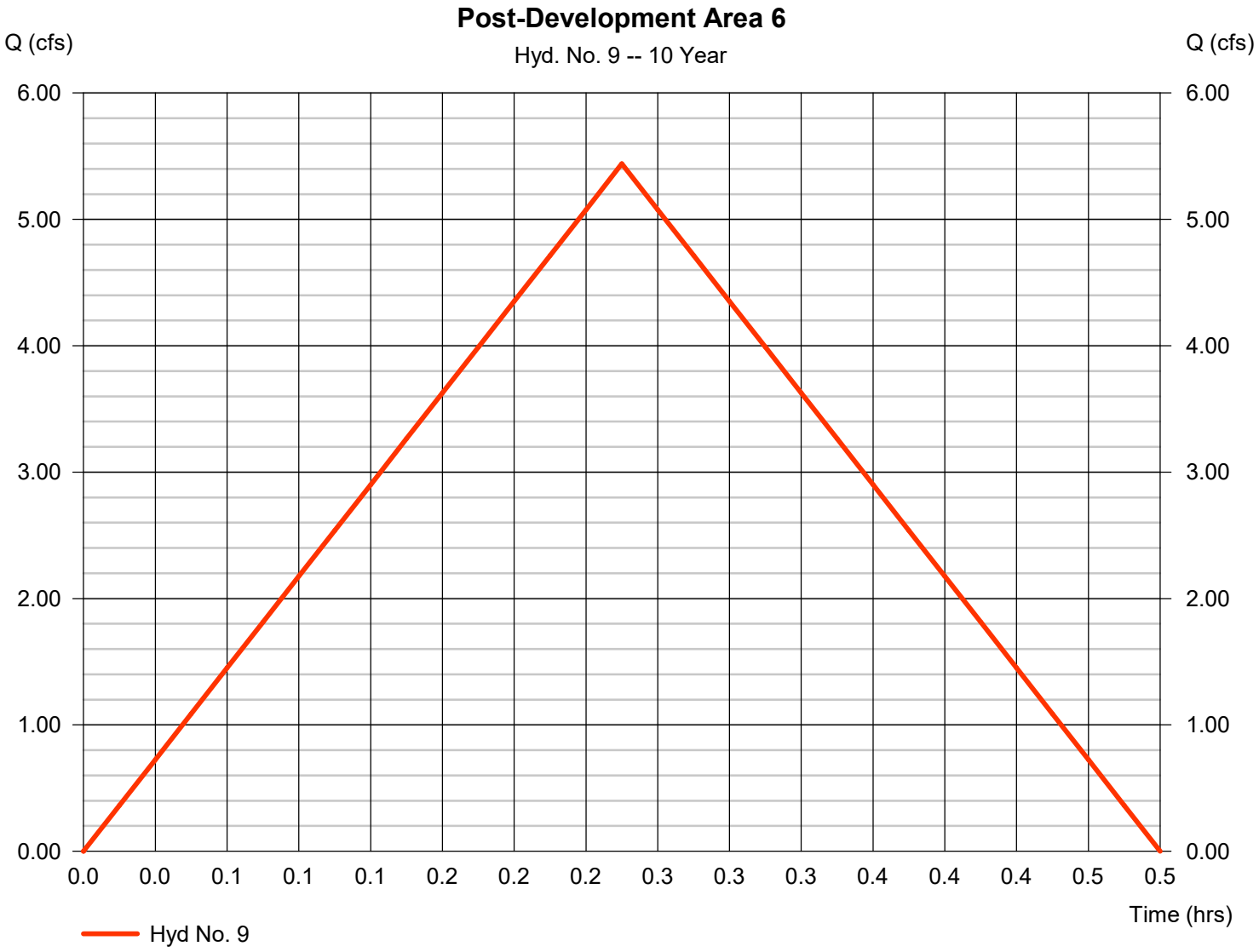


Hydrograph Report

Hyd. No. 9

Post-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	5.440 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	4,896 cuft
Drainage area	=	1.640 ac	Runoff coeff.	=	0.64
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

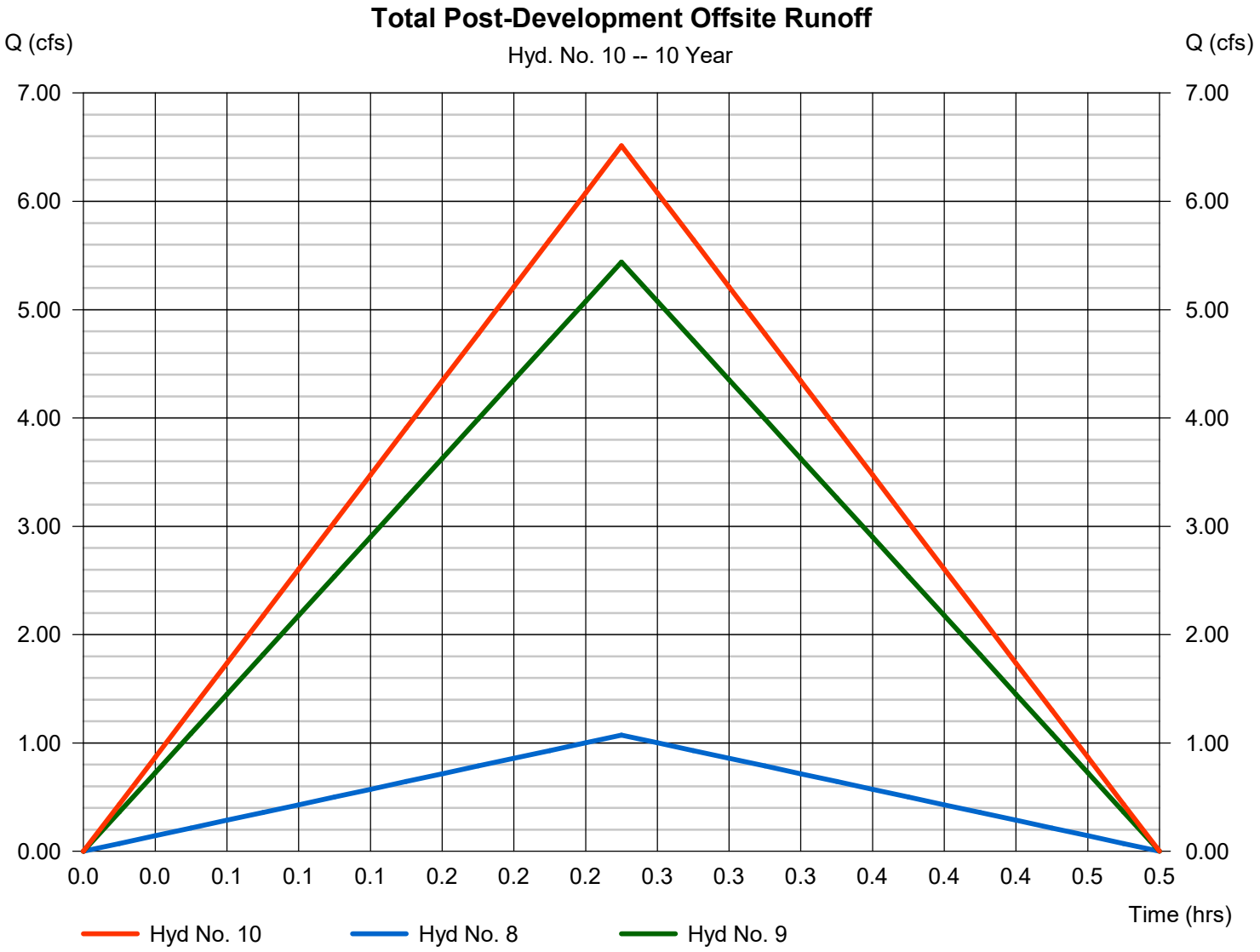


Hydrograph Report

Hyd. No. 10

Total Post-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 6.512 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 5,861 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 2.330 ac

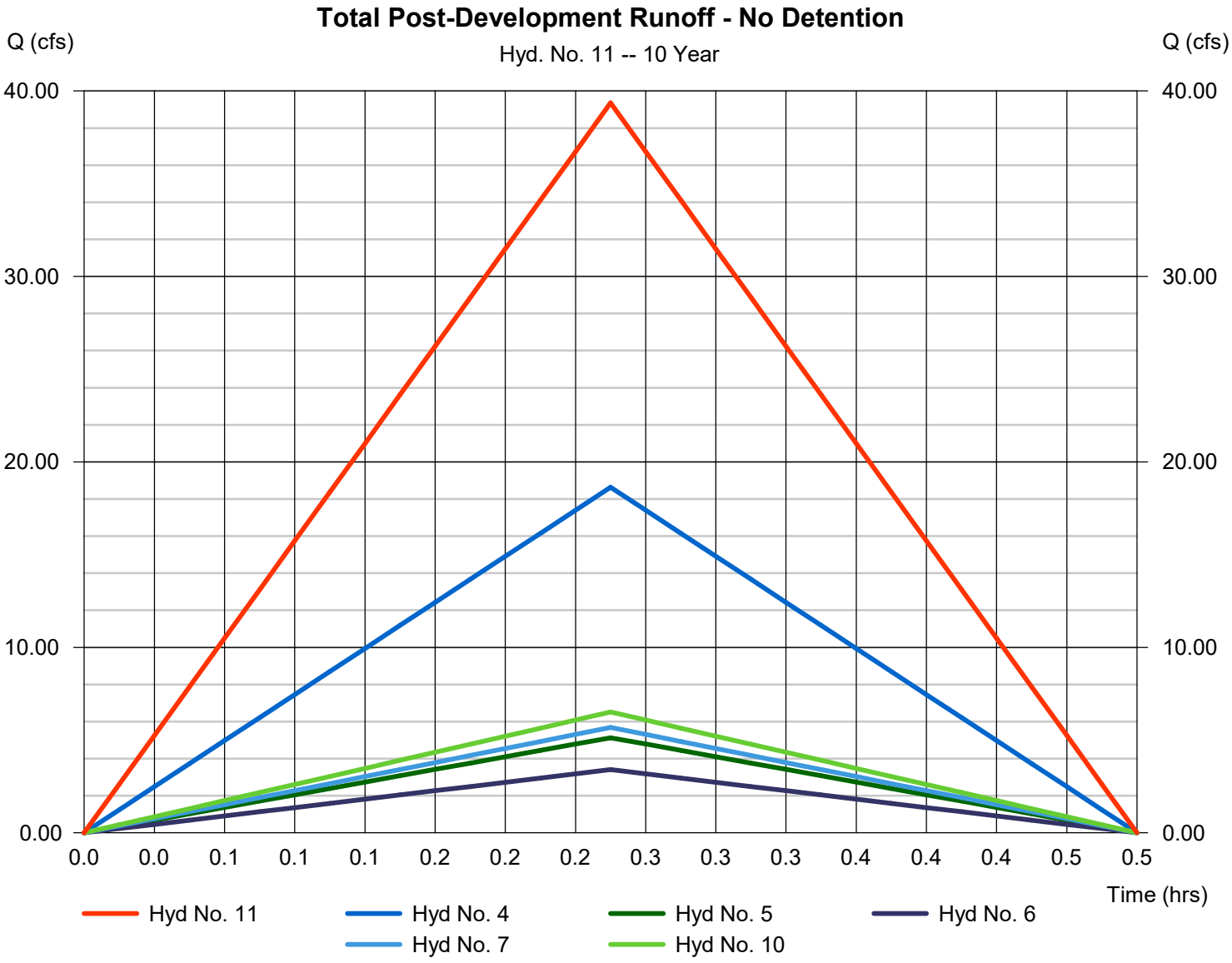


Hydrograph Report

Hyd. No. 11

Total Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 39.36 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 35,421 cuft
Inflow hyds.	= 4, 5, 6, 7, 10	Contrib. drain. area	= 12.640 ac

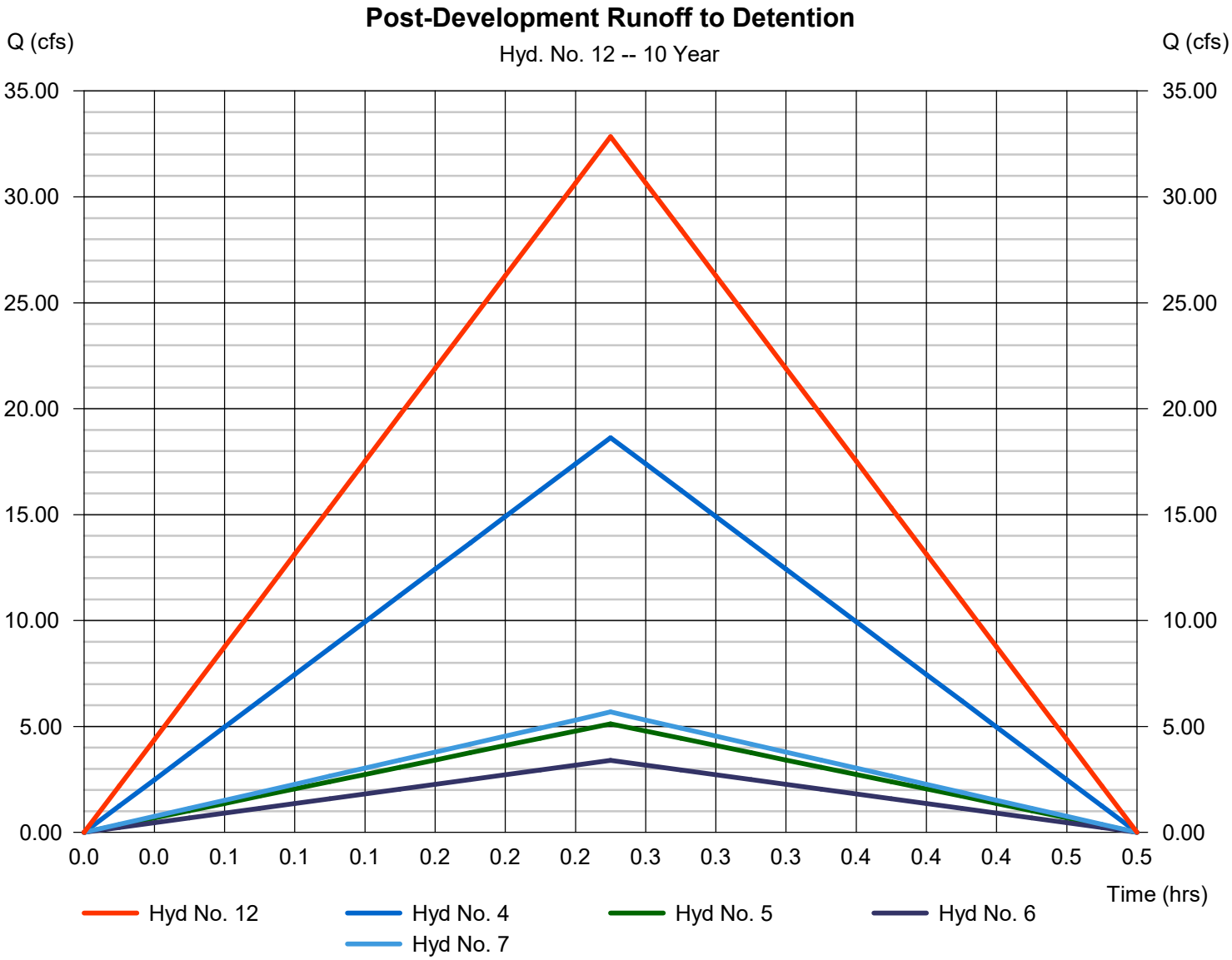


Hydrograph Report

Hyd. No. 12

Post-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 32.84 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 29,560 cuft
Inflow hyds.	= 4, 5, 6, 7	Contrib. drain. area	= 12.640 ac



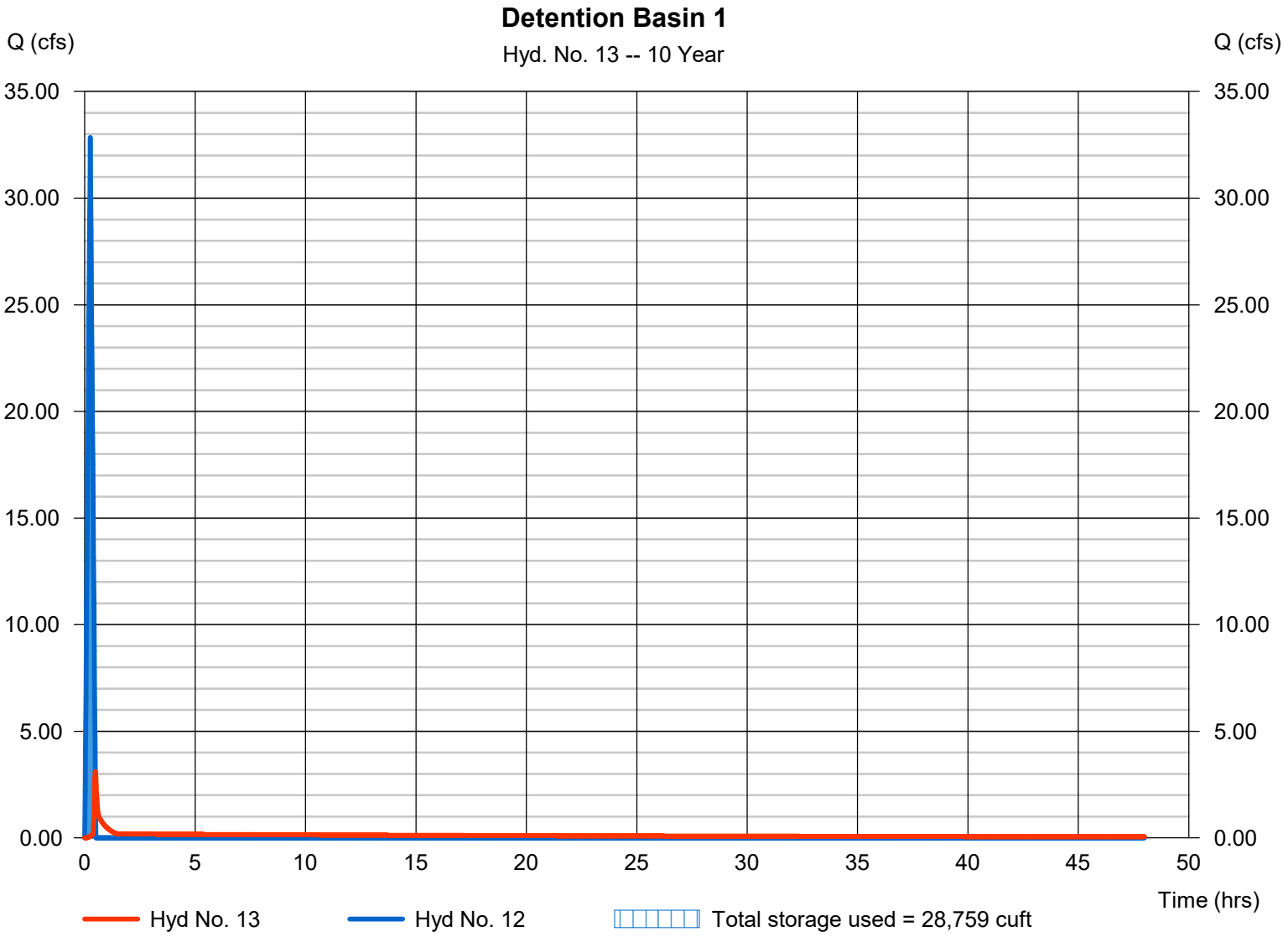
Hydrograph Report

Hyd. No. 13

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	3.093 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.48 hrs
Time interval	=	1 min	Hyd. volume	=	19,363 cuft
Inflow hyd. No.	=	12 - Post-Development Runoff	Max. Elevation	=	1002.16 ft
Reservoir name	=	Detention Basin	Max. Storage	=	28,759 cuft

Storage Indication method used.

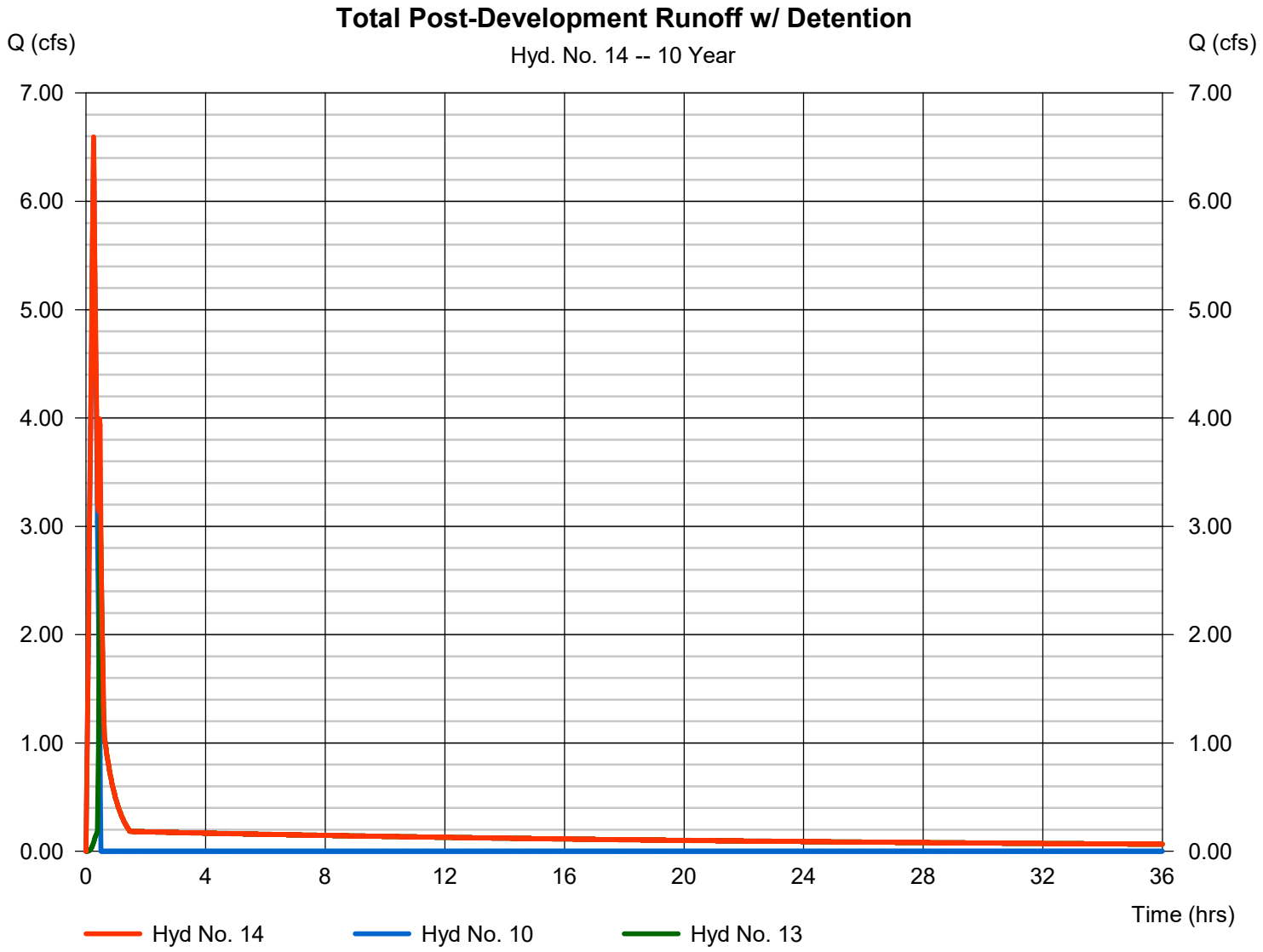


Hydrograph Report

Hyd. No. 14

Total Post-Development Runoff w/ Detention

Hydrograph type	=	Combine	Peak discharge	=	6.593 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	25,224 cuft
Inflow hyds.	=	10, 13	Contrib. drain. area	=	0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	3.771	1	15	3,394	------	------	------	Pre-Development Area A
2	Rational	31.27	1	15	28,140	------	------	------	Pre-Development Area B
3	Combine	35.04	1	15	31,534	1, 2	------	------	Total Pre-Development Runoff
4	Rational	28.07	1	15	25,265	------	------	------	Post-Development Area 1
5	Rational	7.721	1	15	6,949	------	------	------	Post-Development Area 2
6	Rational	5.125	1	15	4,613	------	------	------	Post-Development Area 3
7	Rational	8.558	1	15	7,702	------	------	------	Post-Development Area 4
8	Rational	1.616	1	15	1,454	------	------	------	Post-Development Area 5
9	Rational	8.194	1	15	7,375	------	------	------	Post-Development Area 6
10	Combine	9.810	1	15	8,829	8, 9	------	------	Total Post-Development Offsite Runof
11	Combine	59.29	1	15	53,359	4, 5, 6, 7, 10	------	------	Total Post-Development Runoff - No
12	Combine	49.48	1	15	44,529	4, 5, 6, 7,	------	------	Post-Development Runoff to Detentio
13	Reservoir	15.51	1	25	34,299	12	1002.63	36,096	Detention Basin 1
14	Combine	19.91	1	21	43,129	10, 13	------	------	Total Post-Development Runoff w/ De

Hydrograph Report

Hyd. No. 1

Pre-Development Area A

Hydrograph type	=	Rational	Peak discharge	=	3.771 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	3,394 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.3
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 2

