Received
Planning Division
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PACIFIC COMMUNITY DESIGN

Scholls Ferry Multifamily

WATER QUALITY ANALYSIS

JOB# 136-007

Prepared By:
Pacific Community Design, Inc.
12564 SW Main Street
Tigard, OR 97223
(503.941.9484

Prepared For:
Placid Holding, Inc.

REGISTERED PROFESSIONAL ENGINEER
54703
OREGON
JULY 9, 2001
JAKLIN M. HUNT
5/15/24
RENEWS: 6/30/2025

DATE: 5/15/2024
BY: Jaki Hunt, P.E.

TABLE OF CONTENTS:

INTRODUCTION

This report represents the analysis done for the Scholls Ferry Multifamily water quality and detention facilities to demonstrate compliance with the City of Beaverton (City) 2019 Engineering Design Manual and the Clean Water Services (District) 2019 Design and Construction Standards. All calculations and supporting figures are included with this document.

PROJECT DESCRIPTION

The proposed Scholls Ferry Multifamily development is located on tax lot 200 of Washington County Tax Map 2S105BA. The proposed development of the 2.7-acre site within the Beaverton City limits consists of 2 apartment buildings, a parking lot, open space area, and a wetland.

EXISTING CONDITIONS

The subject property is currently a single-family residential lot with a detached garage and a paved driveway. The site slopes from north to south at grades between 5% and 10%. The site drains via surface flow into an onsite wetland located at the southerly end of the property. The wetland flows offsite to the southwest to an existing storm system that discharges into Summer Creek which is a part of the Tualatin River drainage basin. A map showing the existing site is included as Figure A1.

The point of discharge is in a storm water system adjacent to SW Barrows Road, east of its intersection with SW 157th Avenue. Per District mapping, said storm water system is categorized as having a high risk of hydro-modification. The project is within a Developed Area and is classified as a Medium Project (over 12,000 to 80,000 square feet impervious) per District standards. Taken together, these factors classify this development as a Category 3 project.

Existing soils are made of Cornelius and Kinton silt loams, which are within hydrologic group C. The soil survey map is shown in Appendix B.

WATER QUANTITY

District requirements mandate that Category 3 projects use one of the following to mitigate the effects of hydromodification: Peak-Flow Matching Detention and LIDA, or Flow Duration Curve Matching Detention. Due to the limited area available onsite to provide detention, Peak-Flow Matching Detention that requires the post-development 2-year runoff to match ½ of the pre-development 2-year runoff is being proposed as part of this development, as well as a vegetated LIDA swale to provide runoff treatment for 30% of the impervious area.

METHODOLOGY

The Santa Barbara Urban Hydrograph (SBUH) methodology was used to calculate the runoff hydrographs for the project site. The Hydraflow Hydrographs 2019 software program for AutoCAD was used to generate hydrographs for both the predeveloped and developed conditions.

The storm events modeled in this report reflect the rainfall intensities as shown in the following table.

TABLE 1
24-HOUR STORM EVENT RATES (inches)

STORM EVENT	PRECIPITATION
2-YEAR	2.50
10-YEAR	3.45
25-YEAR	3.90
100-YEAR	4.50

PRE-DEVELOPED CONDITIONS

All flows were generated using a composite SCS curve number based on the existing hydrologic soil group C and land use: 76 for pervious areas in undisturbed wood or forest land, 100 for open water bodies, and 98 for impervious areas.

The time of concentration (Tc) was calculated based on the existing drainage conditions for Basin A. The following tables summarize the input parameters for the hydrographs as well as the results of the pre-developed analysis. For all corresponding calculations see Appendix B.

TABLE 2
PRE-DEVELOPED CONDITIONS HYDROCAD INPUT PARAMETERS

SHED ID	AREA (acre)	TIME OF CONCENTRATION (min)	COMPOSITE CURVE NUMBER
BASIN A	2.33	20.02	80.2
WETLAND BASIN	0.80	-	-

TABLE 3
PRE-DEVELOPED CONDITIONS RUNOFF RATES (cfs)

SHED ID	2-YEAR	5-YEAR	10-YEAR	25-YEAR
BASIN A	0.42	0.56	0.65	0.76

DEVELOPED CONDITIONS

The flows were generated using an SCS curve number based on the hydrologic soil group and land use: 86 for pervious areas of open space in good condition, 100 for open water bodies, and 98 for impervious areas. The time of concentration (Tc) was based on the conveyance calculations for the individual pipe runs, assuming an initial catchment time of 5 mins. The following tables summarize the input parameters used to generate the hydrographs, as well as the results of the overall developed analysis.