Pre-Development Area B

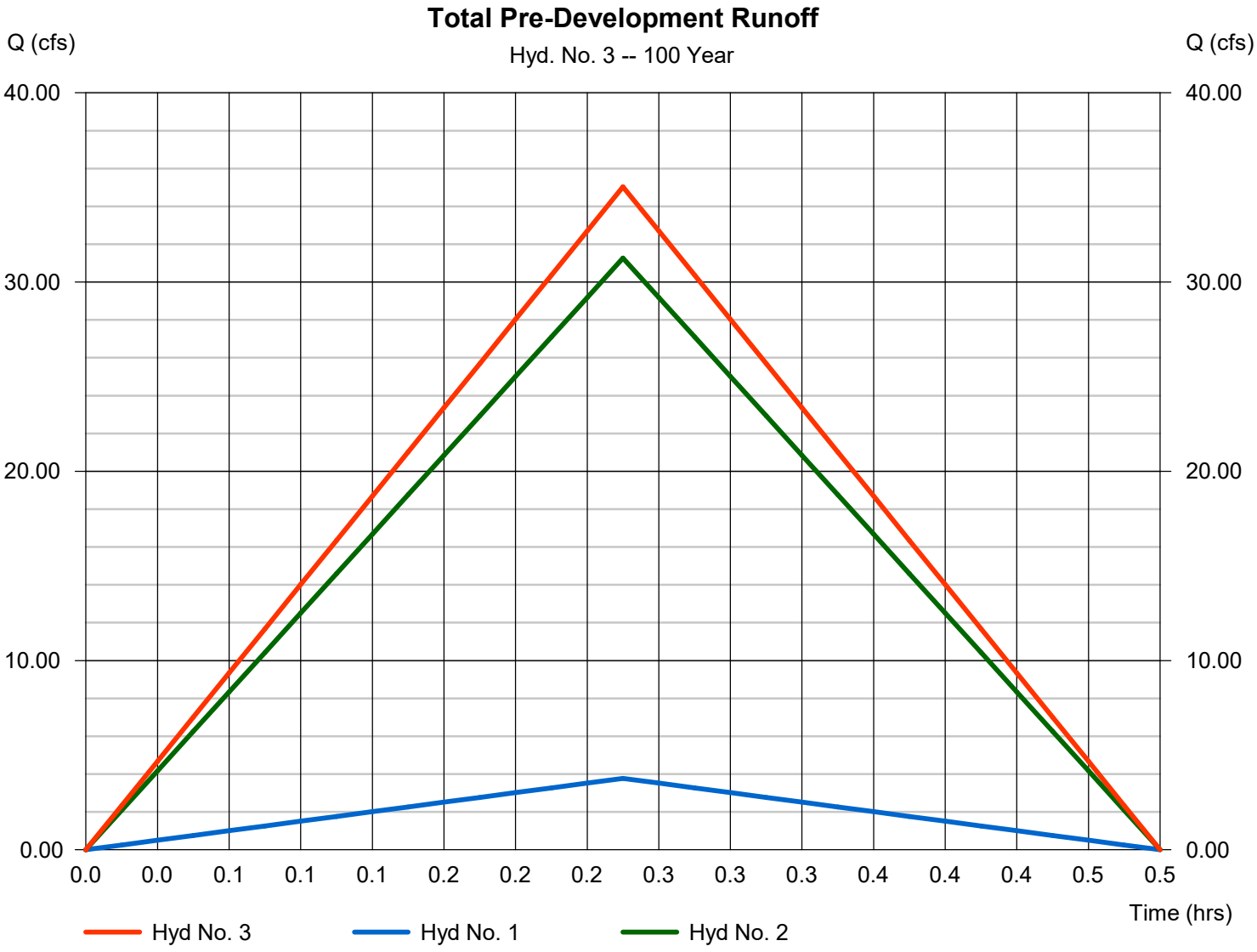
Hydrograph type	=	Rational	Peak discharge	=	31.27 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	28,140 cuft
Drainage area	=	13.350 ac	Runoff coeff.	=	0.3
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type	= Combine	Peak discharge	= 35.04 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 31,534 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.960 ac

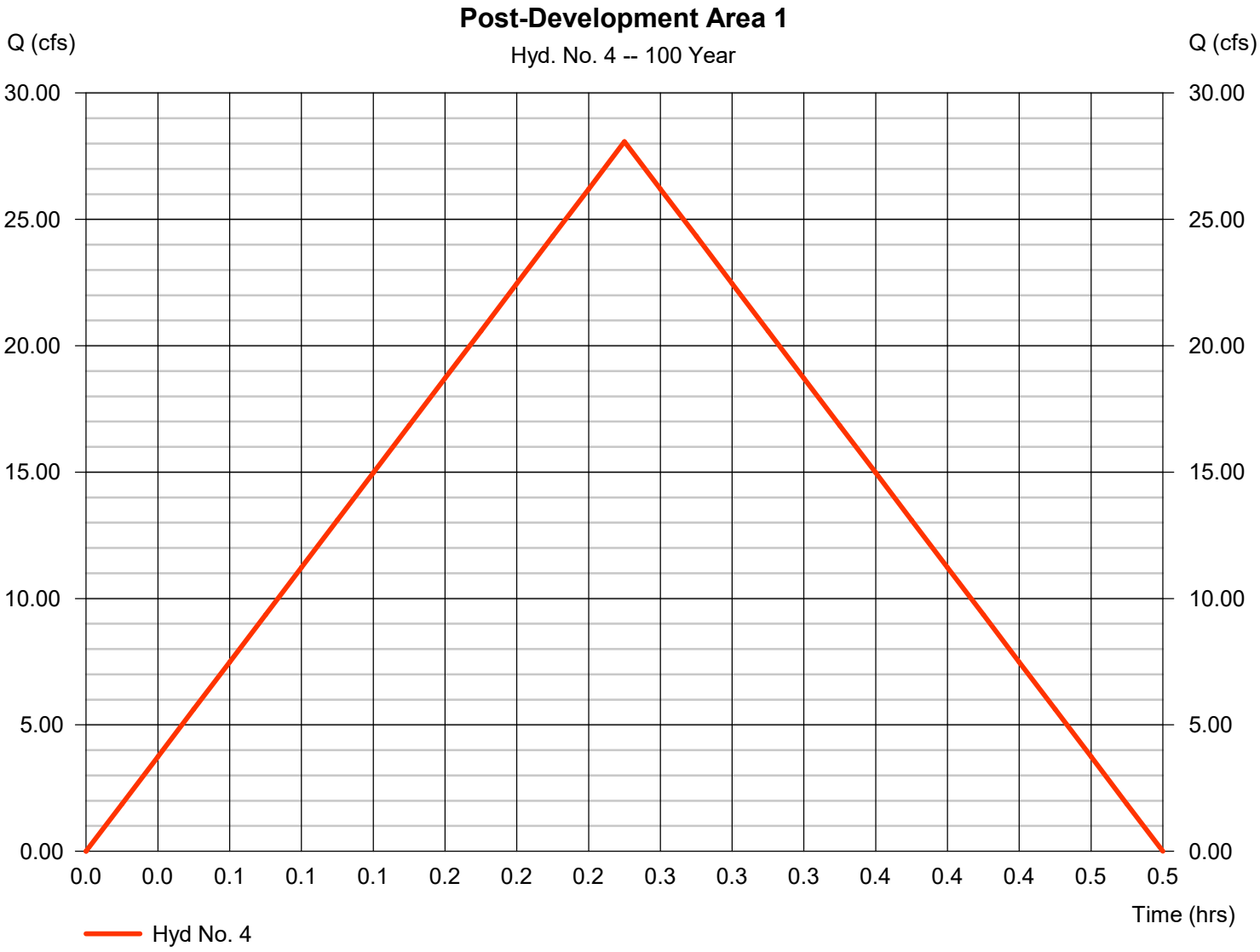


Hydrograph Report

Hyd. No. 4

Post-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	28.07 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	25,265 cuft
Drainage area	=	9.220 ac	Runoff coeff.	=	0.39
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

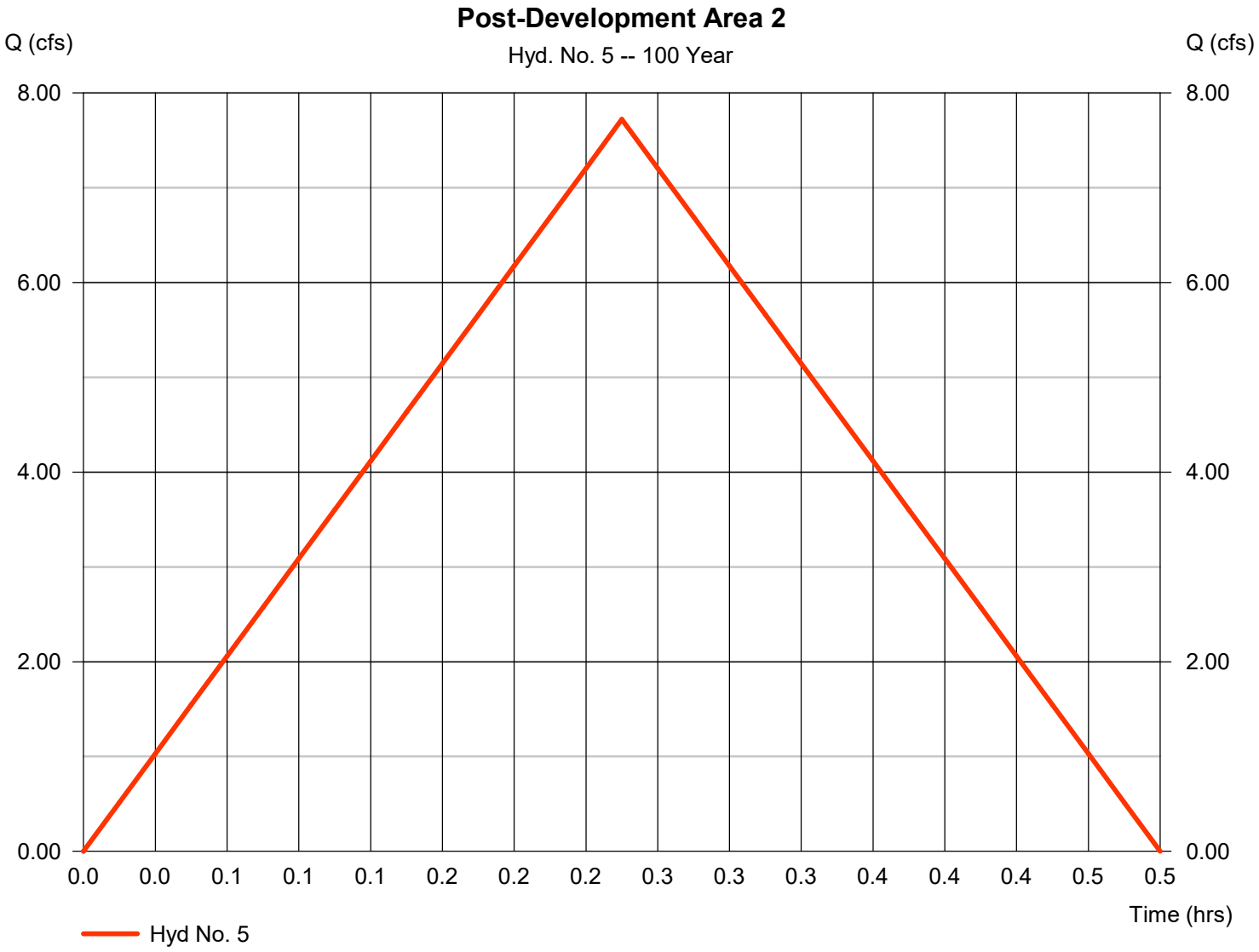


Hydrograph Report

Hyd. No. 5

Post-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	7.721 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	6,949 cuft
Drainage area	=	1.150 ac	Runoff coeff.	=	0.86
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

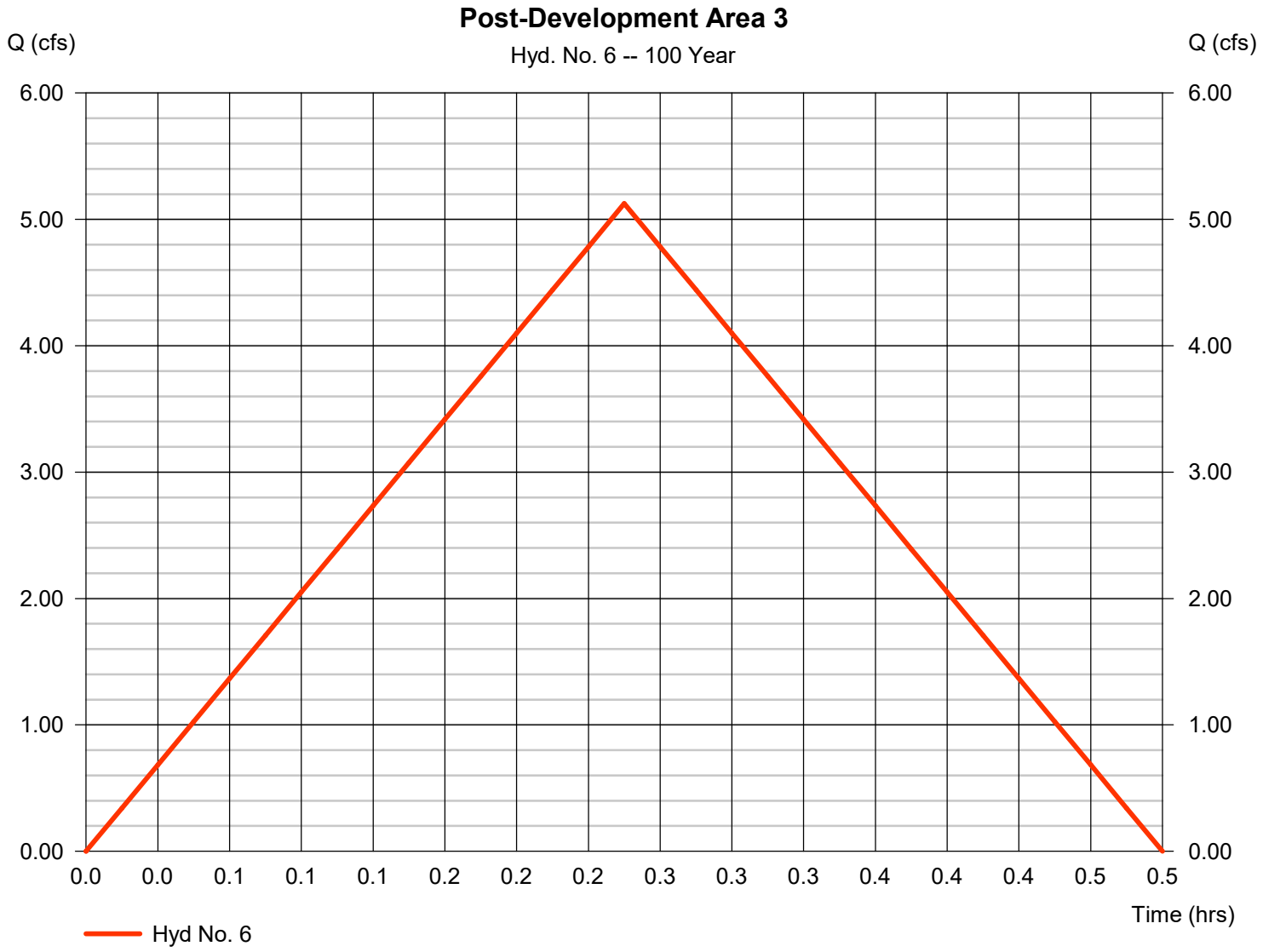


Hydrograph Report

Hyd. No. 6

Post-Development Area 3

Hydrograph type	=	Rational	Peak discharge	=	5.125 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	4,613 cuft
Drainage area	=	1.010 ac	Runoff coeff.	=	0.65
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

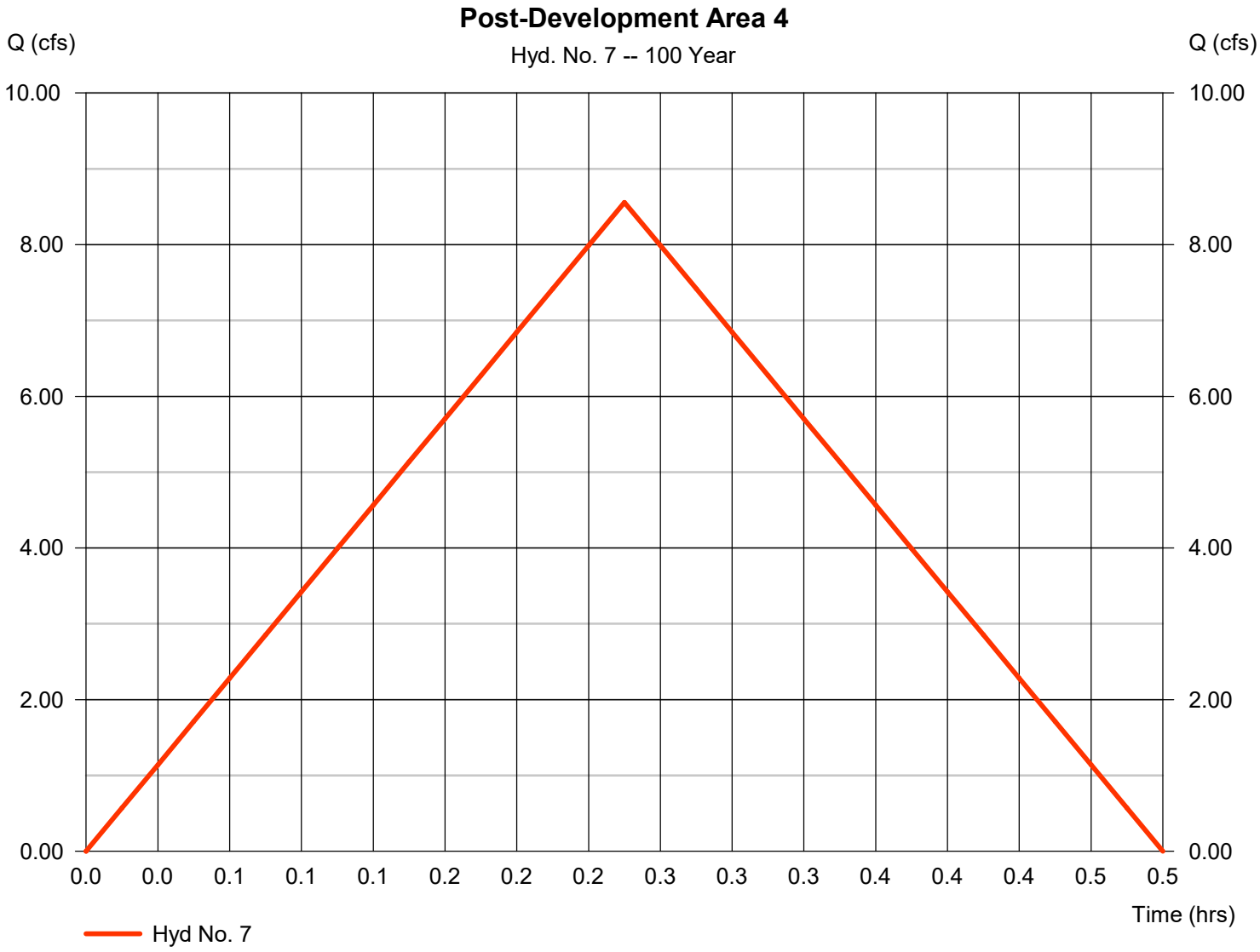


Hydrograph Report

Hyd. No. 7

Post-Development Area 4

Hydrograph type	=	Rational	Peak discharge	=	8.558 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	7,702 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.87
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

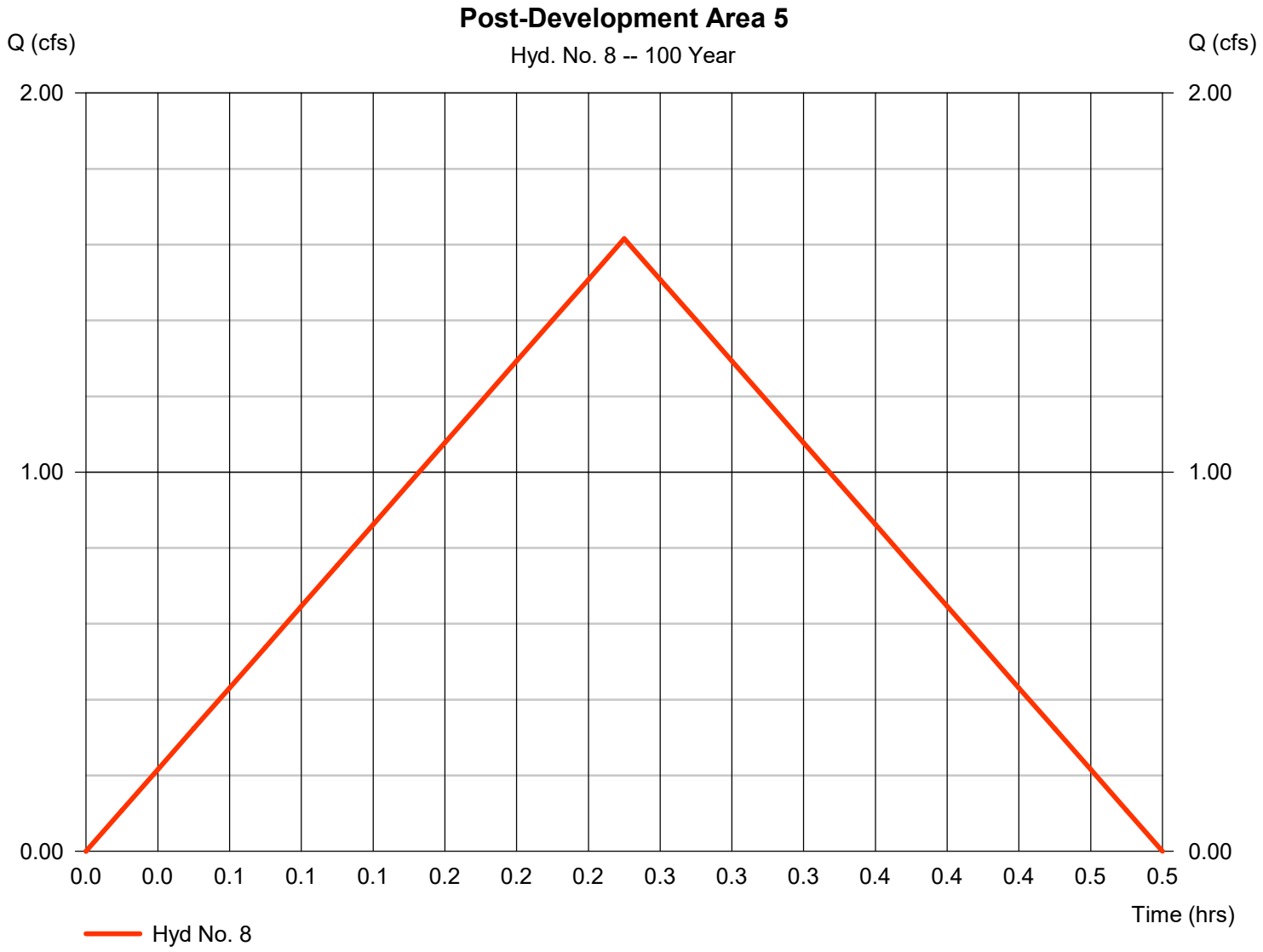


Hydrograph Report

Hyd. No. 8

Post-Development Area 5

Hydrograph type	=	Rational	Peak discharge	=	1.616 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	1,454 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

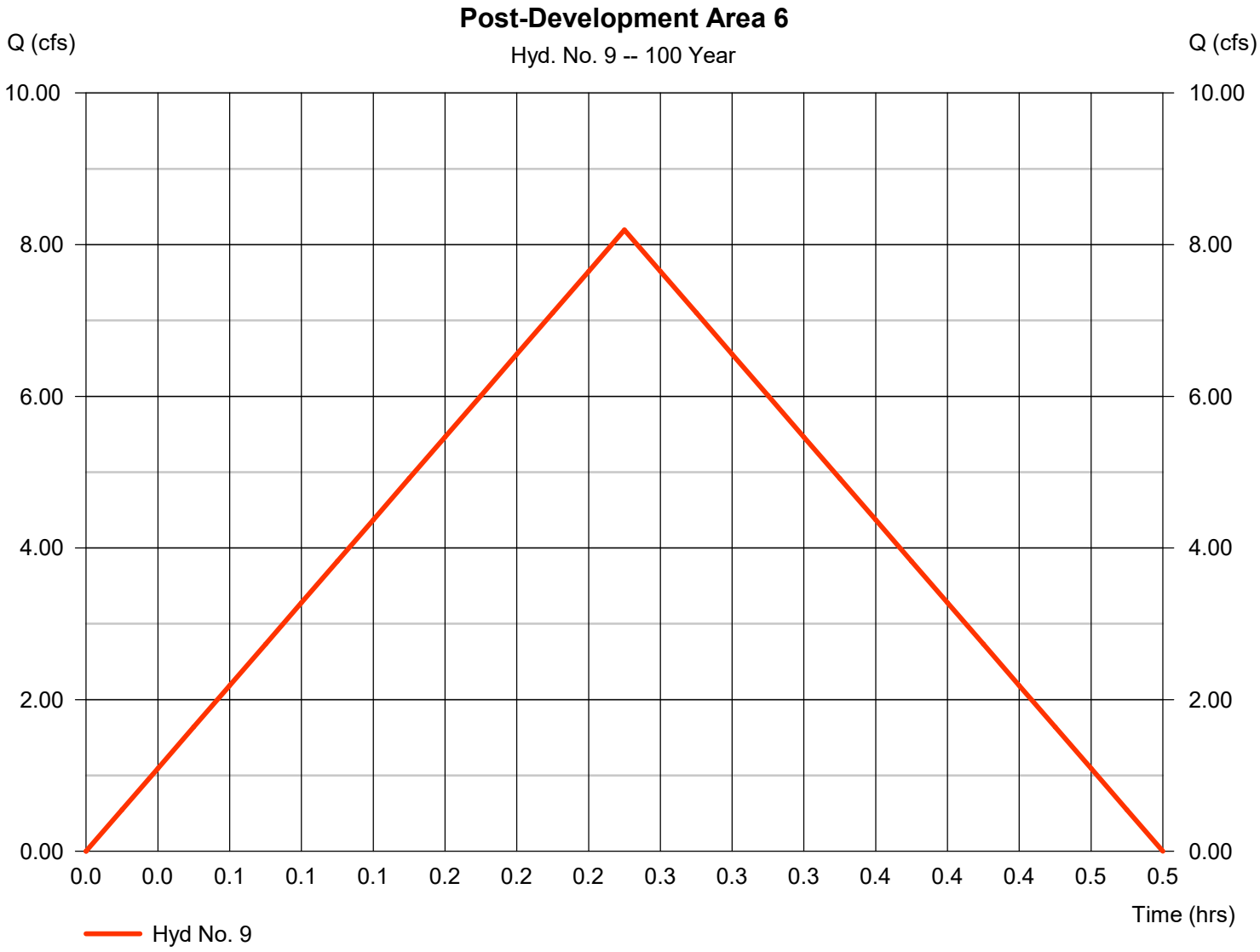


Hydrograph Report

Hyd. No. 9

Post-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	8.194 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	7,375 cuft
Drainage area	=	1.640 ac	Runoff coeff.	=	0.64
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	KCAPWA.IDF	Asc/Rec limb fact	=	1/1

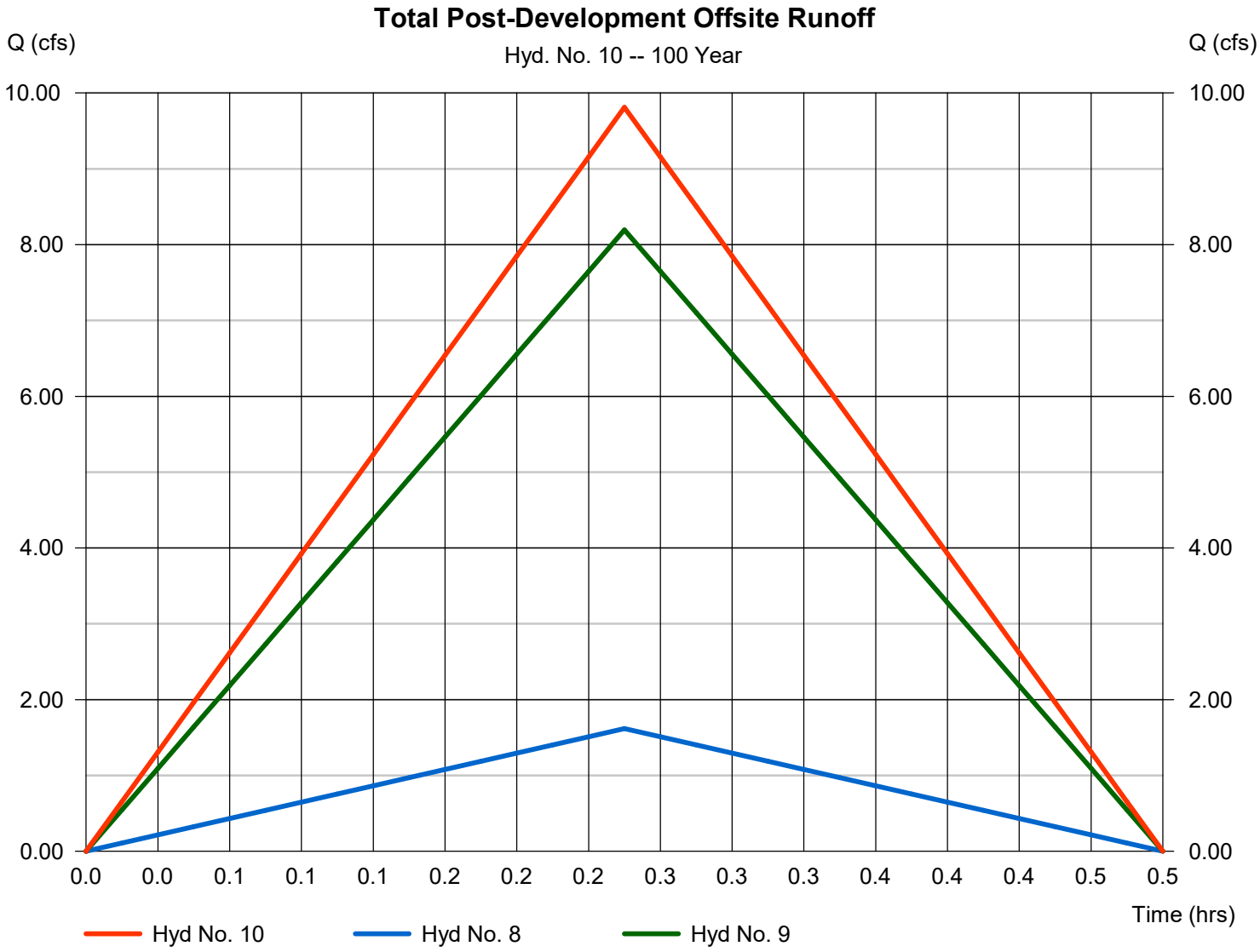


Hydrograph Report

Hyd. No. 10

Total Post-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 9.810 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 8,829 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 2.330 ac

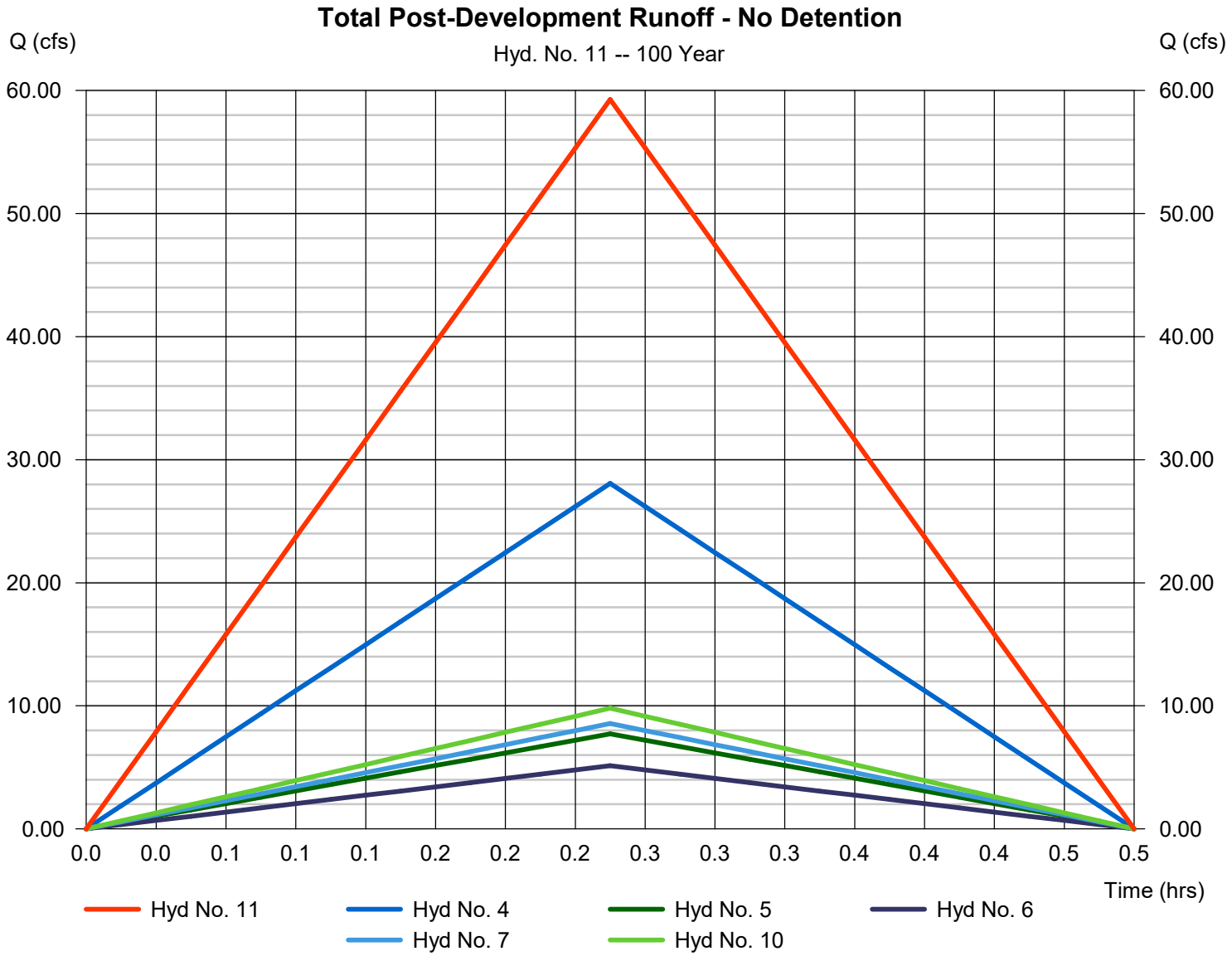


Hydrograph Report

Hyd. No. 11

Total Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 59.29 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 53,359 cuft
Inflow hyds.	= 4, 5, 6, 7, 10	Contrib. drain. area	= 12.640 ac

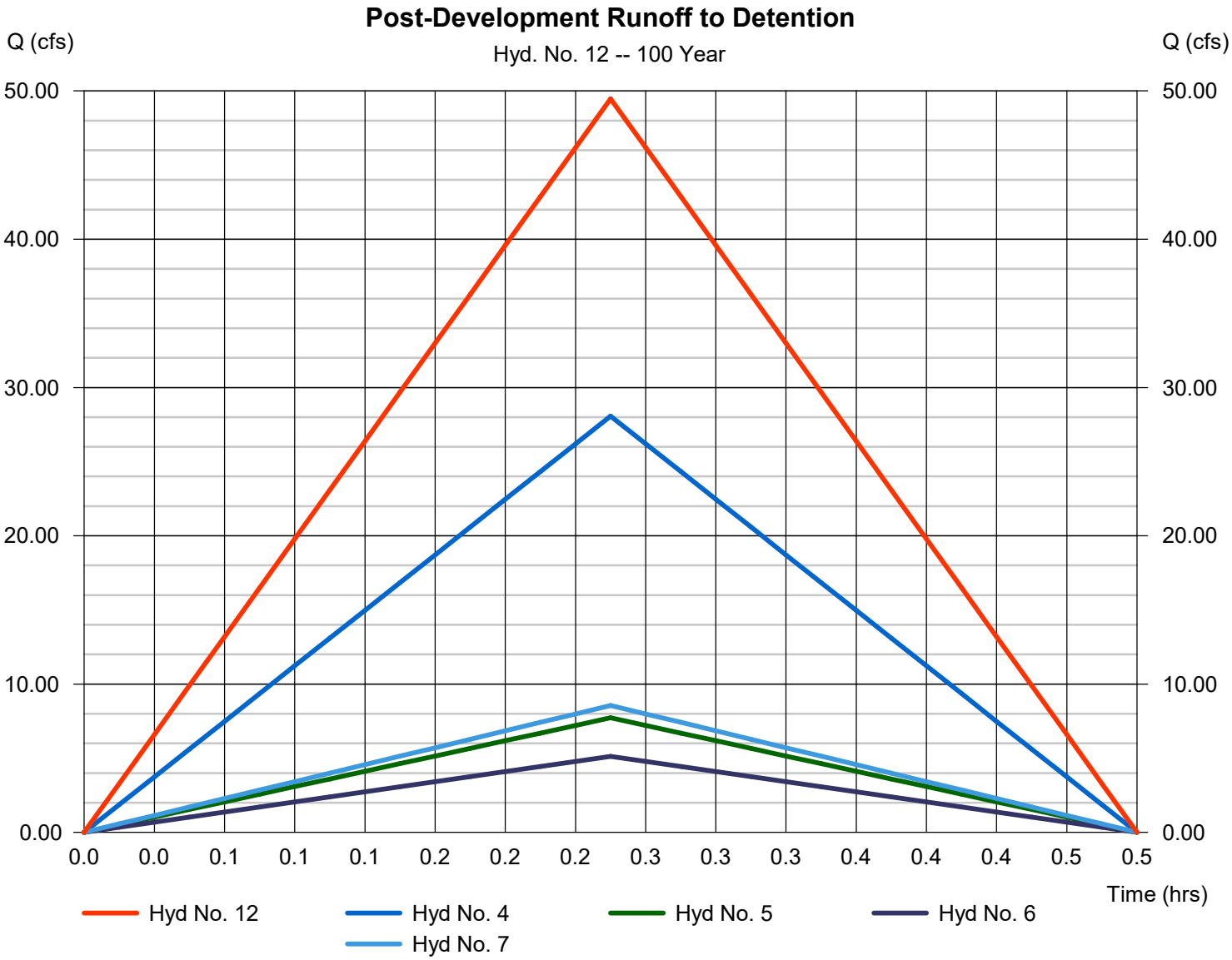


Hydrograph Report

Hyd. No. 12

Post-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 49.48 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 44,529 cuft
Inflow hyds.	= 4, 5, 6, 7	Contrib. drain. area	= 12.640 ac



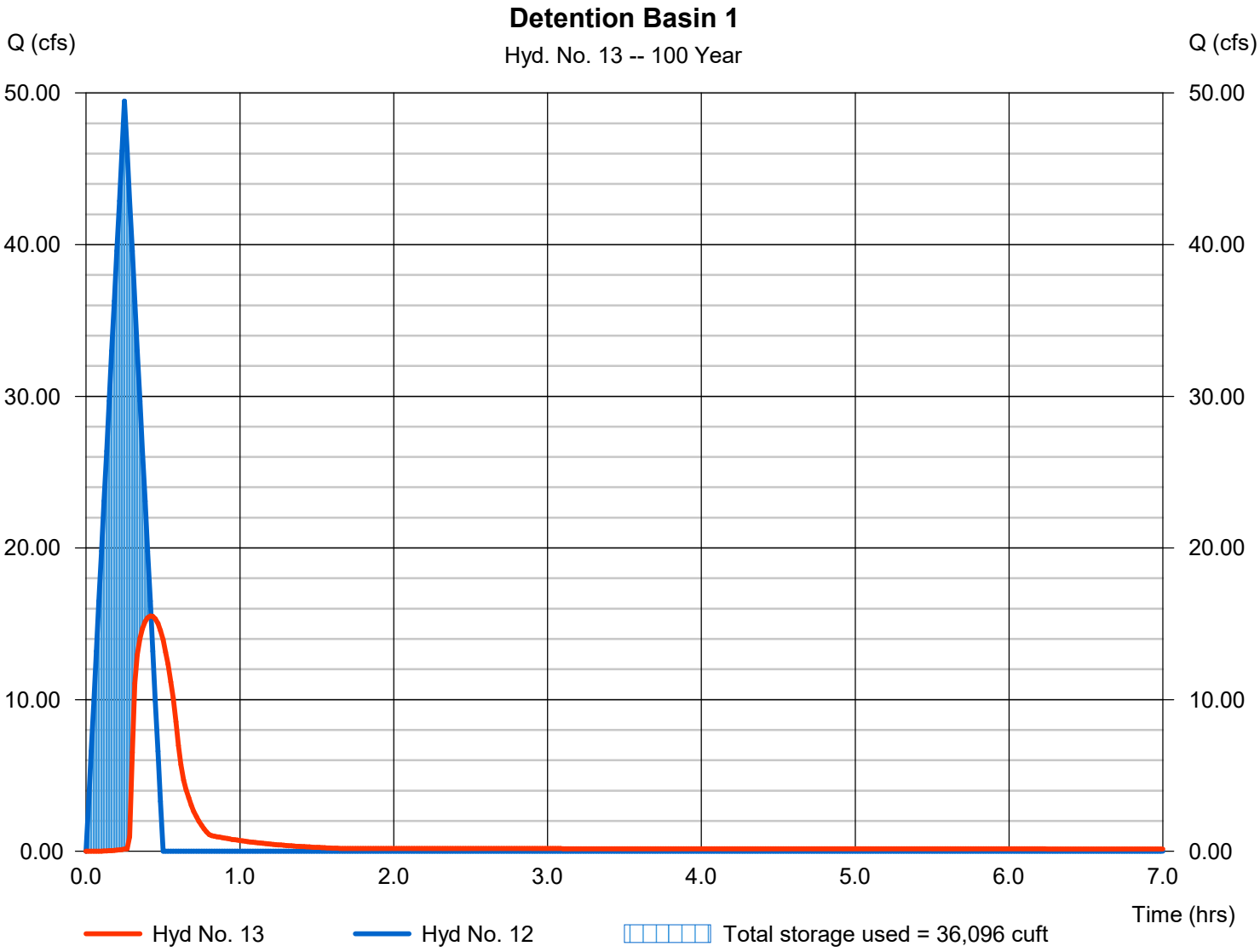
Hydrograph Report

Hyd. No. 13

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	15.51 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.42 hrs
Time interval	=	1 min	Hyd. volume	=	34,299 cuft
Inflow hyd. No.	=	12 - Post-Development Runoff to Detention	Max. Elevation	=	1002.63 ft
Reservoir name	=	Detention Basin	Max. Storage	=	36,096 cuft

Storage Indication method used.

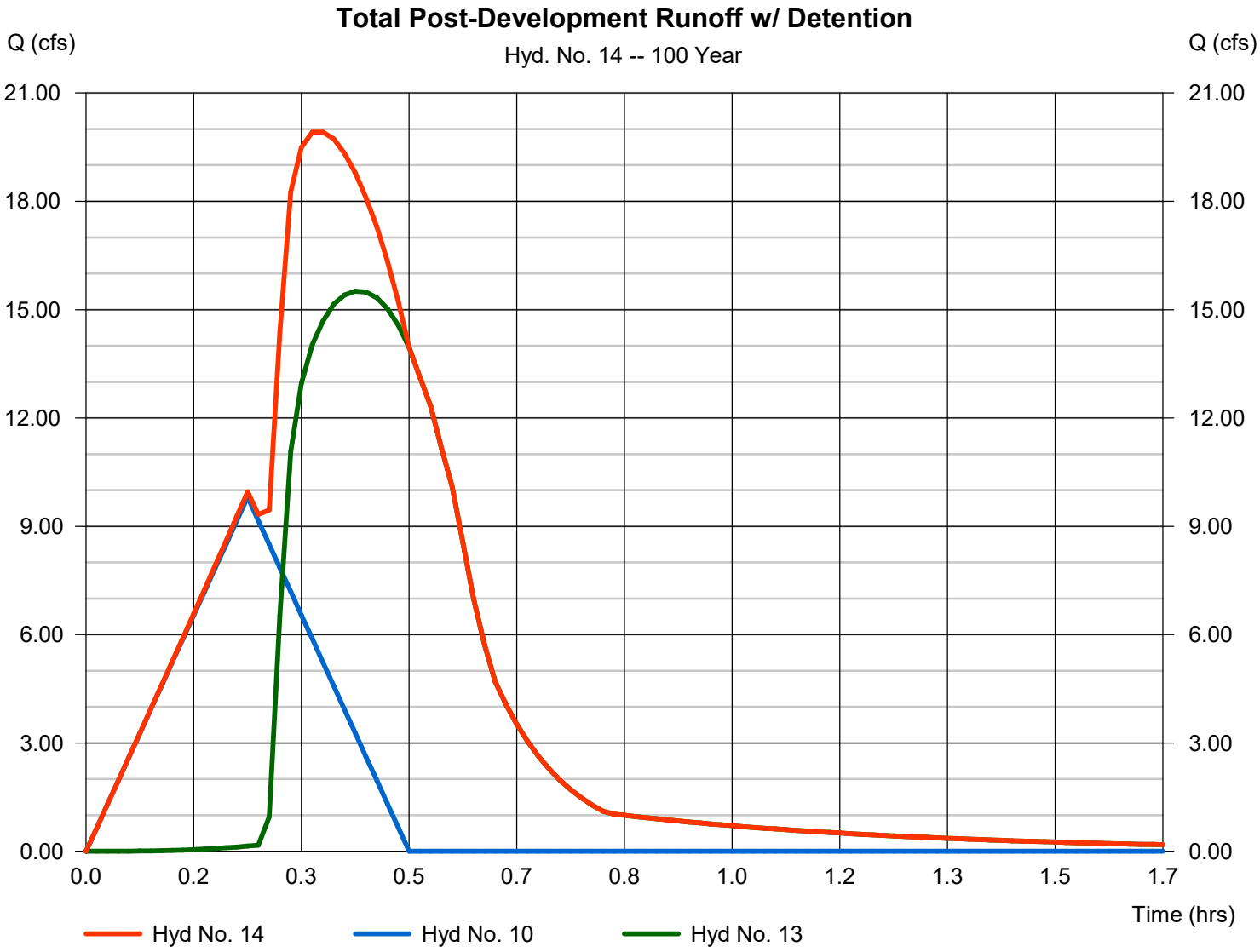


Hydrograph Report

Hyd. No. 14

Total Post-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 19.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 43,129 cuft
Inflow hyds.	= 10, 13	Contrib. drain. area	= 0.000 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	2.9200	0.1000	0.0000	--------
2	110.7137	16.5000	0.9842	--------
3	0.0000	0.0000	0.0000	--------
5	168.3971	19.5000	1.0189	--------
10	183.3473	19.2000	1.0096	--------
25	103.5313	15.9000	0.8218	--------
50	235.4014	19.9000	1.0020	--------
100	83.7894	6.1000	0.7783	--------

File name: KCAPWA.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
2	5.41	4.40	3.71	3.21	2.83	2.53	2.29	2.09	1.92	1.78	1.66	1.55
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95
10	7.35	6.08	5.18	4.52	4.00	3.59	3.26	2.98	2.74	2.54	2.37	2.22
25	8.51	7.14	6.17	5.46	4.90	4.46	4.10	3.79	3.54	3.31	3.12	2.95
50	9.39	7.82	6.70	5.86	5.20	4.68	4.25	3.90	3.60	3.34	3.12	2.92
100	12.87	9.64	7.81	6.62	5.77	5.14	4.65	4.25	3.92	3.65	3.41	3.21

Tc = time in minutes. Values may exceed 60.

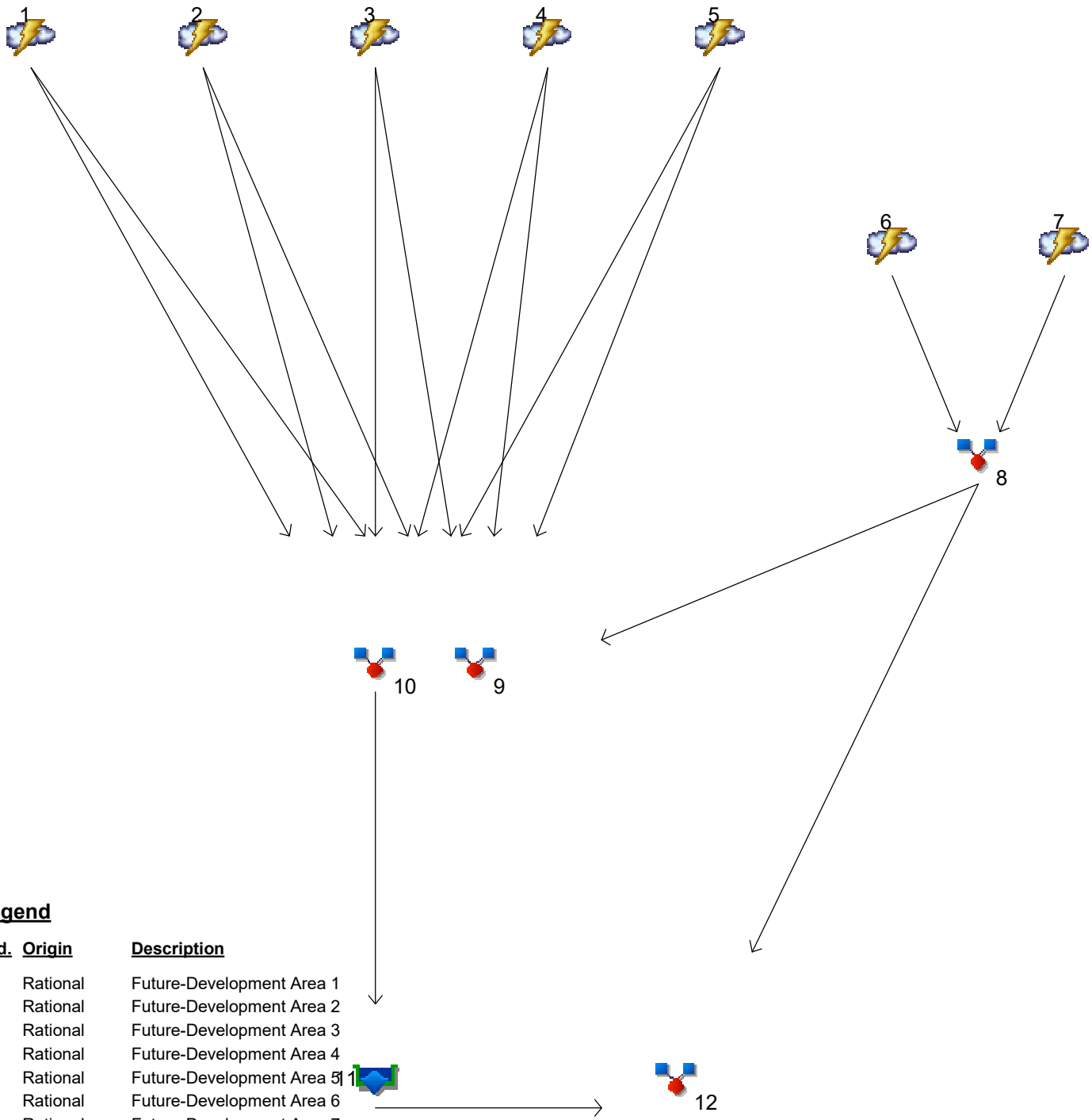
Precip. file name: P:\DAE Civil\Hydraflow Storm Sewer\SCS 24-hr Rainfall.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.85	3.50	0.00	4.50	5.30	6.10	6.90	7.50
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	2.90	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Appendix C

Hydraflow Table of Contents

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Rational	Future-Development Area 1
2	Rational	Future-Development Area 2
3	Rational	Future-Development Area 3
4	Rational	Future-Development Area 4
5	Rational	Future-Development Area 5
6	Rational	Future-Development Area 6
7	Rational	Future-Development Area 7
8	Combine	Total Future-Development Offsite Runoff
9	Combine	Future Post-Development Runoff - No Detention
10	Combine	Future-Development Runoff to Detention
11	Reservoir	Detention Basin 1
12	Combine	Total Future-Development Runoff w/ Detention

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	11.93	15.17	-------	18.65	21.18	25.23	27.36	31.90	Future-Development Area 1
2	Rational	------	2.888	3.671	-------	4.515	5.126	6.106	6.623	7.721	Future-Development Area 2
3	Rational	------	1.917	2.437	-------	2.997	3.402	4.053	4.396	5.125	Future-Development Area 3
4	Rational	------	3.201	4.069	-------	5.004	5.681	6.768	7.341	8.558	Future-Development Area 4
5	Rational	------	3.630	4.615	-------	5.675	6.443	7.676	8.325	9.706	Future-Development Area 5
6	Rational	------	3.098	3.938	-------	4.843	5.498	6.549	7.103	8.282	Future-Development Area 6
7	Rational	------	0.604	0.768	-------	0.945	1.073	1.278	1.386	1.616	Future-Development Area 7
8	Combine	6, 7	3.702	4.706	-------	5.787	6.570	7.827	8.490	9.898	Total Future-Development Offsite Ru
9	Combine	1, 2, 3, 4, 5, 8	27.27	34.66	-------	42.63	48.40	57.66	62.53	72.91	Future Post-Development Runoff - No
10	Combine	1, 2, 3, 4, 5,	23.57	29.96	-------	36.84	41.83	49.83	54.04	63.01	Future-Development Runoff to Detent
11	Reservoir	10	0.150	0.437	-------	8.336	13.92	18.03	19.39	21.86	Detention Basin 1
12	Combine	8, 11	3.759	4.786	-------	9.818	16.24	21.68	23.55	27.04	Total Future-Development Runoff w/

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

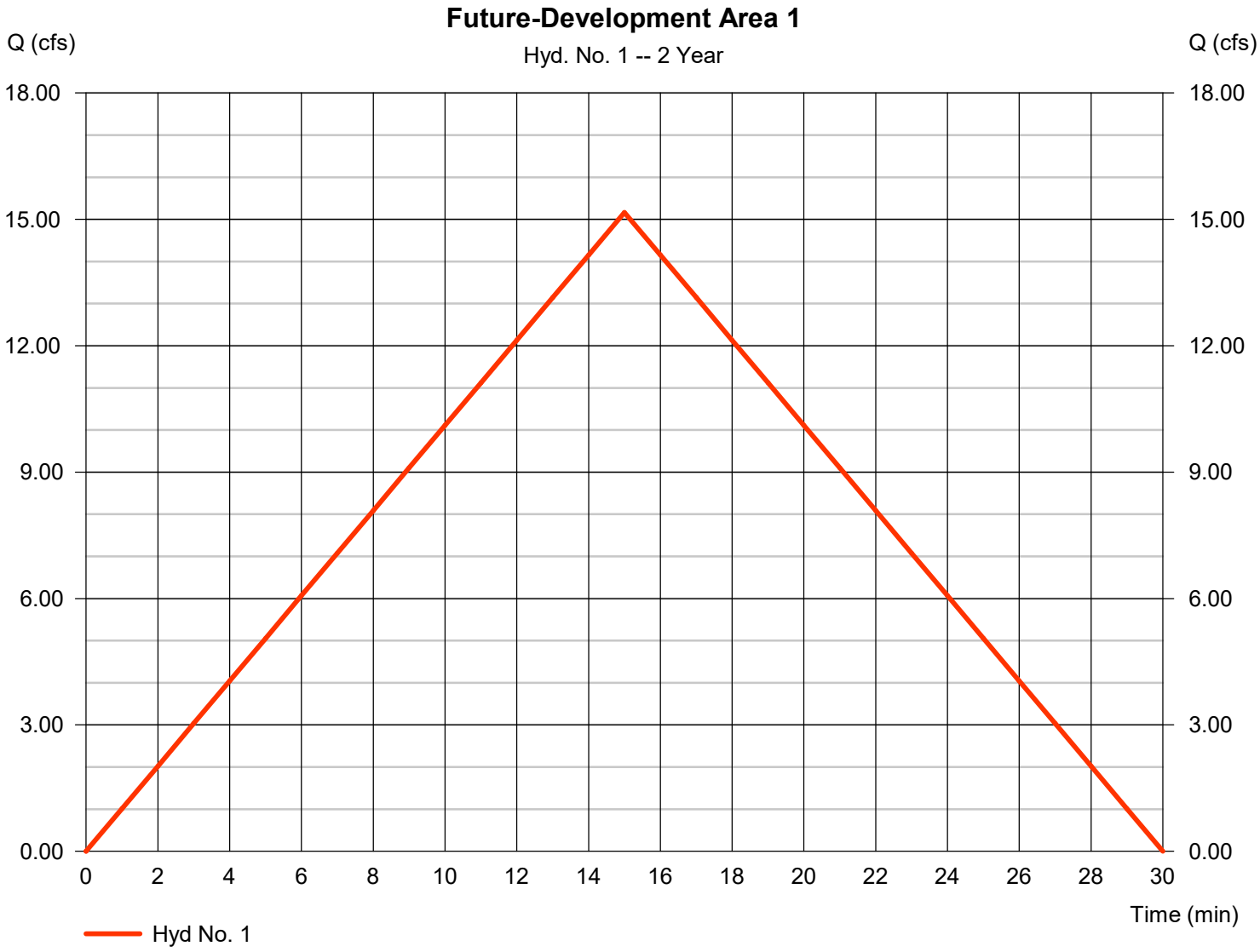
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	15.17	1	15	13,649	------	------	------	Future-Development Area 1
2	Rational	3.671	1	15	3,304	------	------	------	Future-Development Area 2
3	Rational	2.437	1	15	2,193	------	------	------	Future-Development Area 3
4	Rational	4.069	1	15	3,662	------	------	------	Future-Development Area 4
5	Rational	4.615	1	15	4,153	------	------	------	Future-Development Area 5
6	Rational	3.938	1	15	3,544	------	------	------	Future-Development Area 6
7	Rational	0.768	1	15	692	------	------	------	Future-Development Area 7
8	Combine	4.706	1	15	4,235	6, 7	------	------	Total Future-Development Offsite Ru
9	Combine	34.66	1	15	31,197	1, 2, 3, 4, 5, 8	------	------	Future Post-Development Runoff - No
10	Combine	29.96	1	15	26,961	1, 2, 3, 4, 5, 10	------	------	Future-Development Runoff to Detent
11	Reservoir	0.437	1	30	17,810	10	1002.03	26,769	Detention Basin 1
12	Combine	4.786	1	15	22,046	8, 11	------	------	Total Future-Development Runoff w/

Hydrograph Report

Hyd. No. 1

Future-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	15.17 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	13,649 cuft
Drainage area	=	6.590 ac	Runoff coeff.	=	0.62
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

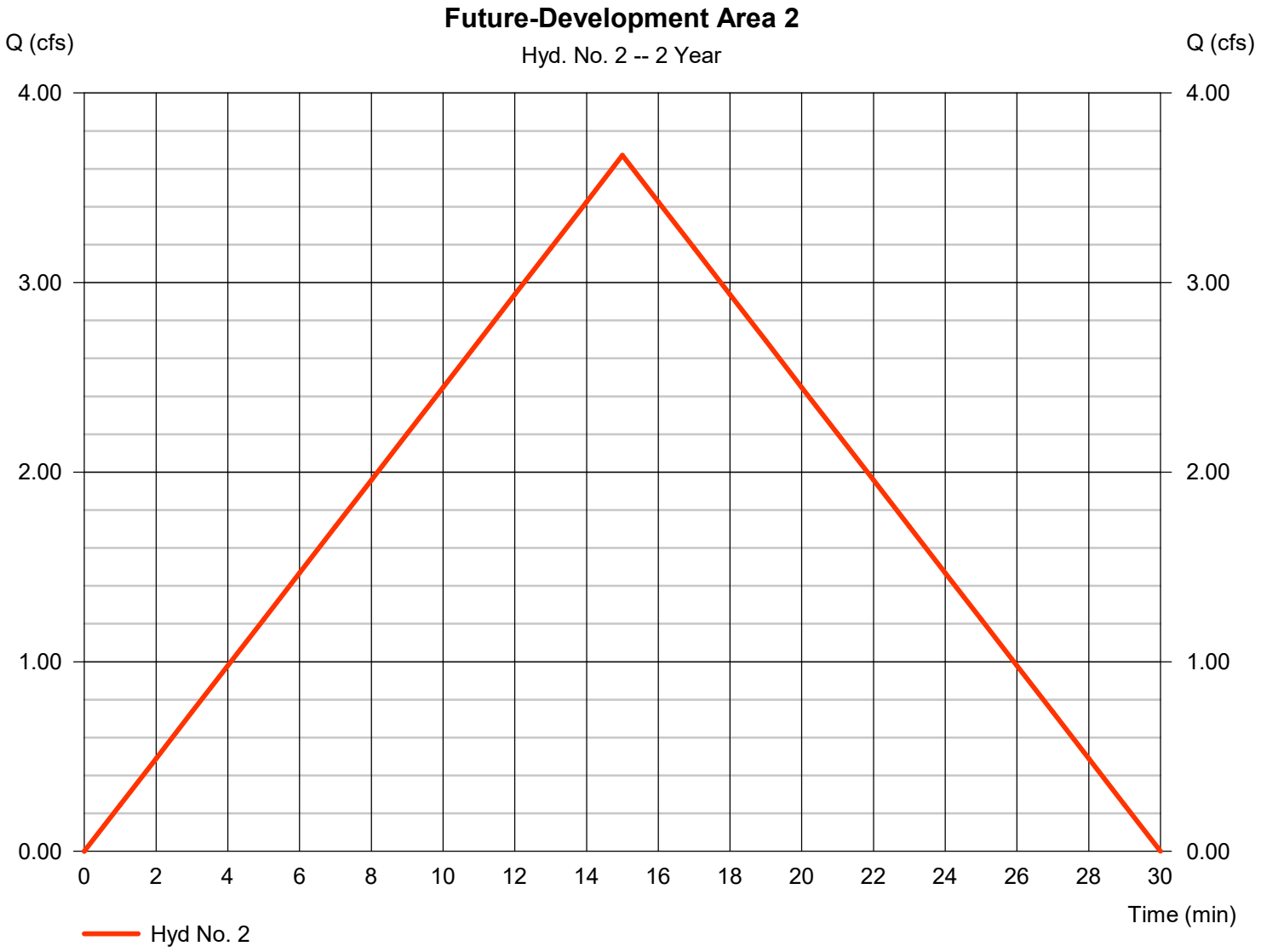


Hydrograph Report

Hyd. No. 2

Future-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	3.671 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,304 cuft
Drainage area	=	1.150 ac	Runoff coeff.	=	0.86
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

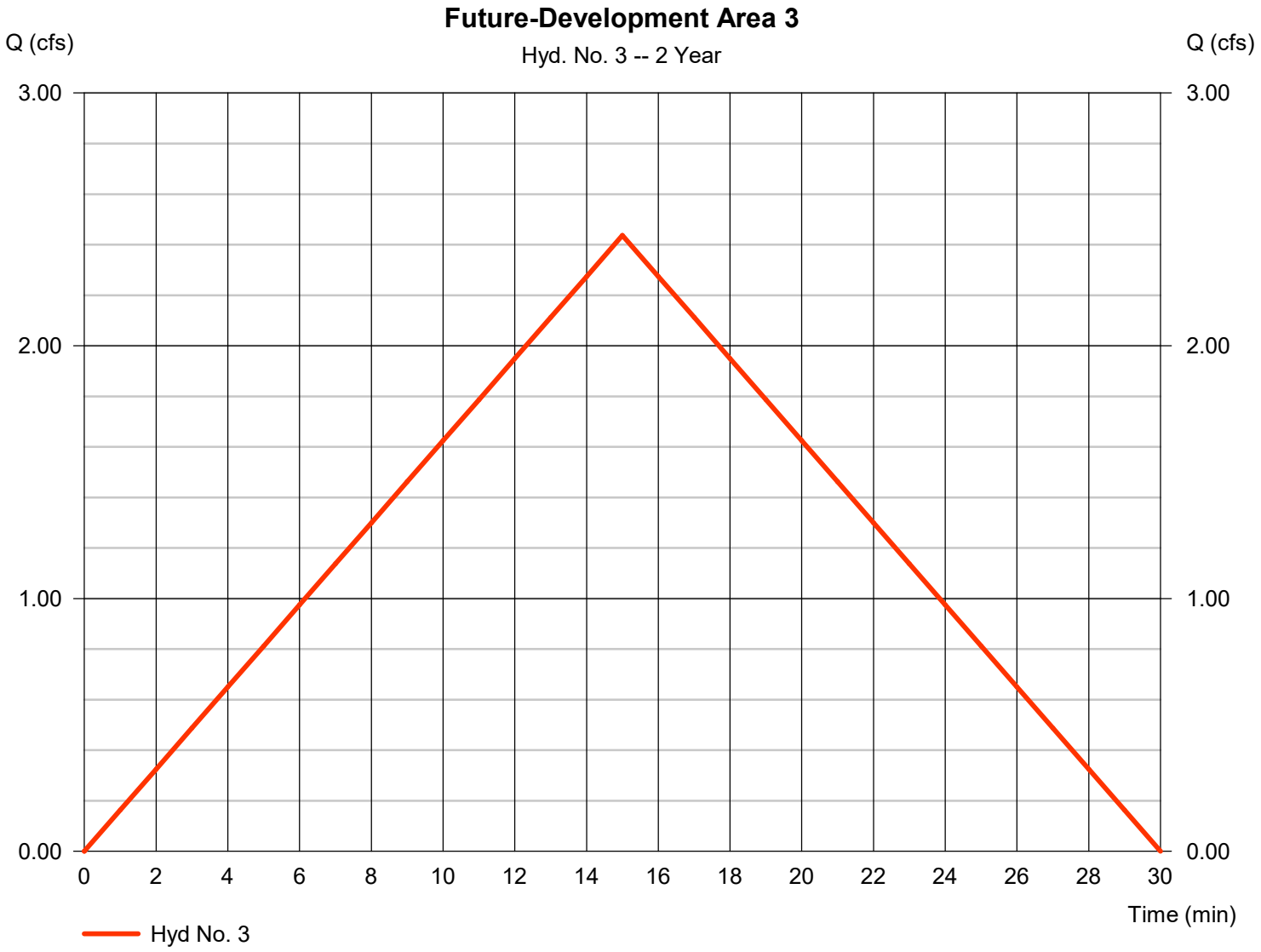


Hydrograph Report

Hyd. No. 3

Future-Development Area 3

Hydrograph type	=	Rational	Peak discharge	=	2.437 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	2,193 cuft
Drainage area	=	1.010 ac	Runoff coeff.	=	0.65
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

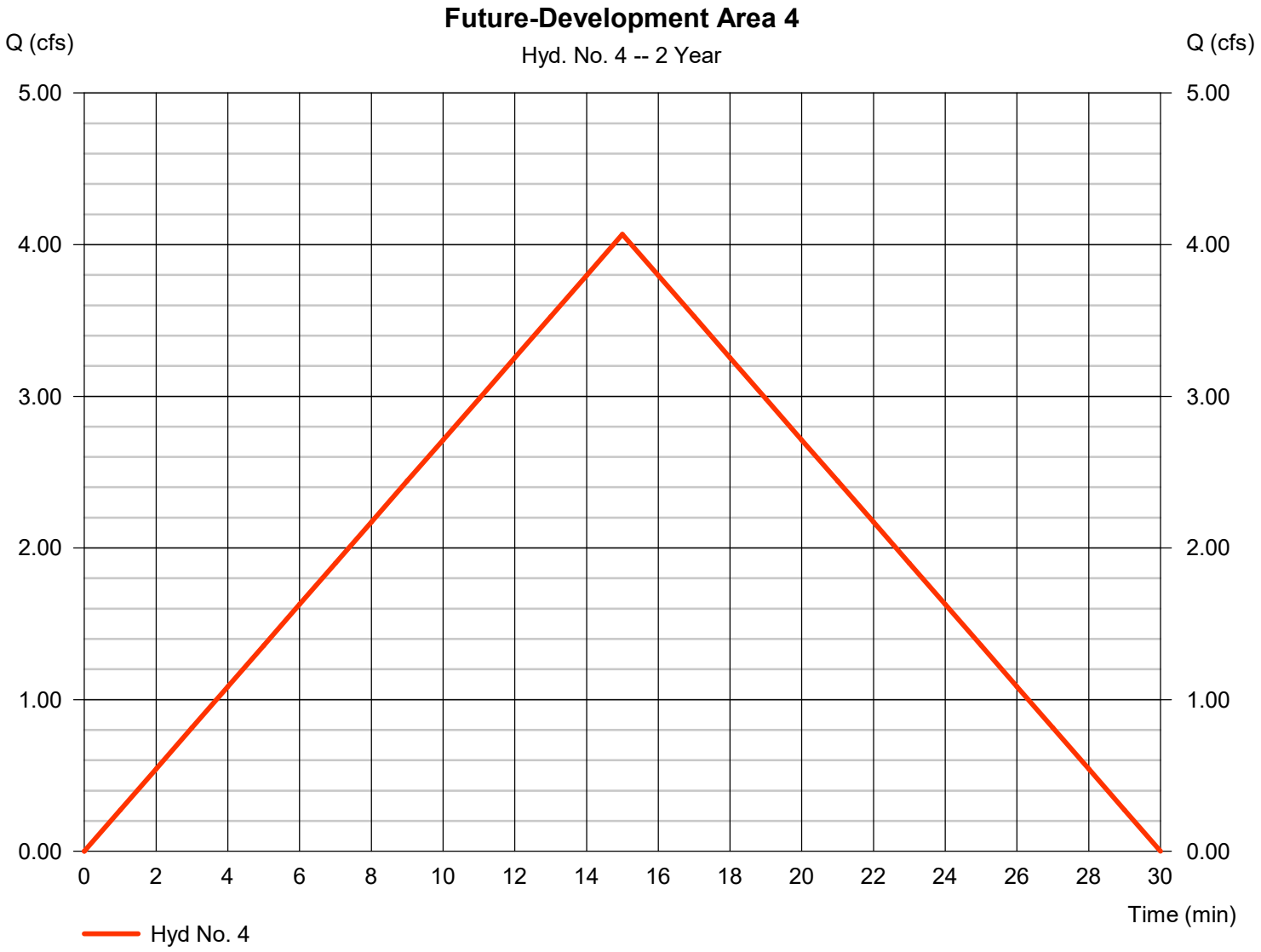


Hydrograph Report

Hyd. No. 4

Future-Development Area 4

Hydrograph type	=	Rational	Peak discharge	=	4.069 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,662 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.87
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 5

Future-Development Area 5

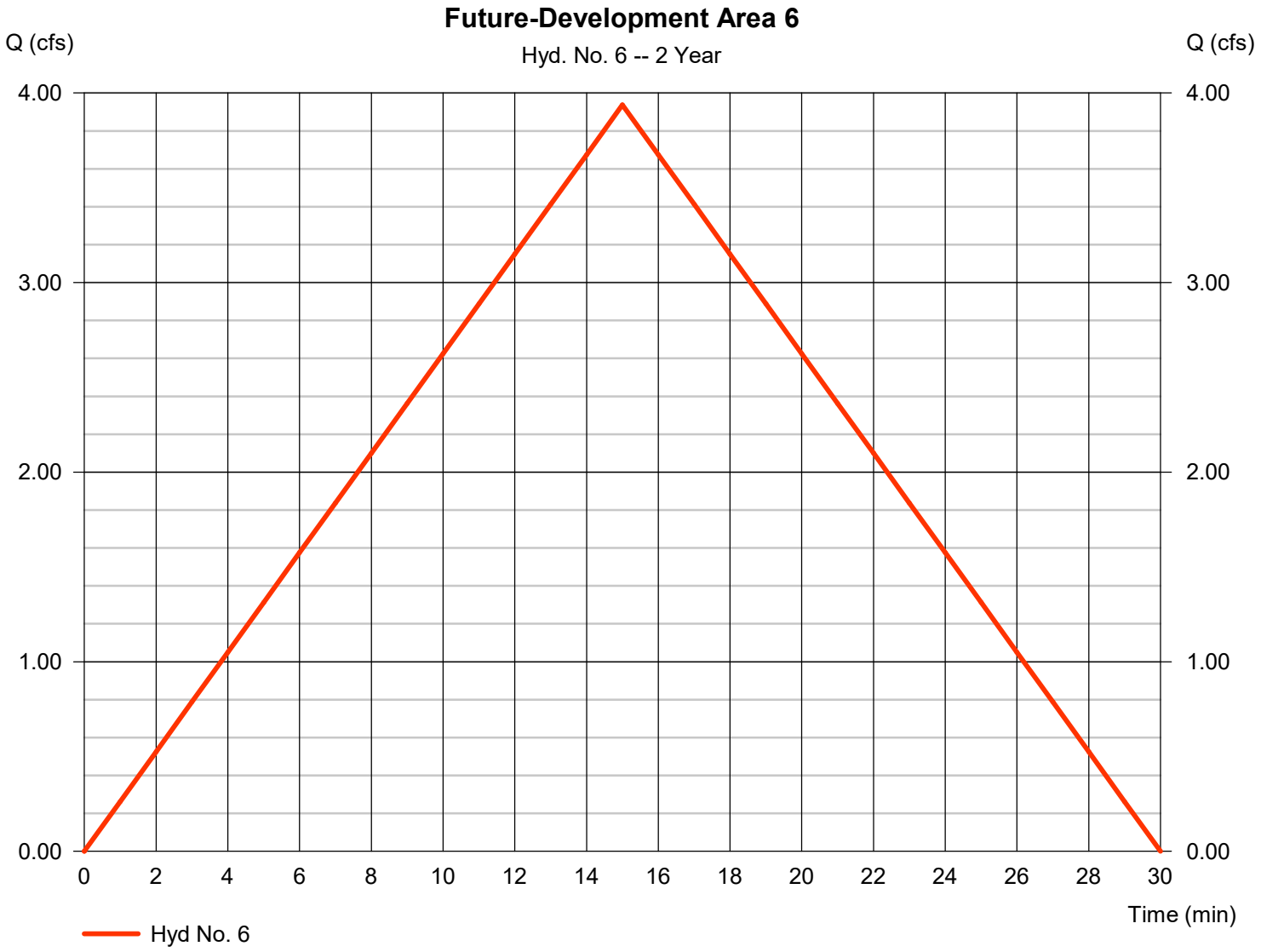
Hydrograph type	=	Rational	Peak discharge	=	4.615 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	4,153 cuft
Drainage area	=	2.220 ac	Runoff coeff.	=	0.56
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 6

Future-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	3.938 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,544 cuft
Drainage area	=	2.040 ac	Runoff coeff.	=	0.52
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 7

Future-Development Area 7

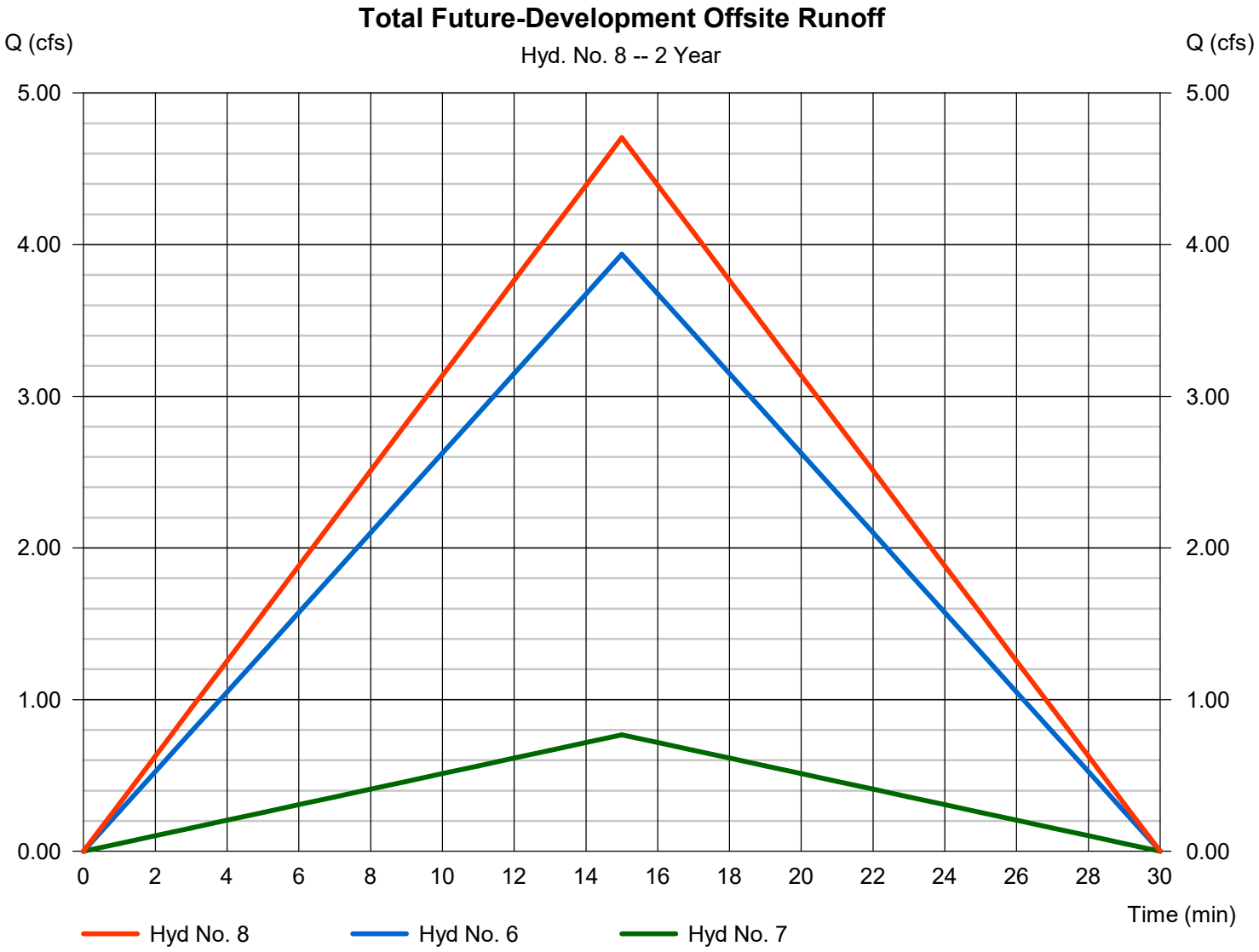
Hydrograph type	=	Rational	Peak discharge	=	0.768 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	692 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 8

Total Future-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 4.706 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 4,235 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 2.730 ac

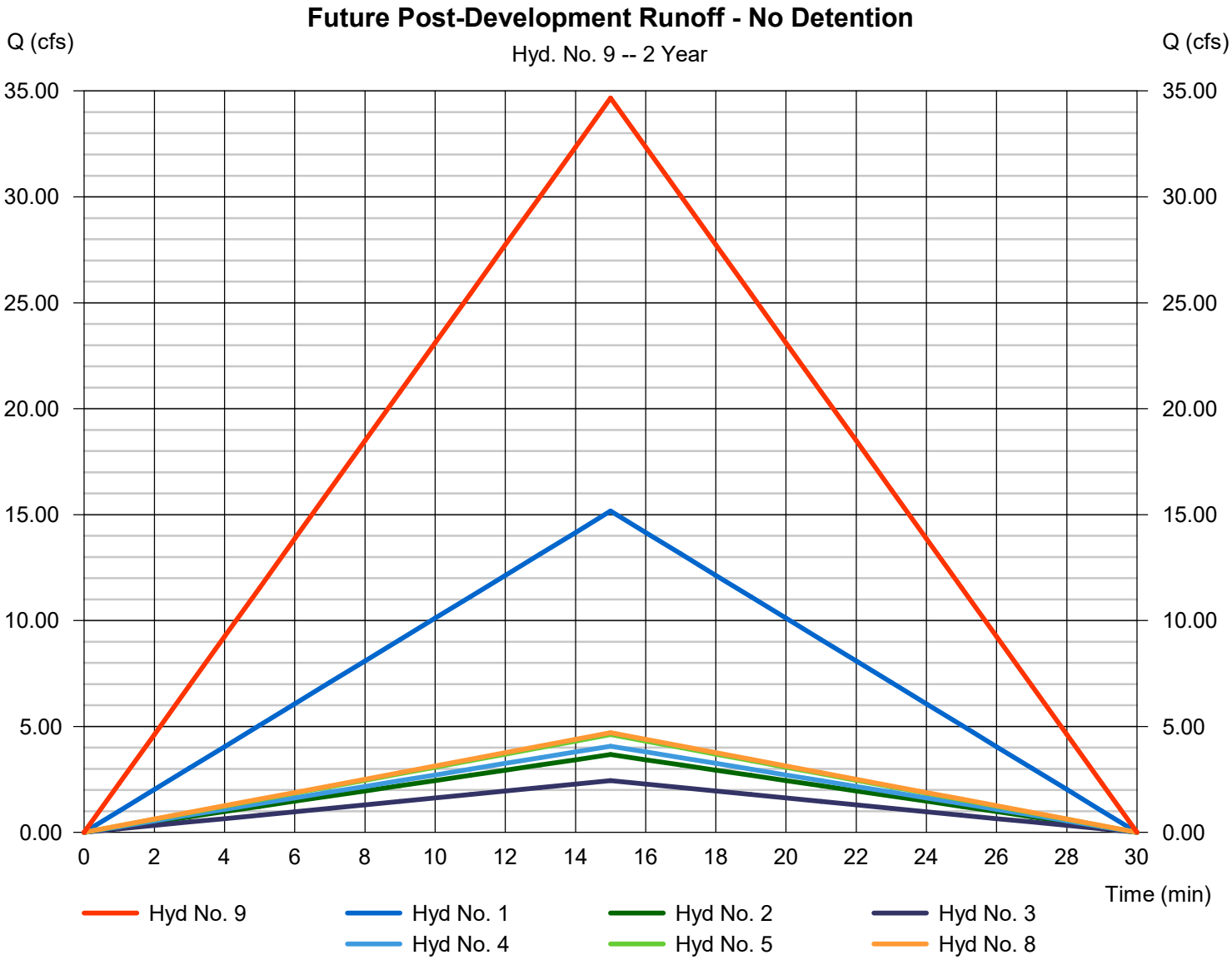


Hydrograph Report

Hyd. No. 9

Future Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 34.66 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 31,197 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 8	Contrib. drain. area	= 12.230 ac

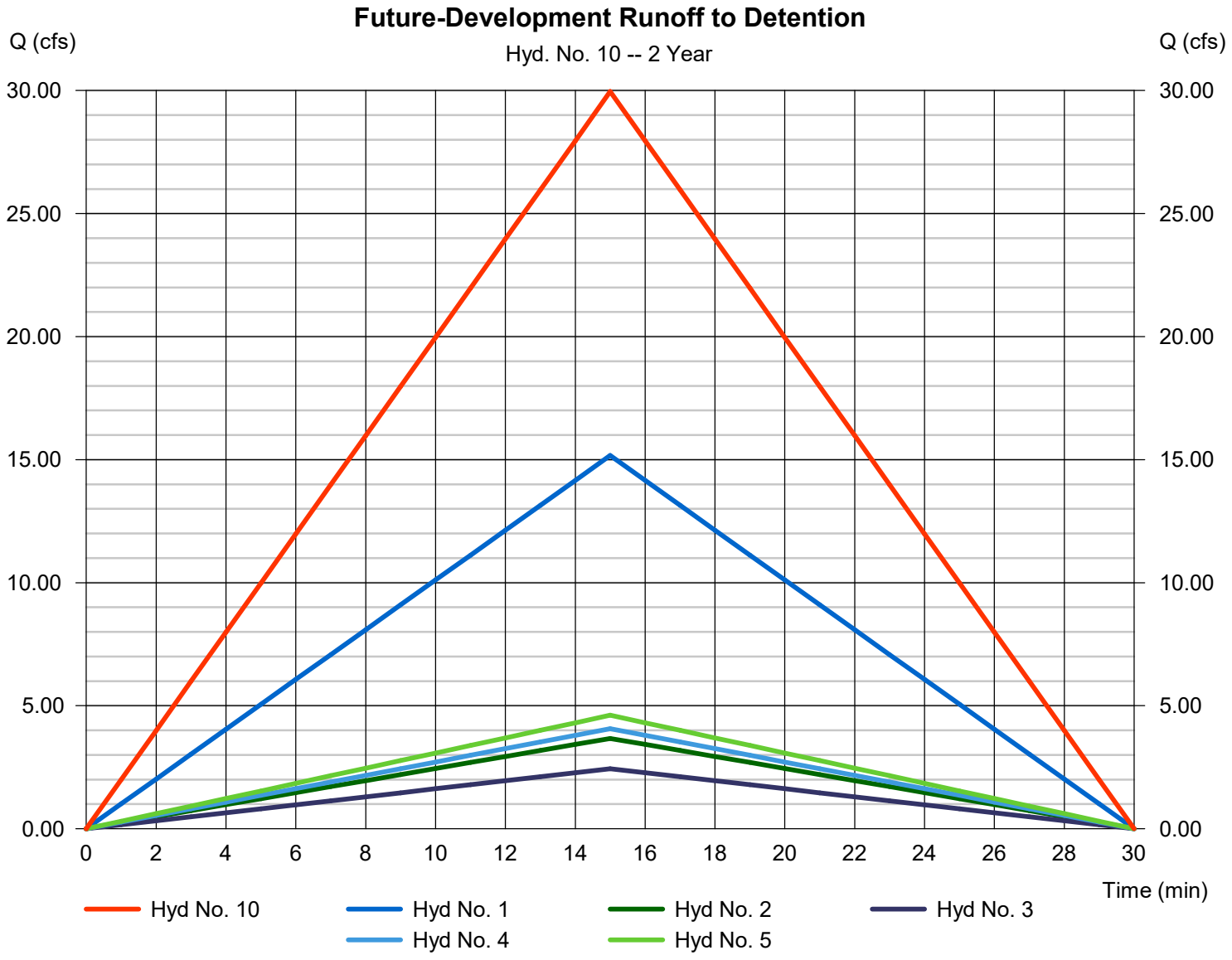


Hydrograph Report

Hyd. No. 10

Future-Development Runoff to Detention

Hydrograph type	=	Combine	Peak discharge	=	29.96 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	26,961 cuft
Inflow hyds.	=	1, 2, 3, 4, 5	Contrib. drain. area	=	12.230 ac



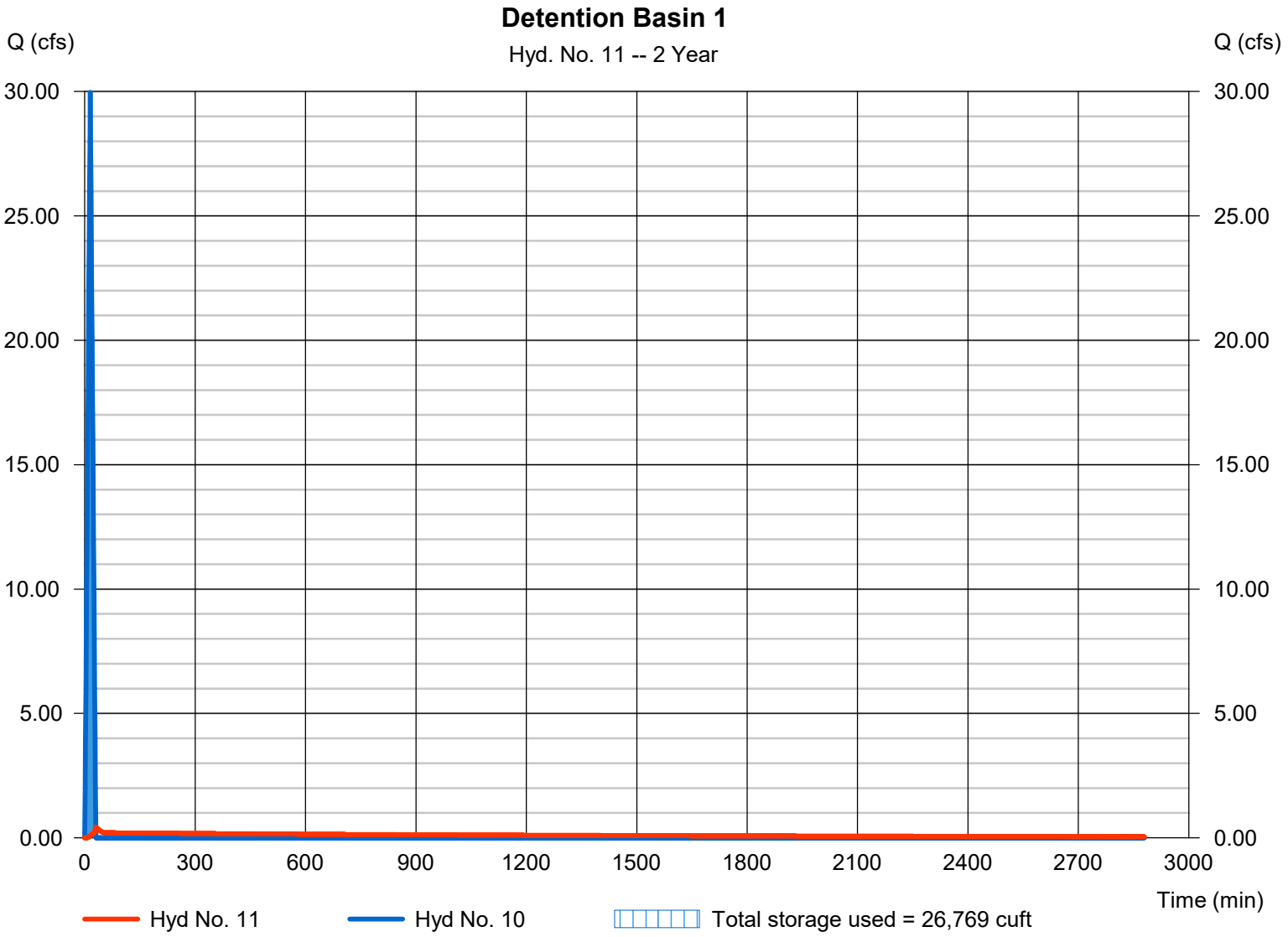
Hydrograph Report

Hyd. No. 11

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	0.437 cfs
Storm frequency	=	2 yrs	Time to peak	=	30 min
Time interval	=	1 min	Hyd. volume	=	17,810 cuft
Inflow hyd. No.	=	10 - Future-Development Runoff	Max. Elevation	=	1002.03 ft
Reservoir name	=	Detention Basin	Max. Storage	=	26,769 cuft

Storage Indication method used.



Pond No. 1 - Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1000.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1000.00	11,836	0	0
1.00	1001.00	13,183	12,502	12,502
2.00	1002.00	14,586	13,877	26,379
3.00	1003.00	16,045	15,308	41,688
4.00	1004.00	17,561	16,796	58,483

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	1.50
Span (in)	= 24.00	24.00	0.00	1.50
No. Barrels	= 1	2	0	6
Invert El. (ft)	= 999.98	1001.25	0.00	1000.00
Length (ft)	= 58.75	20.00	0.00	3.25
Slope (%)	= 1.00	2.00	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	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 24.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 1002.05	1001.62	0.00	0.00
Weir Coeff.	= 3.33	1.05	3.33	3.33
Weir Type	= Rect	45 degV	---	---
Multi-Stage	= Yes	Yes	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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1000.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.10	1,250	1000.10	0.00 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.002
0.20	2,500	1000.20	0.00 ic	0.00	---	0.01	0.00	---	---	---	---	---	0.007
0.30	3,751	1000.30	0.00 ic	0.00	---	0.01	0.00	---	---	---	---	---	0.012
0.40	5,001	1000.40	0.00 ic	0.00	---	0.02	0.00	---	---	---	---	---	0.018
0.50	6,251	1000.50	0.00 ic	0.00	---	0.03	0.00	---	---	---	---	---	0.026
0.60	7,501	1000.60	0.00 ic	0.00	---	0.03	0.00	---	---	---	---	---	0.034
0.70	8,752	1000.70	0.00 ic	0.00	---	0.04	0.00	---	---	---	---	---	0.043
0.80	10,002	1000.80	0.00 ic	0.00	---	0.05	0.00	---	---	---	---	---	0.052
0.90	11,252	1000.90	0.00 ic	0.00	---	0.06	0.00	---	---	---	---	---	0.062
1.00	12,502	1001.00	0.00 ic	0.00	---	0.07	0.00	---	---	---	---	---	0.073
1.10	13,890	1001.10	0.00 ic	0.00	---	0.08	0.00	---	---	---	---	---	0.084
1.20	15,278	1001.20	0.00 ic	0.00	---	0.10	0.00	---	---	---	---	---	0.096
1.30	16,665	1001.30	0.00 ic	0.00	---	0.11	0.00	---	---	---	---	---	0.108
1.40	18,053	1001.40	0.00 ic	0.00	---	0.12	0.00	---	---	---	---	---	0.120
1.50	19,441	1001.50	0.00 ic	0.00	---	0.13	0.00	---	---	---	---	---	0.134
1.60	20,829	1001.60	0.00 ic	0.00	---	0.15	0.00	---	---	---	---	---	0.147
1.70	22,216	1001.70	0.00 ic	0.00	---	0.16	0.00	---	---	---	---	---	0.161
1.80	23,604	1001.80	0.00 ic	0.00	---	0.18	0.00	---	---	---	---	---	0.176
1.90	24,992	1001.90	0.00 ic	0.00	---	0.19	0.00	---	---	---	---	---	0.190
2.00	26,379	1002.00	0.00 ic	0.00	---	0.21	0.00	---	---	---	---	---	0.206
2.10	27,910	1002.10	0.89 ic	0.00	---	0.22	0.89	---	---	---	---	---	1.114
2.20	29,441	1002.20	4.72 ic	0.00	---	0.24	4.64	---	---	---	---	---	4.881
2.30	30,972	1002.30	10.00 ic	0.00	---	0.25	9.99	---	---	---	---	---	10.24
2.40	32,503	1002.40	15.00 oc	0.00	---	0.27	15.00 s	---	---	---	---	---	15.27
2.50	34,033	1002.50	16.75 oc	0.00	---	0.29	16.75 s	---	---	---	---	---	17.04
2.60	35,564	1002.60	17.94 oc	0.00	---	0.30	17.94 s	---	---	---	---	---	18.24
2.70	37,095	1002.70	18.91 oc	0.00	---	0.32	18.91 s	---	---	---	---	---	19.23
2.80	38,626	1002.80	19.76 oc	0.00	---	0.34	19.75 s	---	---	---	---	---	20.10
2.90	40,157	1002.90	20.54 oc	0.00	---	0.36	20.53 s	---	---	---	---	---	20.89
3.00	41,688	1003.00	21.26 oc	0.00	---	0.38	21.24 s	---	---	---	---	---	21.61
3.10	43,367	1003.10	21.92 ic	0.00	---	0.40	21.88 s	---	---	---	---	---	22.27
3.20	45,047	1003.20	22.45 ic	0.00	---	0.42	22.42 s	---	---	---	---	---	22.83
3.30	46,726	1003.30	22.97 ic	0.00	---	0.44	22.90 s	---	---	---	---	---	23.34
3.40	48,406	1003.40	23.47 ic	0.00	---	0.46	23.44 s	---	---	---	---	---	23.90
3.50	50,085	1003.50	23.96 ic	0.00	---	0.48	23.87 s	---	---	---	---	---	24.35
3.60	51,765	1003.60	24.44 ic	0.00	---	0.50	24.38 s	---	---	---	---	---	24.88
3.70	53,445	1003.70	24.91 ic	0.00	---	0.52	24.78 s	---	---	---	---	---	25.30

Continues on next page...

Detention Basin

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.80	55,124	1003.80	25.37 ic	0.00	---	0.54	25.23 s	---	---	---	---	---	25.77
3.90	56,804	1003.90	25.82 ic	0.00	---	0.56	25.68 s	---	---	---	---	---	26.24
4.00	58,483	1004.00	26.26 ic	0.00	---	0.58	26.13 s	---	---	---	---	---	26.71

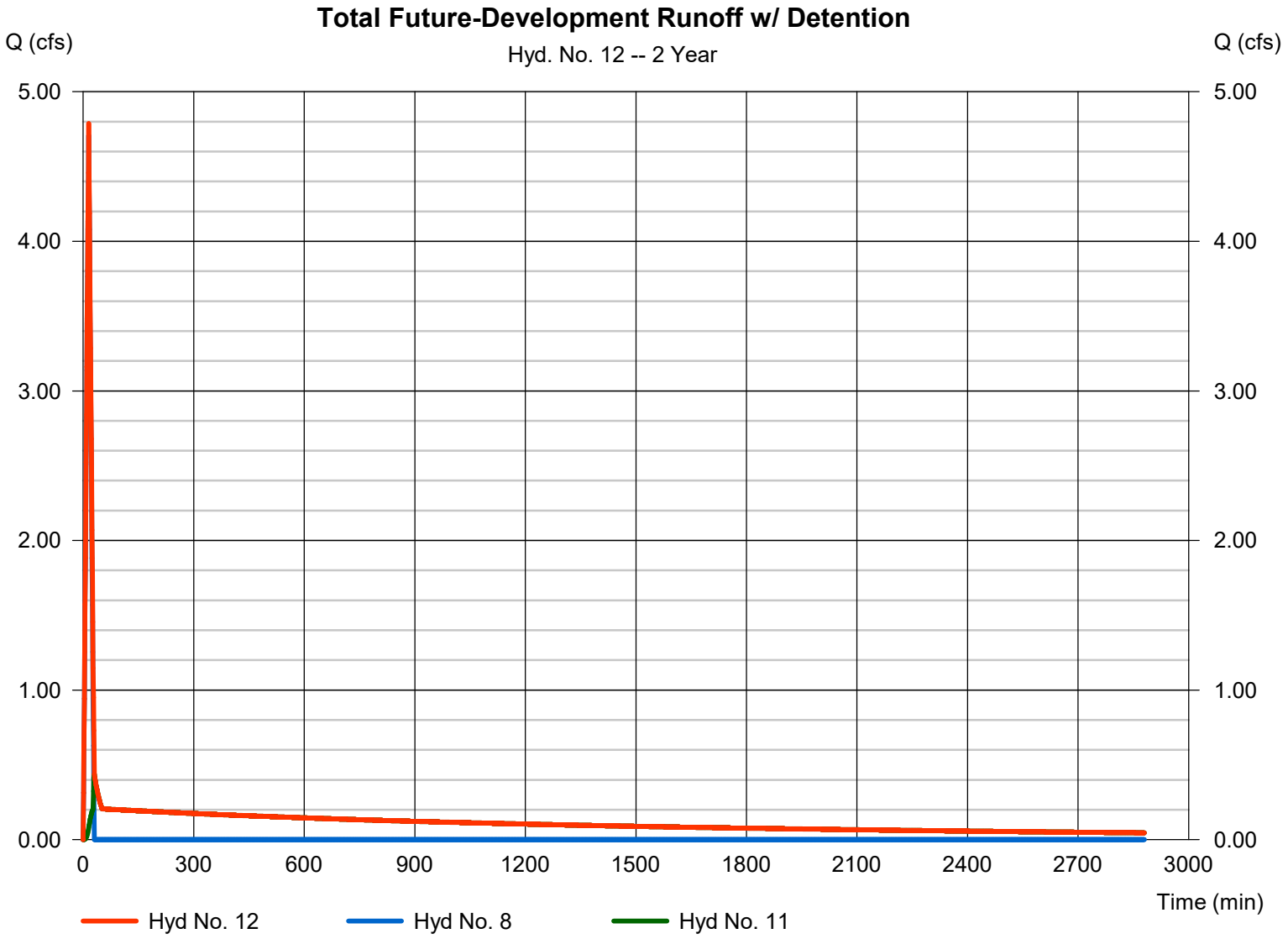
...End

Hydrograph Report

Hyd. No. 12

Total Future-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 4.786 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 22,046 cuft
Inflow hyds.	= 8, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

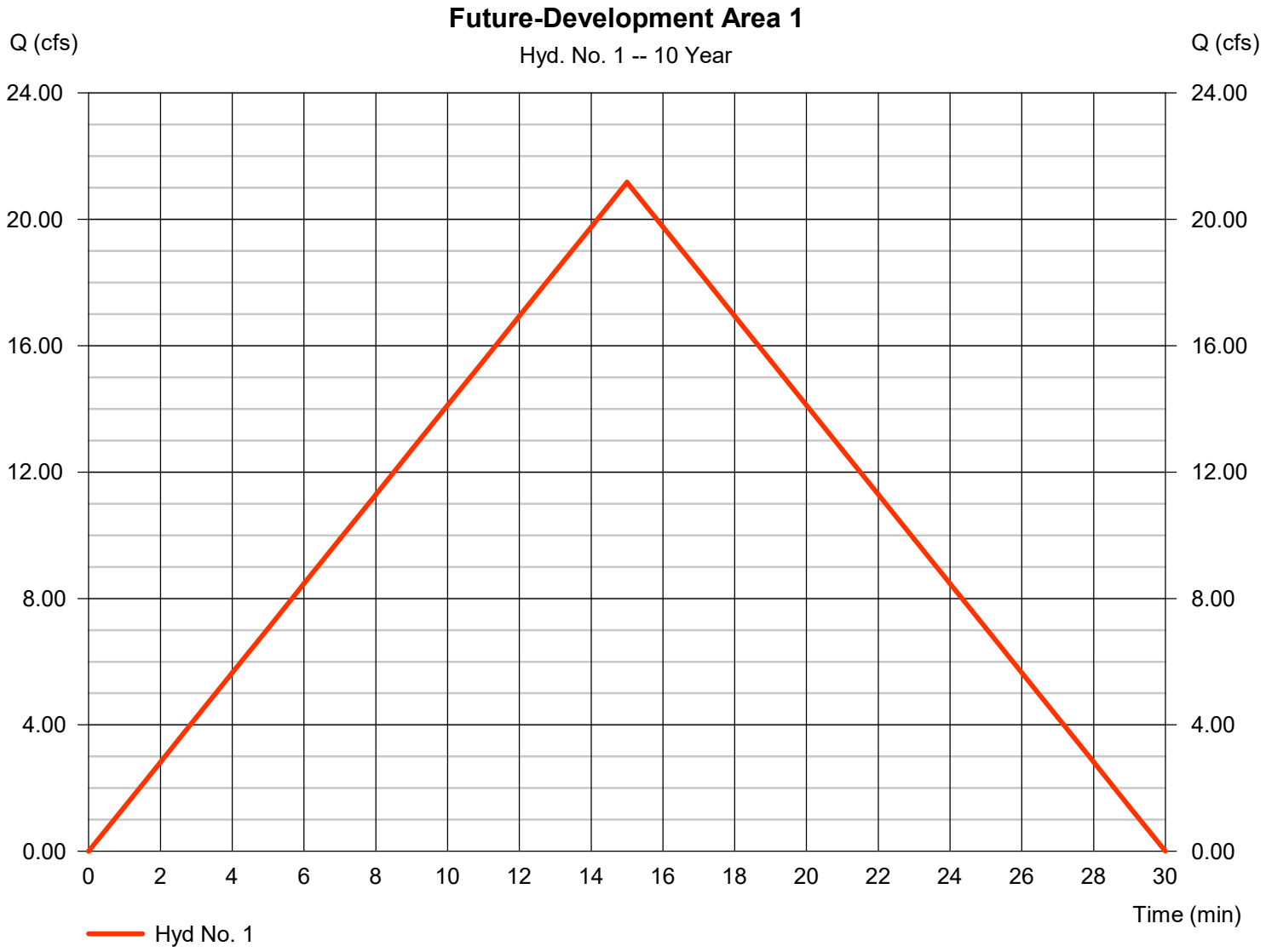
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	21.18	1	15	19,058	------	------	------	Future-Development Area 1
2	Rational	5.126	1	15	4,613	------	------	------	Future-Development Area 2
3	Rational	3.402	1	15	3,062	------	------	------	Future-Development Area 3
4	Rational	5.681	1	15	5,113	------	------	------	Future-Development Area 4
5	Rational	6.443	1	15	5,799	------	------	------	Future-Development Area 5
6	Rational	5.498	1	15	4,948	------	------	------	Future-Development Area 6
7	Rational	1.073	1	15	966	------	------	------	Future-Development Area 7
8	Combine	6.570	1	15	5,913	6, 7	------	------	Total Future-Development Offsite Ru
9	Combine	48.40	1	15	43,558	1, 2, 3, 4, 5, 8	------	------	Future Post-Development Runoff - No
10	Combine	41.83	1	15	37,644	1, 2, 3, 4, 5, 10	------	------	Future-Development Runoff to Detent
11	Reservoir	13.92	1	25	28,386	10	1002.37	32,093	Detention Basin 1
12	Combine	16.24	1	24	34,299	8, 11	------	------	Total Future-Development Runoff w/

Hydrograph Report

Hyd. No. 1

Future-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	21.18 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	19,058 cuft
Drainage area	=	6.590 ac	Runoff coeff.	=	0.62
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 2

Future-Development Area 2

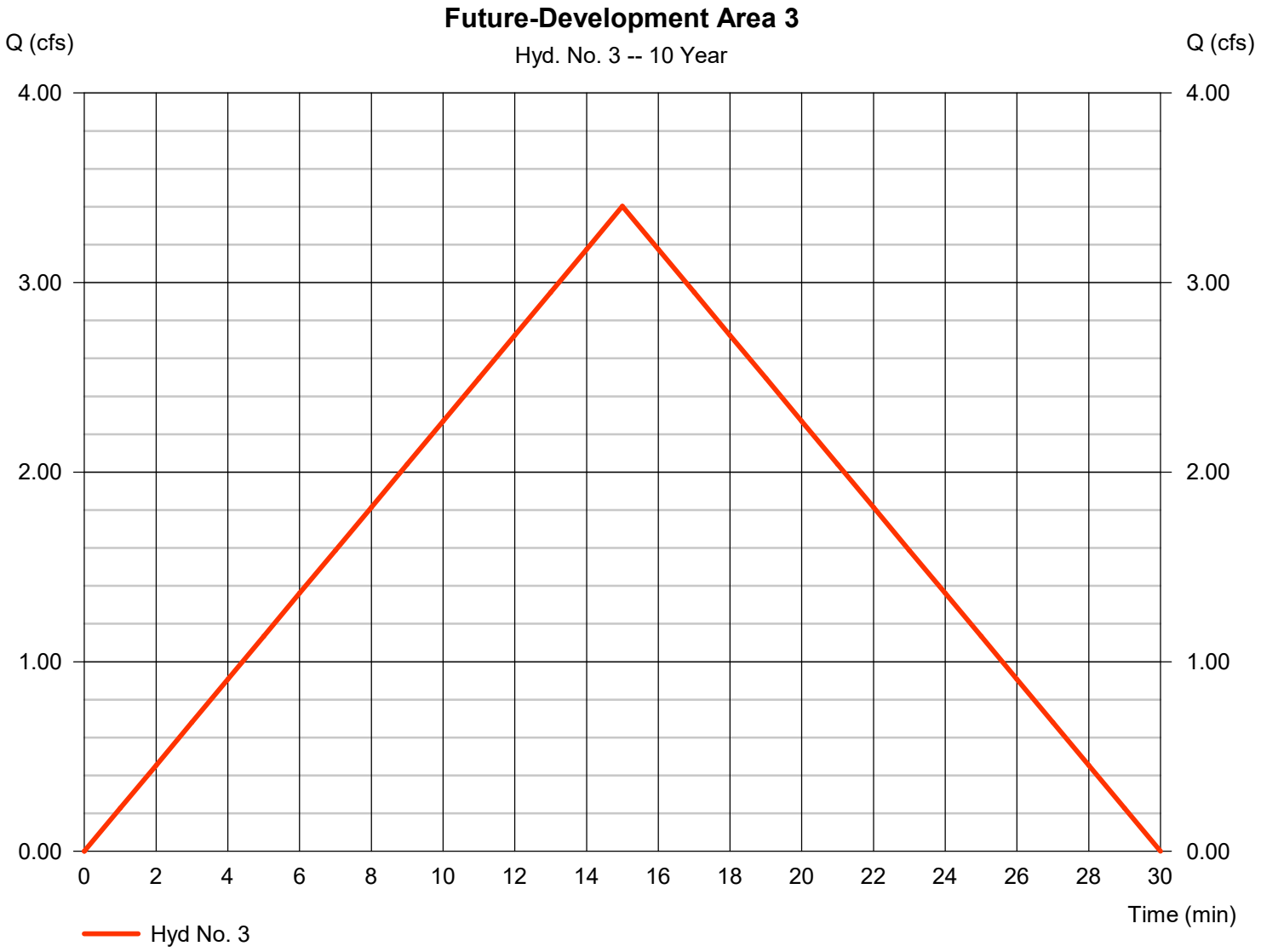
Hydrograph type	=	Rational	Peak discharge	=	5.126 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	4,613 cuft
Drainage area	=	1.150 ac	Runoff coeff.	=	0.86
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 3

Future-Development Area 3

Hydrograph type	=	Rational	Peak discharge	=	3.402 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,062 cuft
Drainage area	=	1.010 ac	Runoff coeff.	=	0.65
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

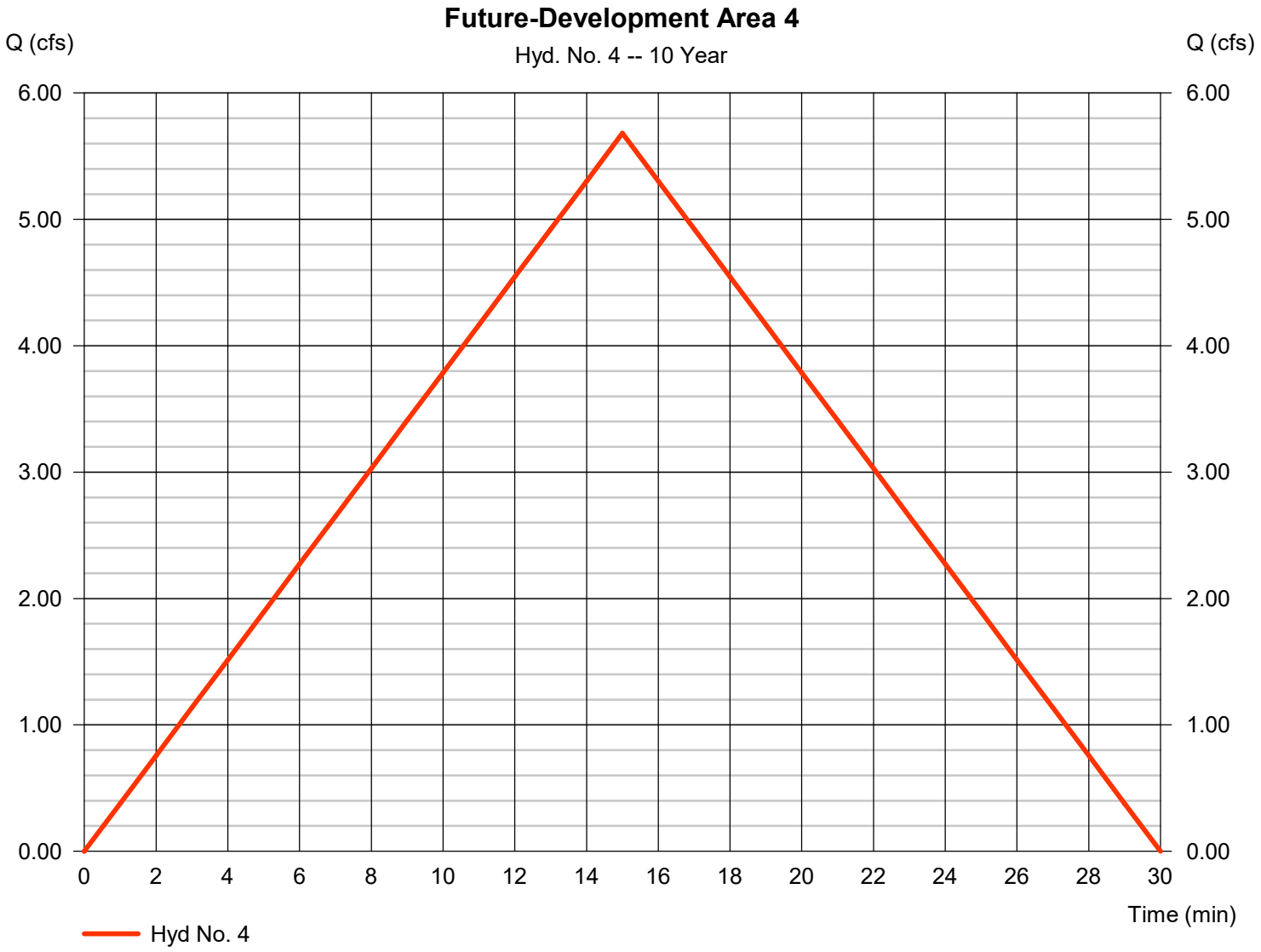


Hydrograph Report

Hyd. No. 4

Future-Development Area 4

Hydrograph type	=	Rational	Peak discharge	=	5.681 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	5,113 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.87
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

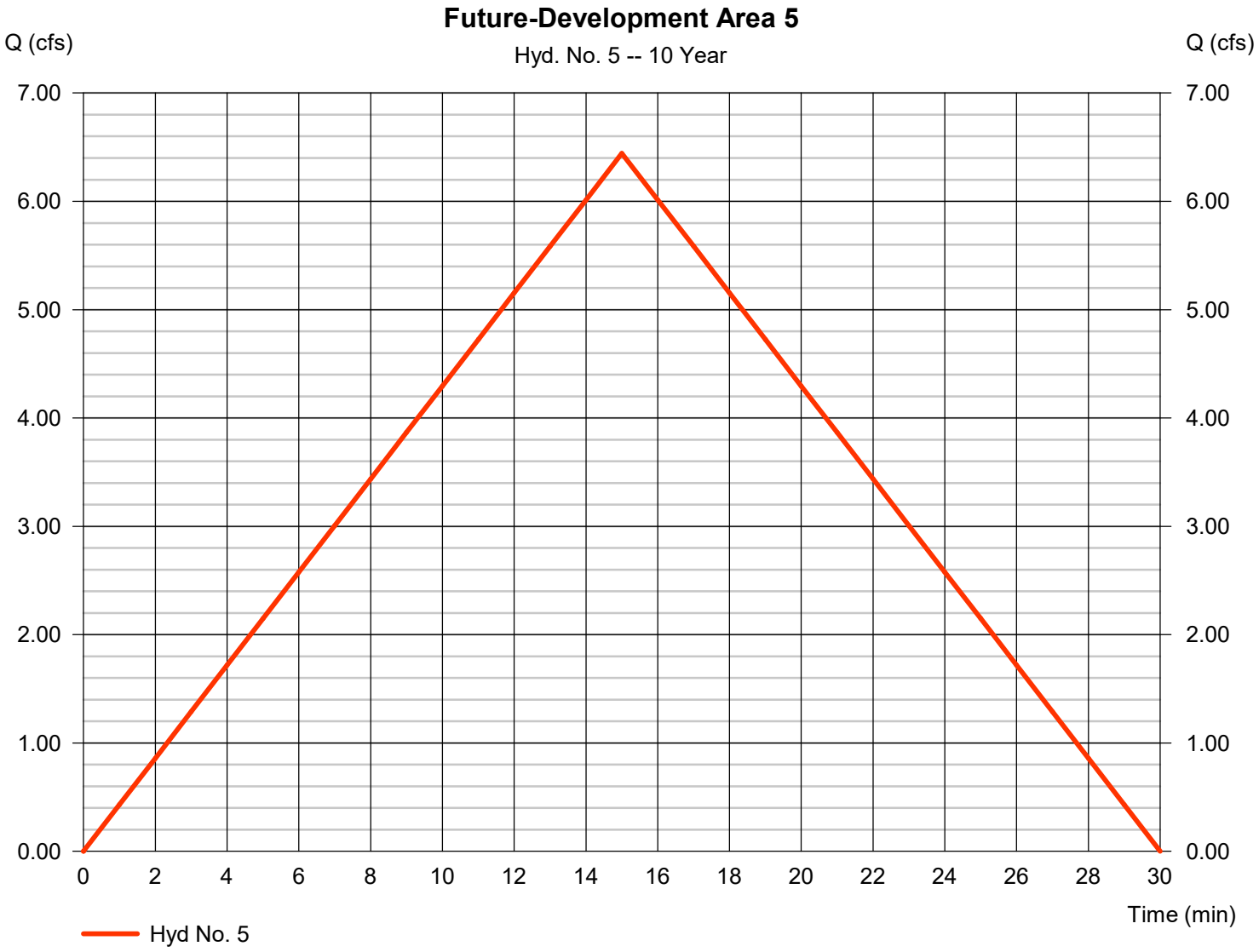


Hydrograph Report

Hyd. No. 5

Future-Development Area 5

Hydrograph type	=	Rational	Peak discharge	=	6.443 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	5,799 cuft
Drainage area	=	2.220 ac	Runoff coeff.	=	0.56
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 6

Future-Development Area 6

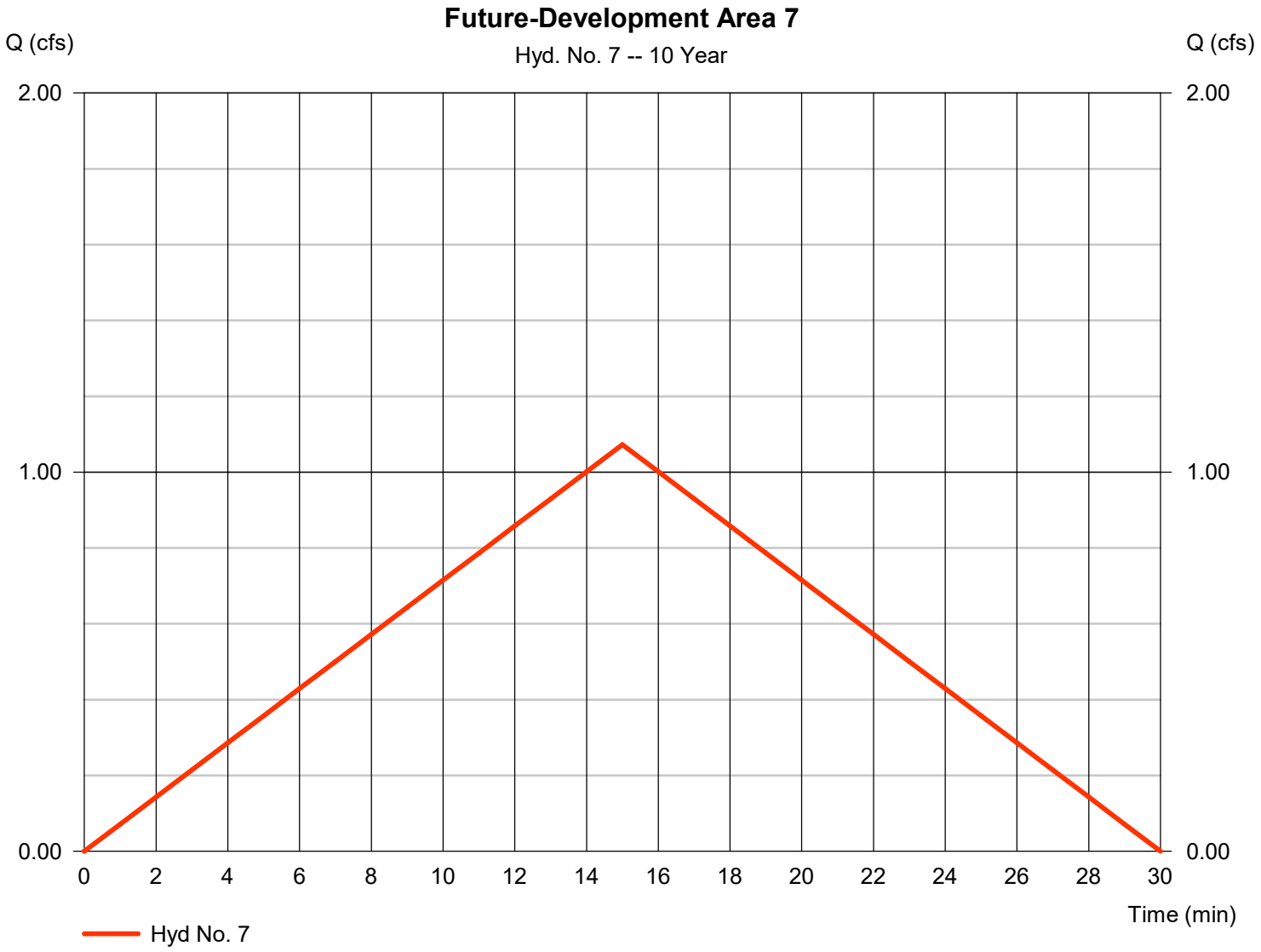
Hydrograph type	=	Rational	Peak discharge	=	5.498 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	4,948 cuft
Drainage area	=	2.040 ac	Runoff coeff.	=	0.52
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 7

Future-Development Area 7

Hydrograph type	=	Rational	Peak discharge	=	1.073 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	966 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

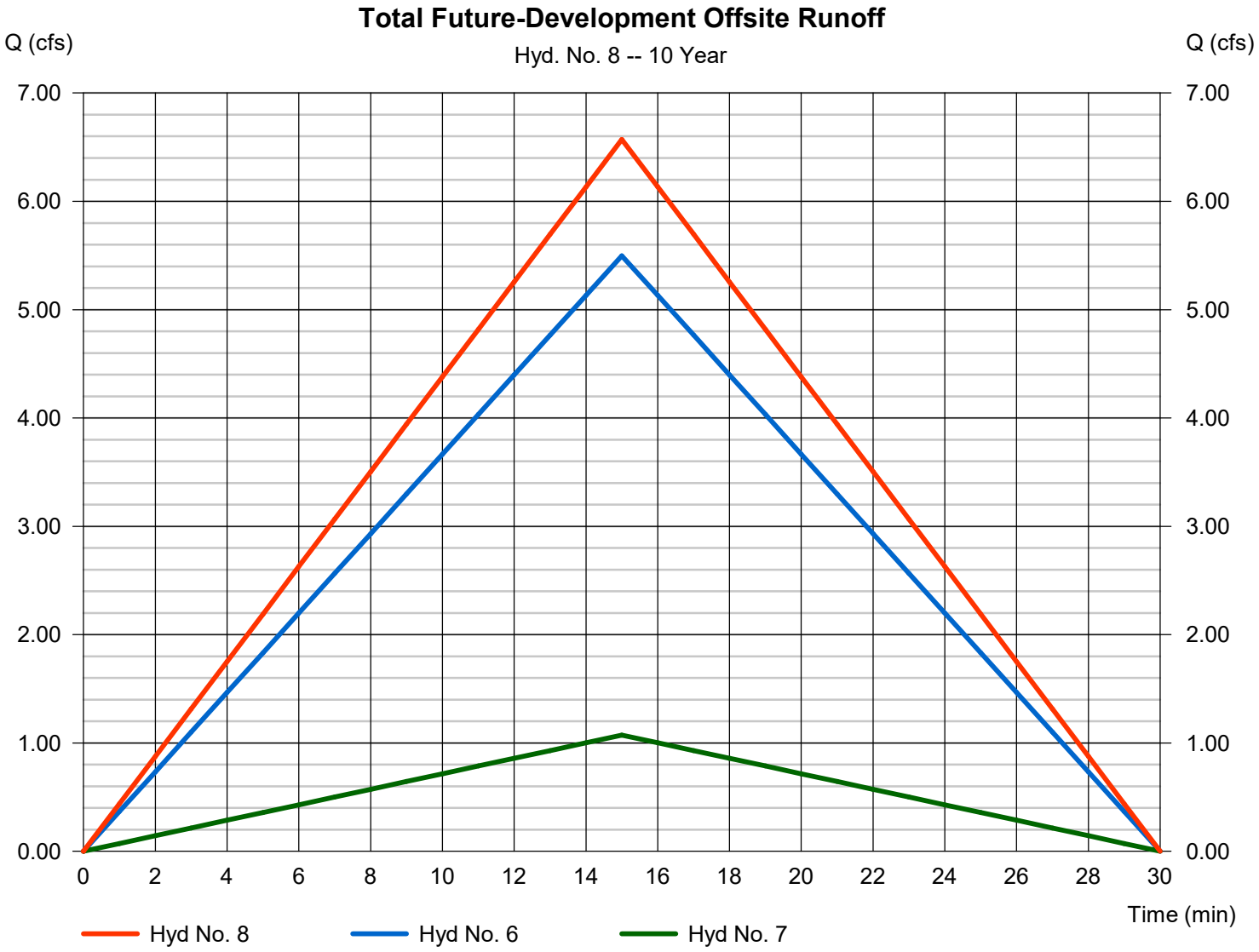


Hydrograph Report

Hyd. No. 8

Total Future-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 6.570 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 5,913 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 2.730 ac

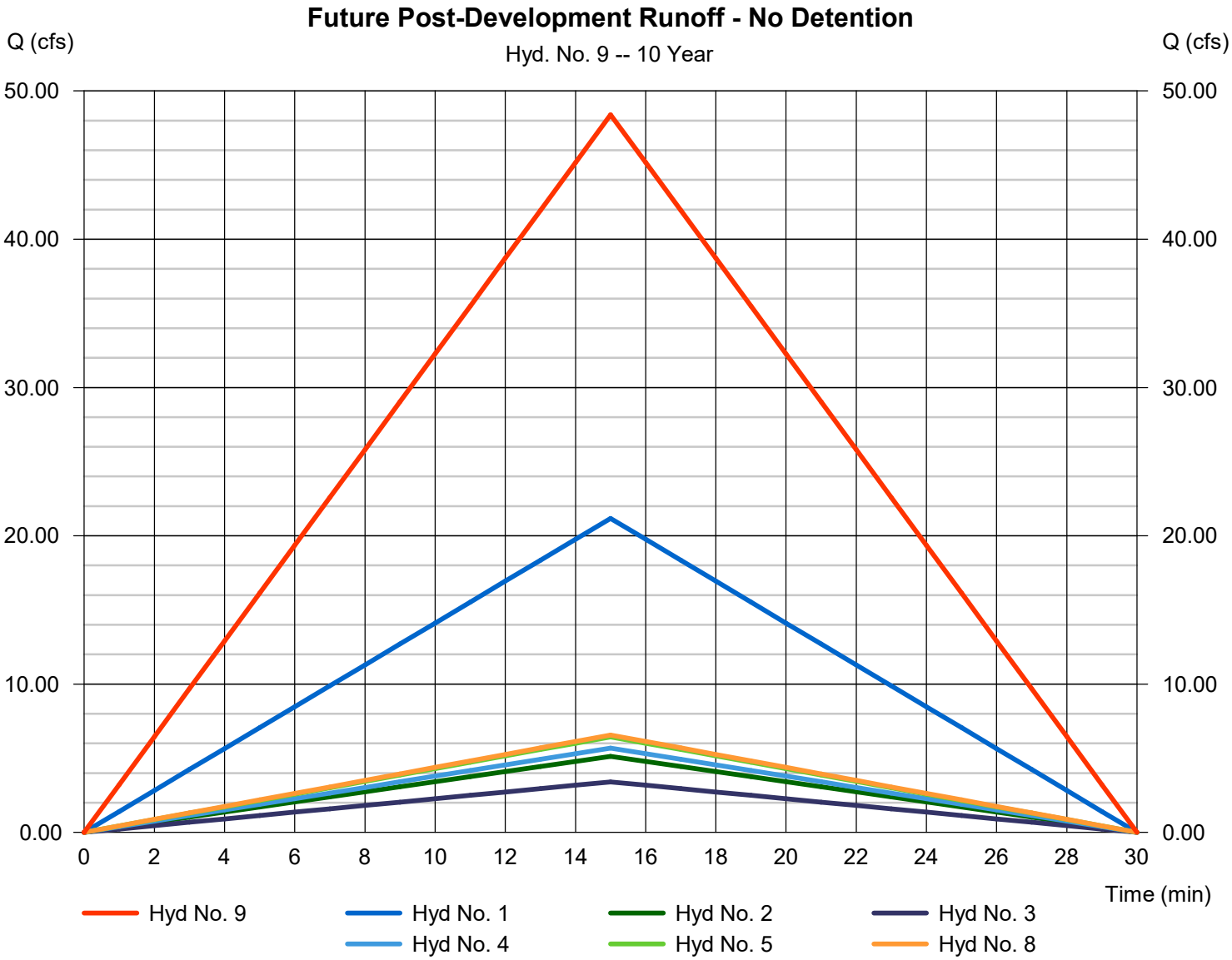


Hydrograph Report

Hyd. No. 9

Future Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 48.40 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 43,558 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 8	Contrib. drain. area	= 12.230 ac

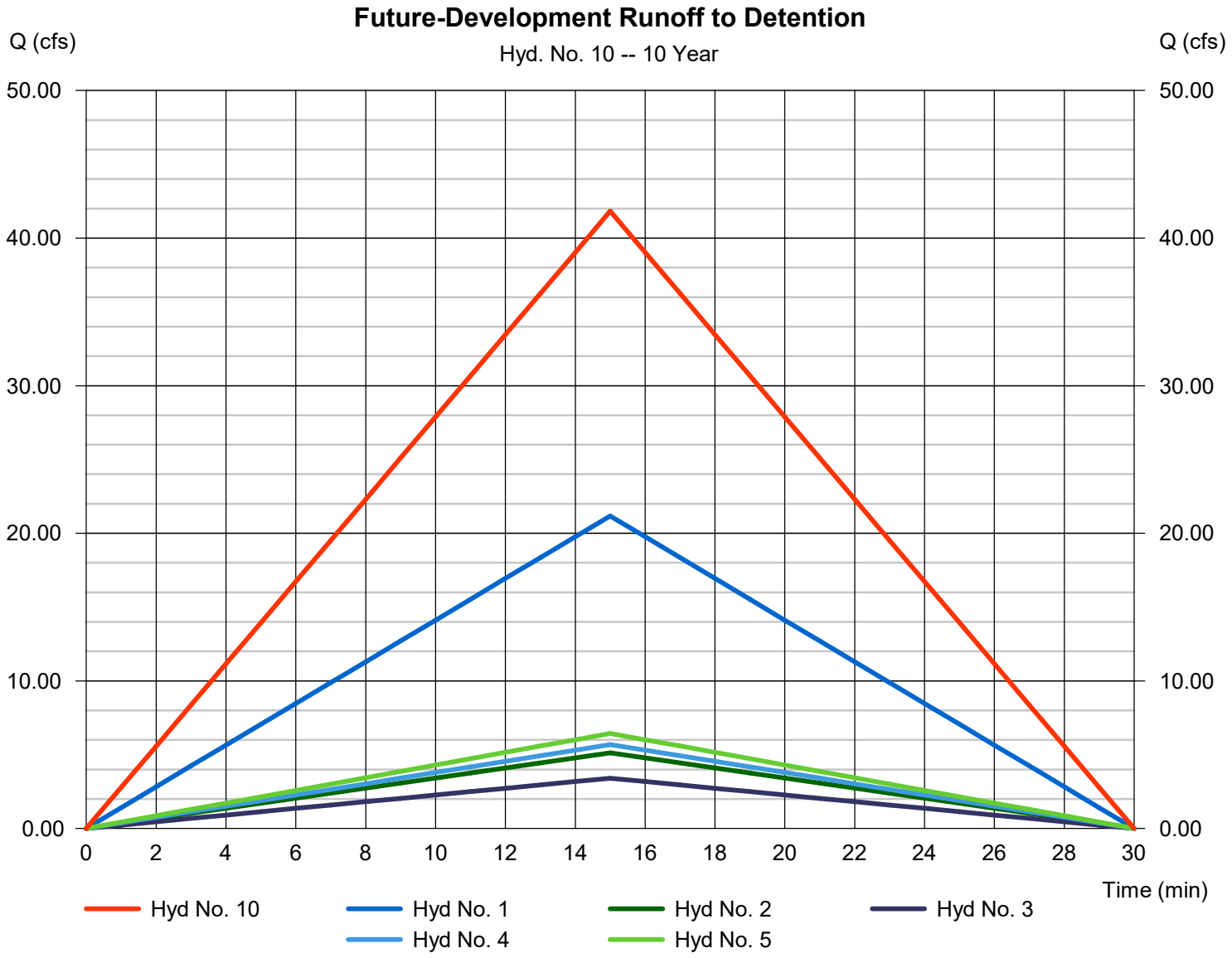


Hydrograph Report

Hyd. No. 10

Future-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 41.83 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 37,644 cuft
Inflow hyds.	= 1, 2, 3, 4, 5	Contrib. drain. area	= 12.230 ac



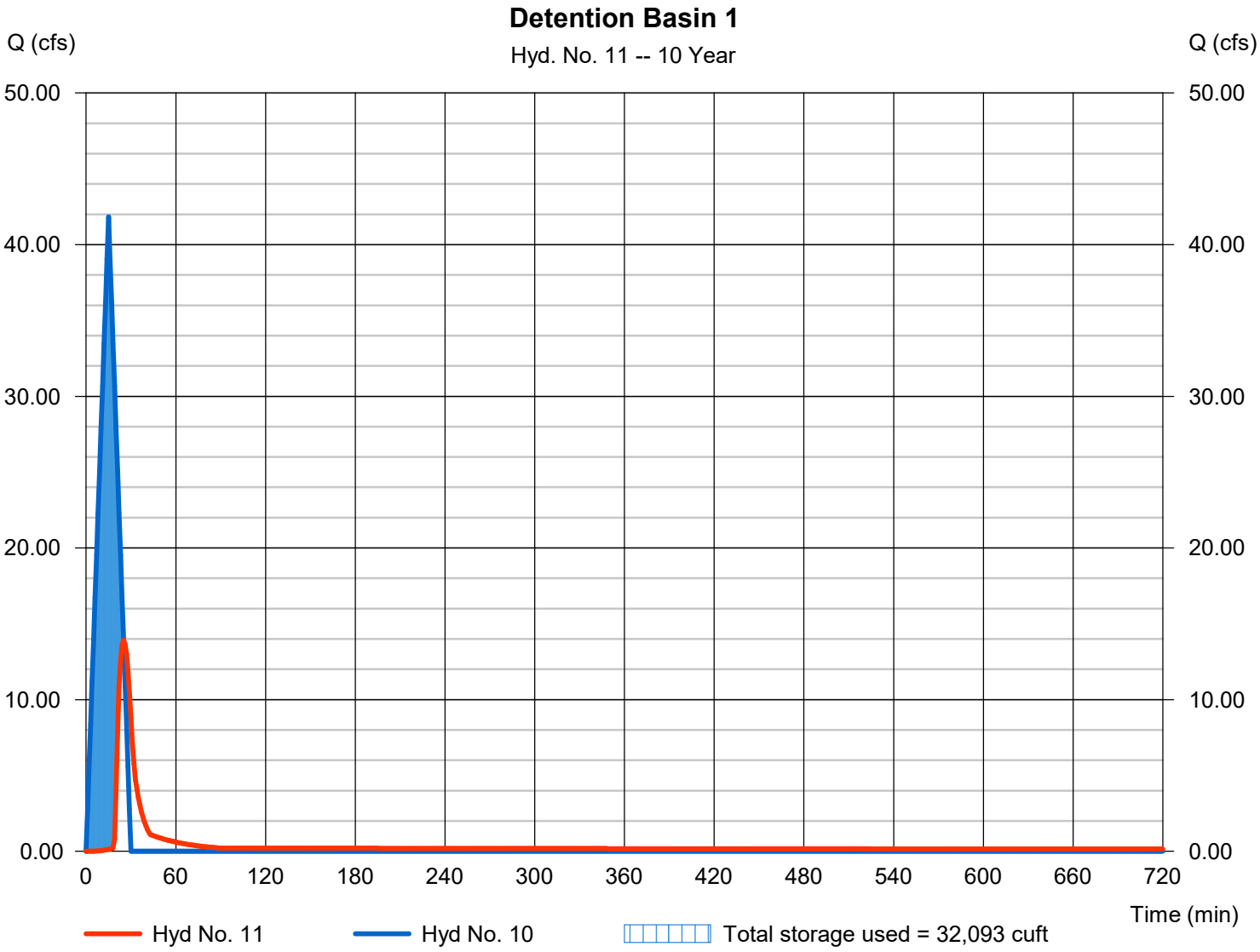
Hydrograph Report

Hyd. No. 11

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	13.92 cfs
Storm frequency	=	10 yrs	Time to peak	=	25 min
Time interval	=	1 min	Hyd. volume	=	28,386 cuft
Inflow hyd. No.	=	10 - Future-Development Runoff	Max. Elevation	=	1002.37 ft
Reservoir name	=	Detention Basin	Max. Storage	=	32,093 cuft

Storage Indication method used.

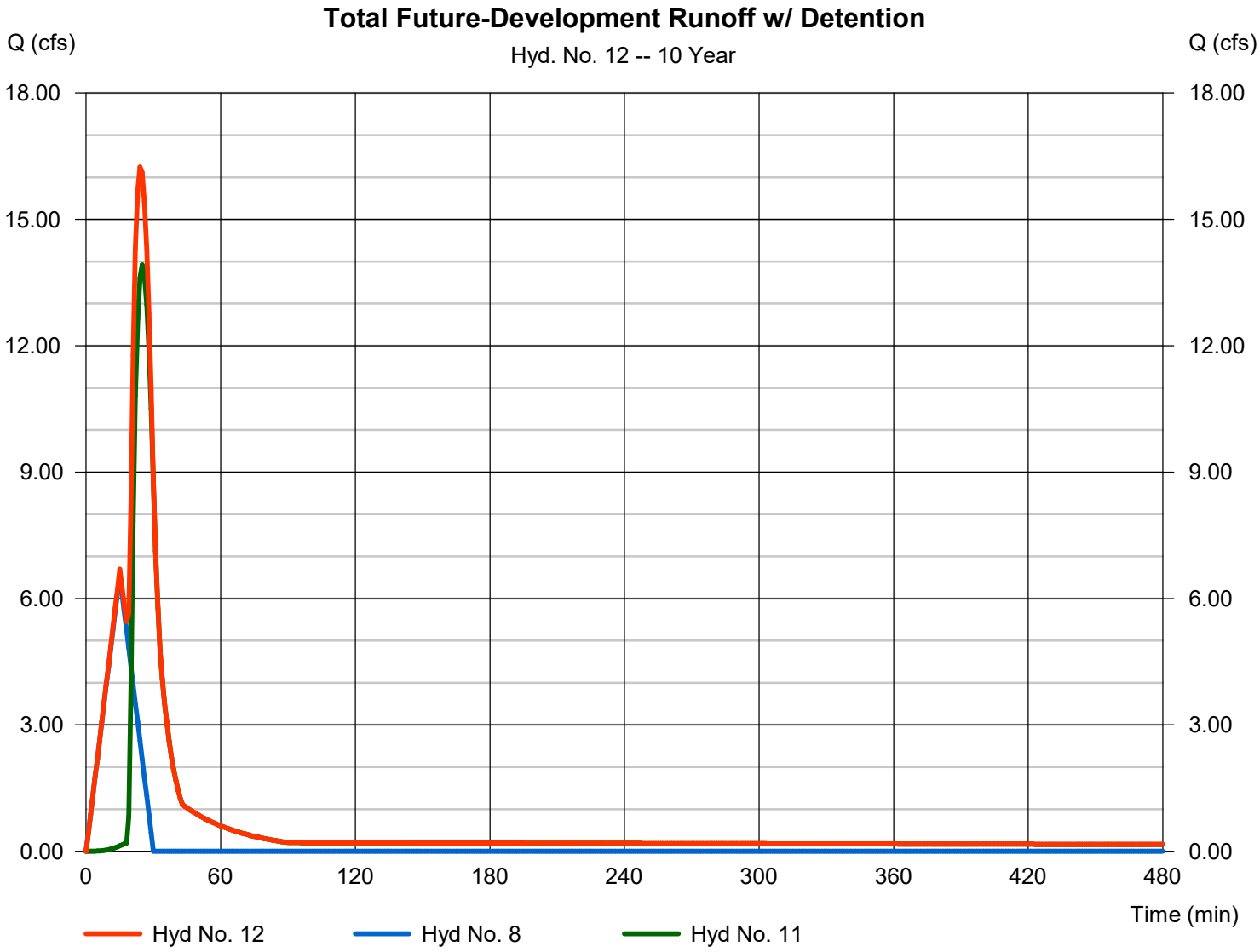


Hydrograph Report

Hyd. No. 12

Total Future-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 16.24 cfs
Storm frequency	= 10 yrs	Time to peak	= 24 min
Time interval	= 1 min	Hyd. volume	= 34,299 cuft
Inflow hyds.	= 8, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

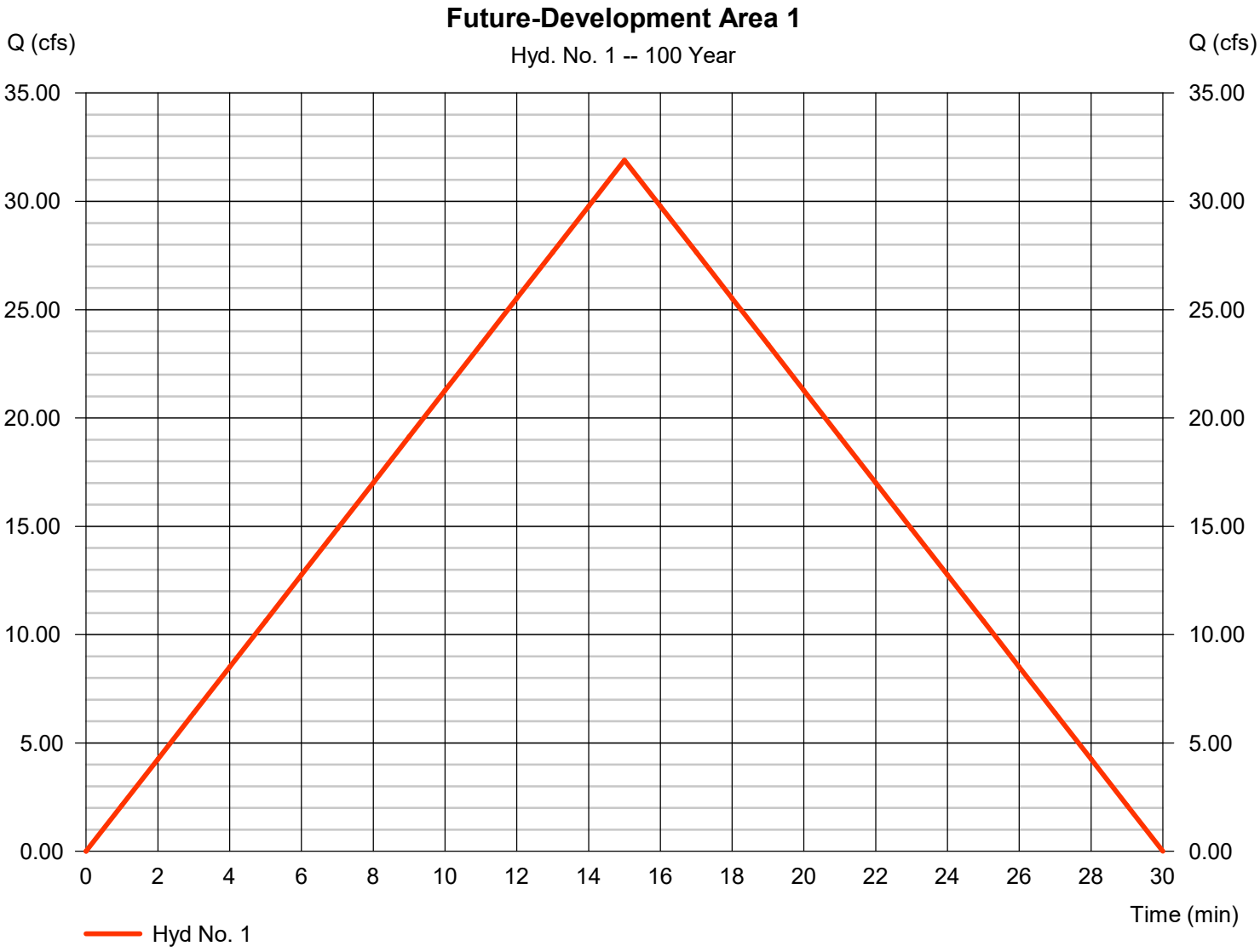
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	31.90	1	15	28,708	------	------	------	Future-Development Area 1
2	Rational	7.721	1	15	6,949	------	------	------	Future-Development Area 2
3	Rational	5.125	1	15	4,613	------	------	------	Future-Development Area 3
4	Rational	8.558	1	15	7,702	------	------	------	Future-Development Area 4
5	Rational	9.706	1	15	8,735	------	------	------	Future-Development Area 5
6	Rational	8.282	1	15	7,454	------	------	------	Future-Development Area 6
7	Rational	1.616	1	15	1,454	------	------	------	Future-Development Area 7
8	Combine	9.898	1	15	8,908	6, 7	------	------	Total Future-Development Offsite Ru
9	Combine	72.91	1	15	65,615	1, 2, 3, 4, 5, 8	------	------	Future Post-Development Runoff - No
10	Combine	63.01	1	15	56,707	1, 2, 3, 4, 5,	------	------	Future-Development Runoff to Detent
11	Reservoir	21.86	1	25	47,424	10	1003.04	42,319	Detention Basin 1
12	Combine	27.04	1	20	56,332	8, 11	------	------	Total Future-Development Runoff w/

Hydrograph Report

Hyd. No. 1

Future-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	31.90 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	28,708 cuft
Drainage area	=	6.590 ac	Runoff coeff.	=	0.62
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

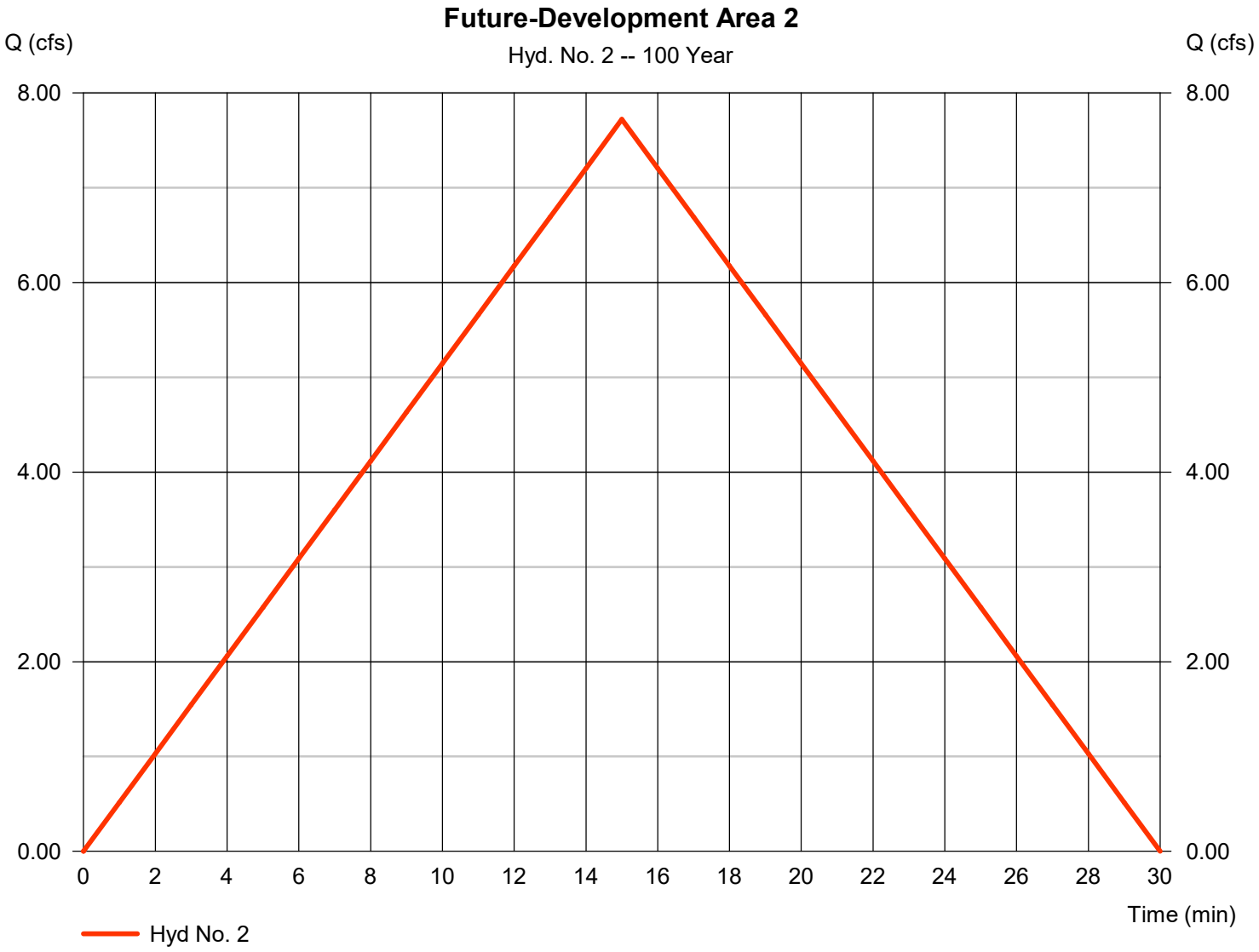


Hydrograph Report

Hyd. No. 2

Future-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	7.721 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	6,949 cuft
Drainage area	=	1.150 ac	Runoff coeff.	=	0.86
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 3

Future-Development Area 3

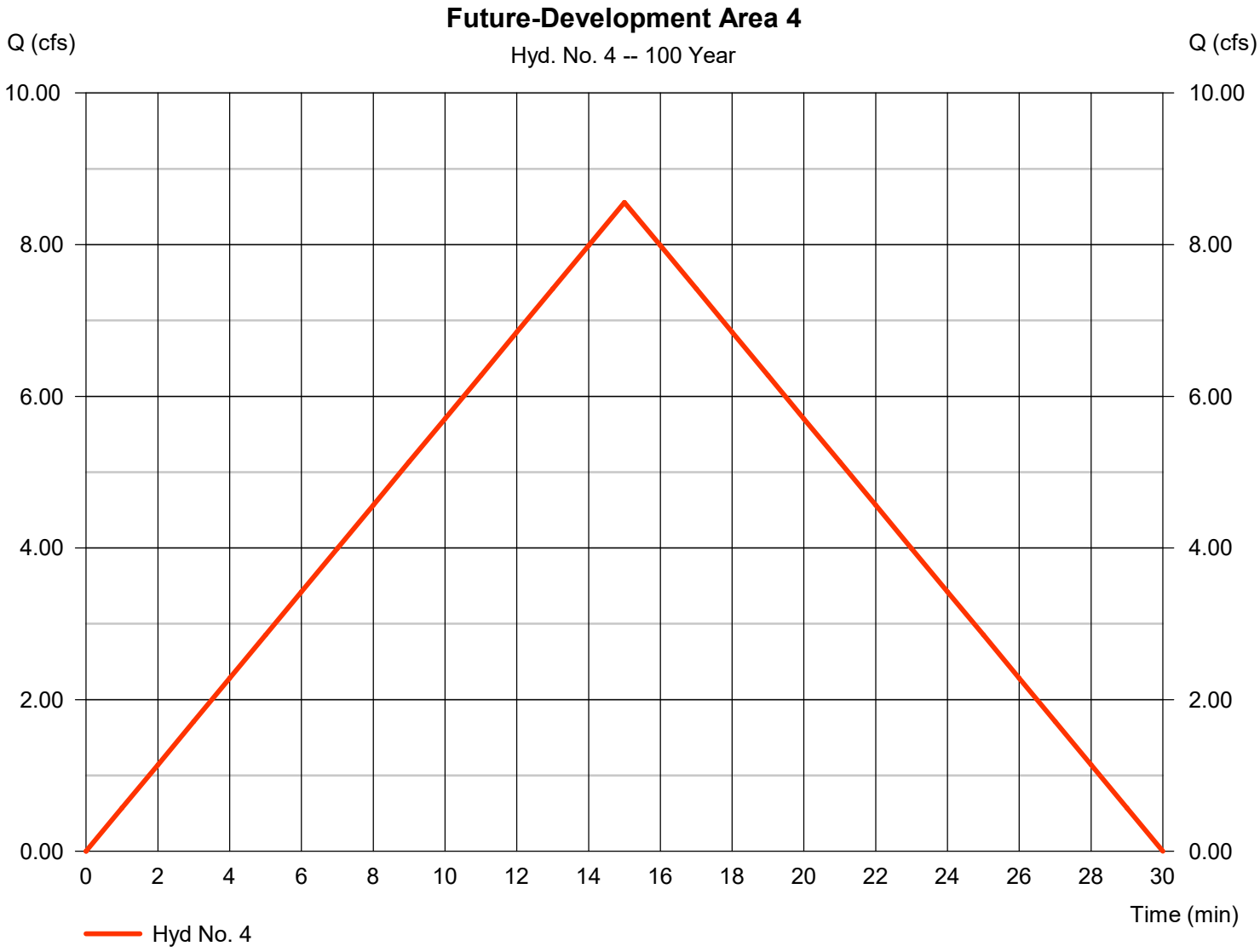
Hydrograph type	=	Rational	Peak discharge	=	5.125 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	4,613 cuft
Drainage area	=	1.010 ac	Runoff coeff.	=	0.65
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 4

Future-Development Area 4

Hydrograph type	=	Rational	Peak discharge	=	8.558 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	7,702 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.87
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

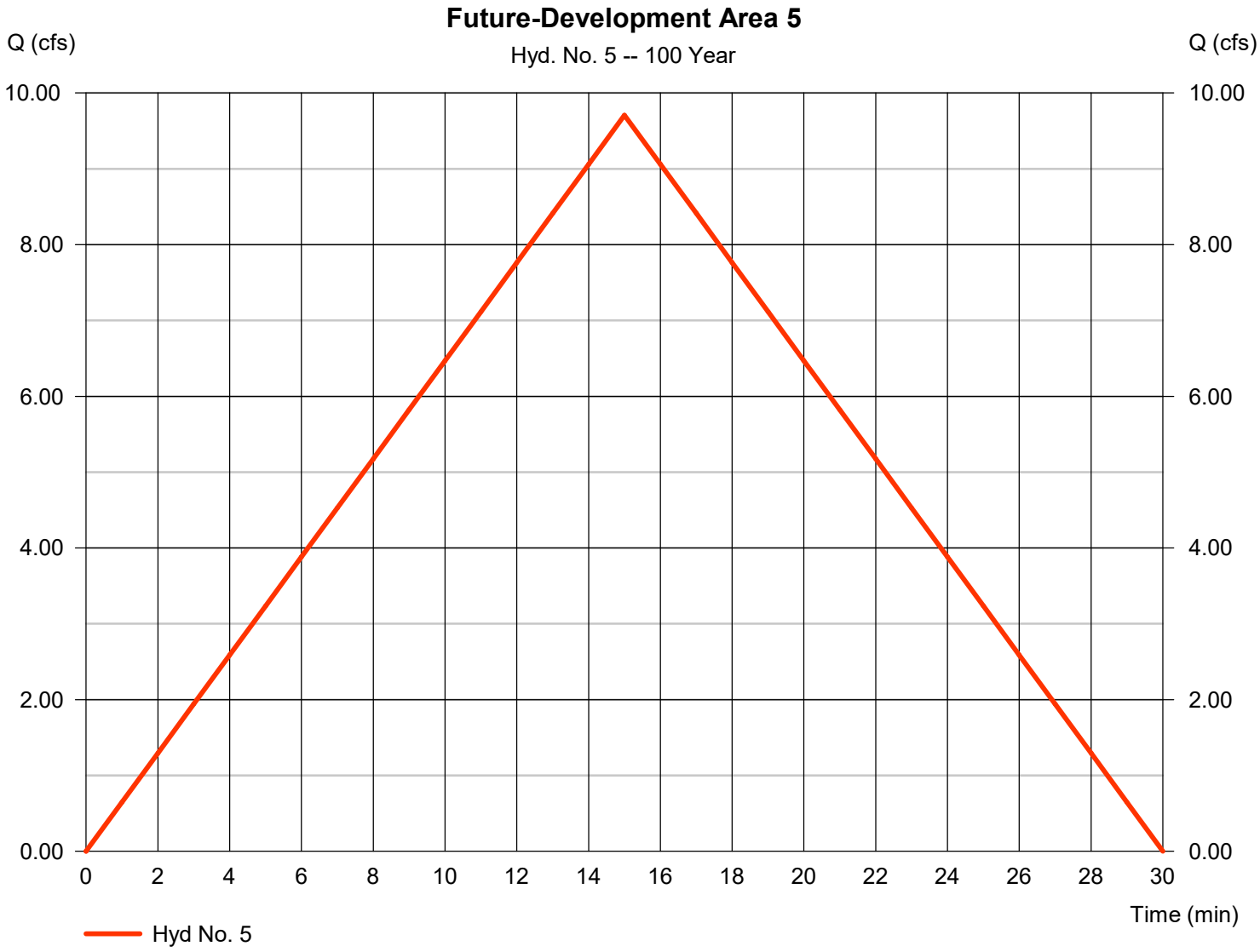


Hydrograph Report

Hyd. No. 5

Future-Development Area 5

Hydrograph type	=	Rational	Peak discharge	=	9.706 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	8,735 cuft
Drainage area	=	2.220 ac	Runoff coeff.	=	0.56
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

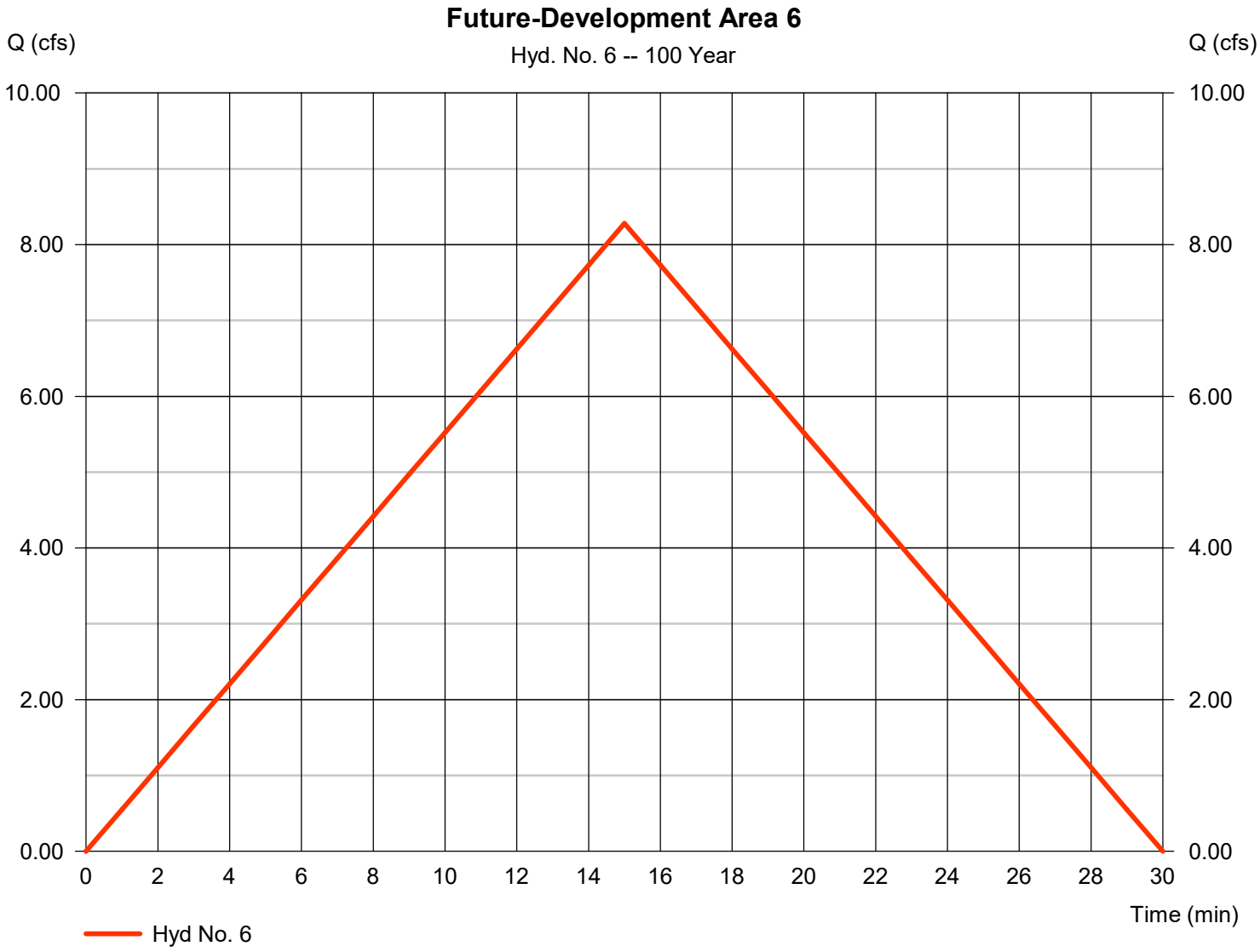


Hydrograph Report

Hyd. No. 6

Future-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	8.282 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	7,454 cuft
Drainage area	=	2.040 ac	Runoff coeff.	=	0.52
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

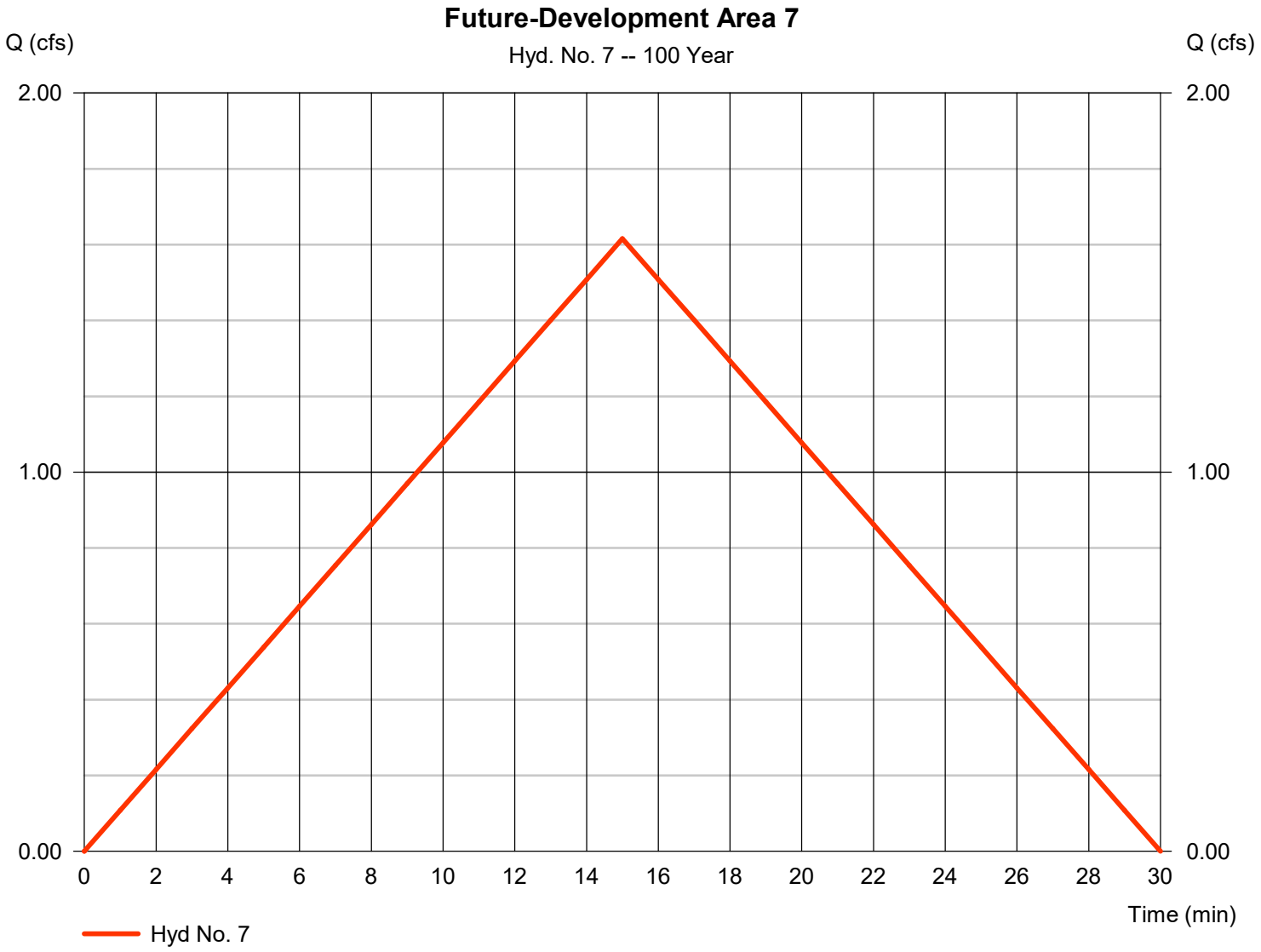


Hydrograph Report

Hyd. No. 7

Future-Development Area 7

Hydrograph type	=	Rational	Peak discharge	=	1.616 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	1,454 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	1.37in-hrWQ Rational.IDF	Asc/Rec limb fact	=	1/1

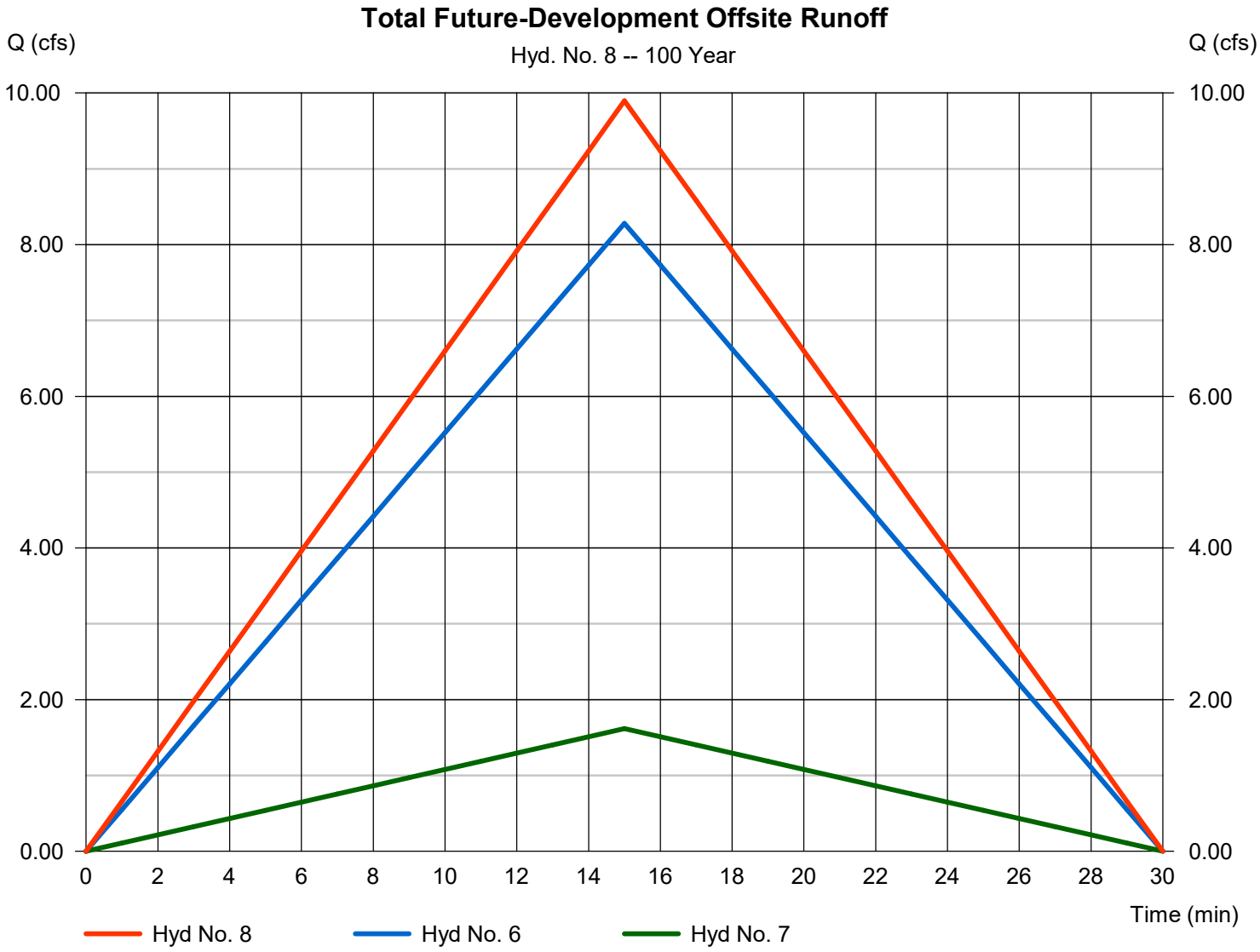


Hydrograph Report

Hyd. No. 8

Total Future-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 9.898 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 8,908 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 2.730 ac

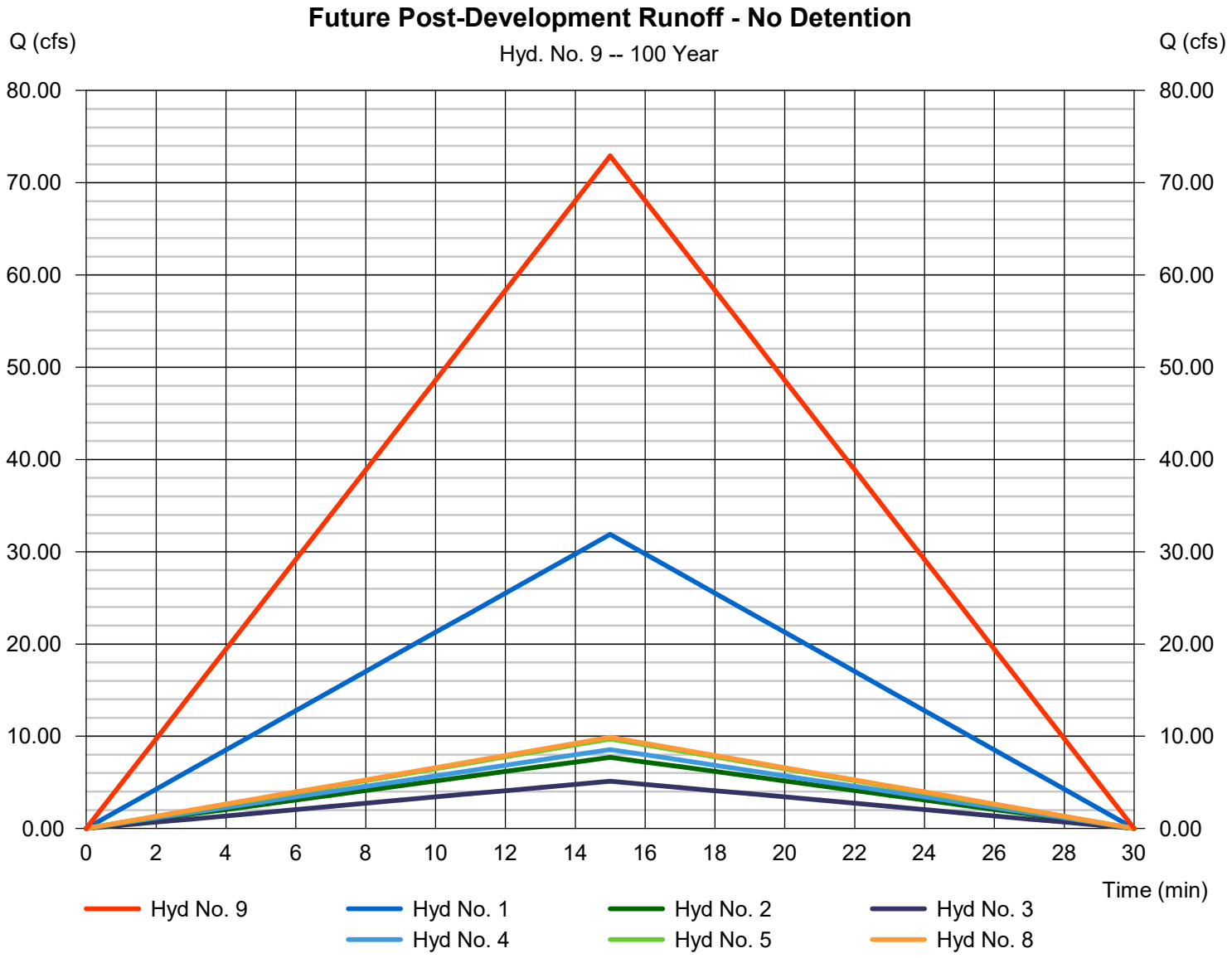


Hydrograph Report

Hyd. No. 9

Future Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 72.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 65,615 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 8	Contrib. drain. area	= 12.230 ac

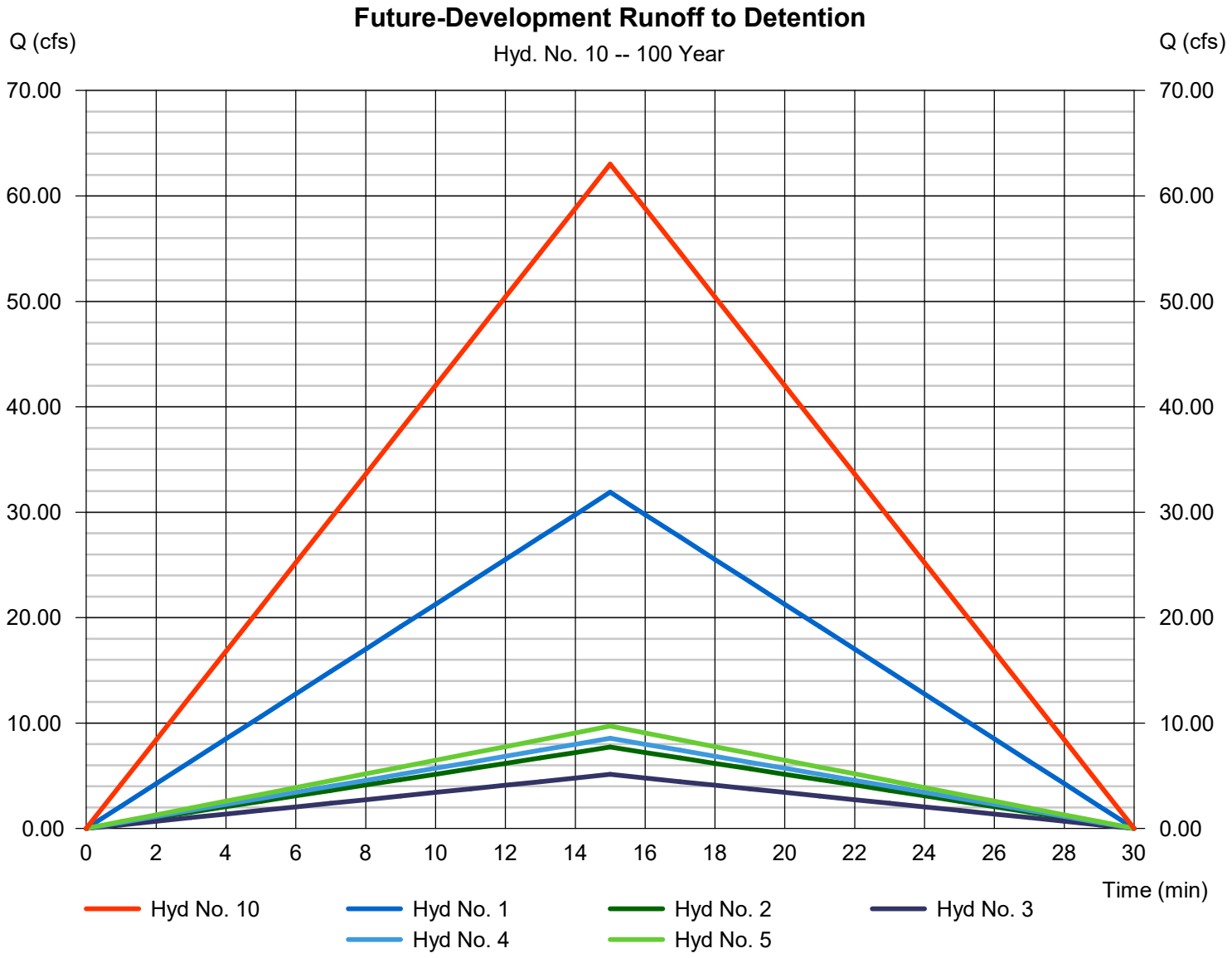


Hydrograph Report

Hyd. No. 10

Future-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 63.01 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 56,707 cuft
Inflow hyds.	= 1, 2, 3, 4, 5	Contrib. drain. area	= 12.230 ac



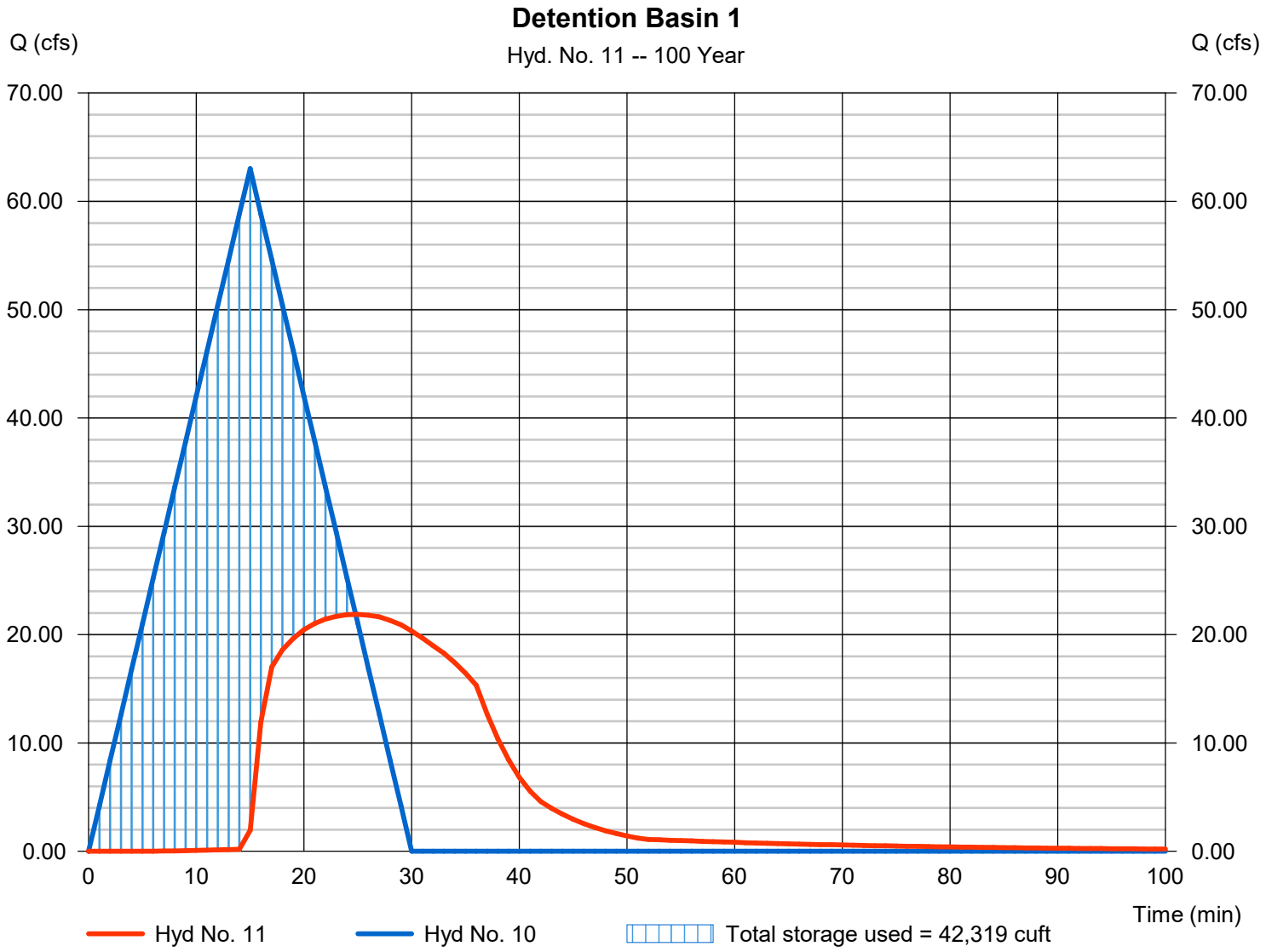
Hydrograph Report

Hyd. No. 11

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	21.86 cfs
Storm frequency	=	100 yrs	Time to peak	=	25 min
Time interval	=	1 min	Hyd. volume	=	47,424 cuft
Inflow hyd. No.	=	10 - Future-Development Runoff	Max. Elevation	=	1003.04 ft
Reservoir name	=	Detention Basin	Max. Storage	=	42,319 cuft

Storage Indication method used.

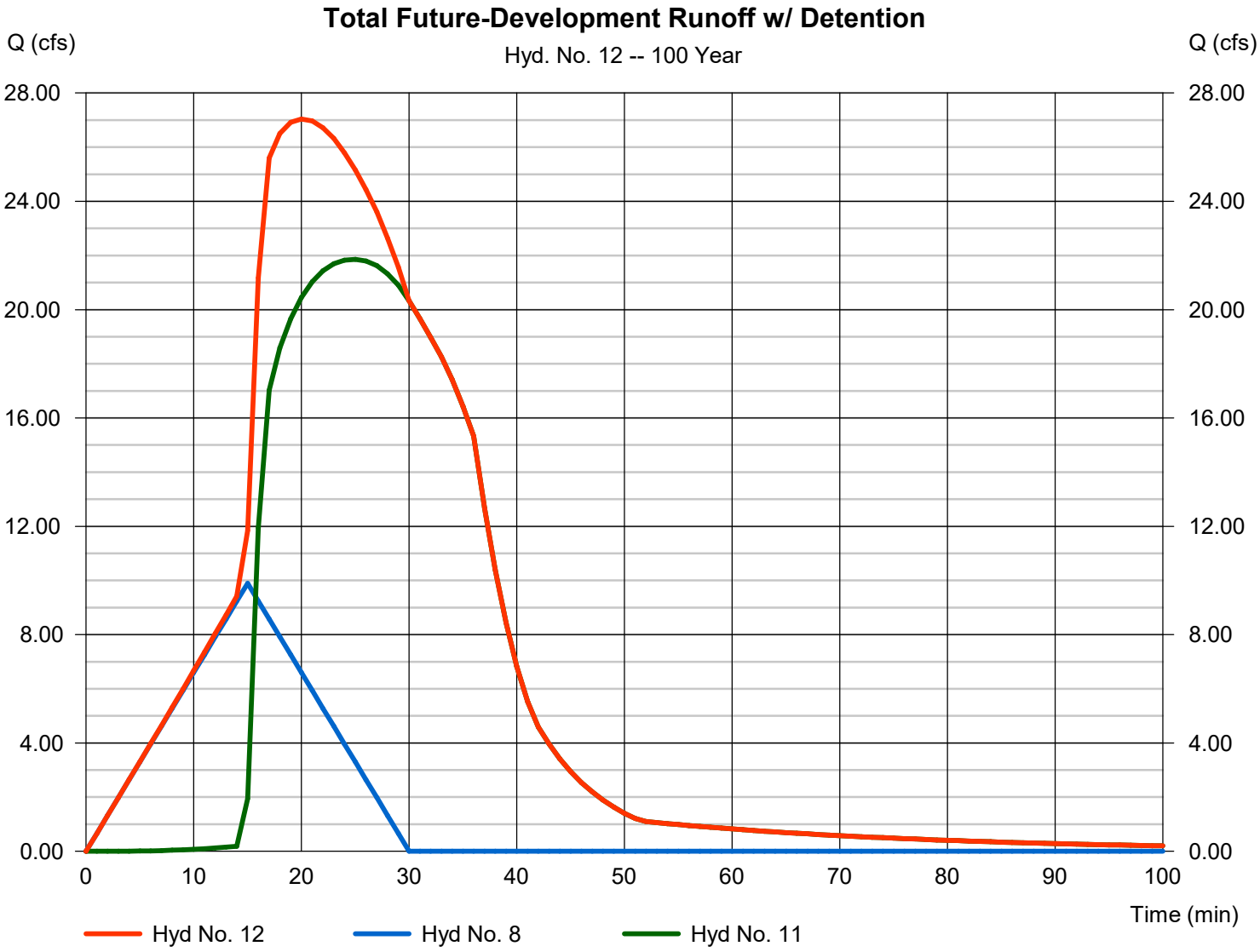


Hydrograph Report

Hyd. No. 12

Total Future-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 27.04 cfs
Storm frequency	= 100 yrs	Time to peak	= 20 min
Time interval	= 1 min	Hyd. volume	= 56,332 cuft
Inflow hyds.	= 8, 11	Contrib. drain. area	= 0.000 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	2.9200	0.1000	0.0000	--------
2	110.7137	16.5000	0.9842	--------
3	0.0000	0.0000	0.0000	--------
5	168.3971	19.5000	1.0189	--------
10	183.3473	19.2000	1.0096	--------
25	103.5313	15.9000	0.8218	--------
50	235.4014	19.9000	1.0020	--------
100	83.7894	6.1000	0.7783	--------

File name: 1.37in-hrWQ Rational.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
2	5.41	4.40	3.71	3.21	2.83	2.53	2.29	2.09	1.92	1.78	1.66	1.55
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95
10	7.35	6.08	5.18	4.52	4.00	3.59	3.26	2.98	2.74	2.54	2.37	2.22
25	8.51	7.14	6.17	5.46	4.90	4.46	4.10	3.79	3.54	3.31	3.12	2.95
50	9.39	7.82	6.70	5.86	5.20	4.68	4.25	3.90	3.60	3.34	3.12	2.92
100	12.87	9.64	7.81	6.62	5.77	5.14	4.65	4.25	3.92	3.65	3.41	3.21

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\DAE Civil\Hydraflow Storm Sewer\SCS 24-hr Rainfall.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.85	3.50	0.00	4.50	5.30	6.10	6.90	7.50
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	2.90	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10