TABLE 4
DEVELOPED CONDITIONS HYDROCAD INPUT PARAMETERS

SHED ID	AREA (acre)	TIME OF CONCENTRATION (min)	COMPOSITE CURVE NUMBER
SHED A	1.18	16.2	89.3
SHED B	0.87	6.4	93.0
SHED C	0.13	5.0	94.4
SHED D	0.16	5.0	76.0

TABLE 5
DEVELOPED CONDITIONS RUNOFF RATES BEFORE DETENTION (cfs)

SHED ID	2-YEAR	5-YEAR	10-YEAR	25-YEAR
SHED A	0.364	0.514	0.653	0.720
SHED B	0.392	0.522	0.604	0.695
SHED C	0.063	0.082	0.094	0.108
SHED D	0.018	0.034	0.044	0.058

In addition to peak flow matching for the 5 and 10-year storm events, District criteria requires that 2-year developed flows match ½ of the 2-year predeveloped flows to mitigate for hydro-modification. An underground detention system is being proposed to meet this requirement.

An R-Tank stormwater modular system will be used due to its smaller footprint and flexibility in layout options. This system utilizes rectangular chambers with 95% void space backfilled with drain rock to create the volume needed for detention.

An isolator row is used to distribute water to the adjacent chambers and surrounding drain rock. The isolator row also traps any sediment and debris that may bypass the water quality manhole, so they can more easily be removed from the system.

In order to ensure that the onsite drainage can be routed through the chambers, a shallow system 3.5’ deep will be used. A 4.0’ deep pond was modeled to determine that a volume of about 7,000 cubic feet will be needed to meet the detention and freeboard requirement.

Actual chamber dimensions, chamber configuration, and rock porosity will be used to determine the footprint that will be needed to provide this volume during the final design process. The location and approximate size of the underground detention that would be needed for a 3.5’ deep system is shown in Figure A2. The post detention runoff is summarized in Table 6.

TABLE 6
DEVELOPED CONDITIONS RUNOFF RATES AFTER DETENTION (cfs)

SHED ID	2-YEAR	5-YEAR	10-YEAR	25-YEAR
SHED A + B (DETAINED)	0.170	0.266	0.402	0.575
SHED C (UNDETAINED)	0.063	0.082	0.094	0.108
SHED D (UNDETAINED)	0.018	0.034	0.044	0.058
COMBINED	0.202	0.295	0.445	0.636

WATER QUALITY

Clean Water Services require that 65% removal of phosphorous be provided for stormwater runoff if greater than 1000-square feet of impervious area of an existing development is modified. A permanent water quality facility must be constructed to reduce contaminants that enter the storm and surface water system. Impervious surfaces shall include pavement, gravel roads, buildings, public and private roadways, and other surfaces that contribute runoff to the surface water system. District standards also require that 30% of the proposed impervious area is managed using LIDA facilities to meet the hydromodification requirement.

The LIDA requirements for the Scholls Ferry Multifamily development will be addressed through the use of a vegetated swale. The runoff generated by the flag portion of the site, the drive aisle and northern parking lot, and the northern building (Basin A) will be treated by said vegetated swale.

The small portion of parking to the south (Basin C) that enters the lower garage in the second building will be treated using a Stormfilter catch basin.

The remainder of the site (Basin B) will be treated by a water quality filter manhole. Sizing calculations for the vegetated swale, Stormfilter catch basin, and water quality manhole is included in Appendix D.

CONCLUSION

The detention and water quality facilities being proposed as part of the Scholls Ferry Multifamily are consistent with the design requirements of both the City of Beaverton and Clean Water Services.

APPENDIX A

EXISTING DRAINAGE BASIN A
2.33 AC

EXISTING WETLAND BASIN
0.80 AC

TIME OF CONCENTRATION PATH

SCALE
30 0 15 30
1 INCH = 30 FEET

N:\proj\136-007\09 Drawings\04 Civil\Exhibits - Hydrology\136007 (A1) Existing Drainage Map.dwg - SHEET Layout1 May 14, 2024 - 5:32pm jmh

PACIFIC COMMUNITY DESIGN
12564 SW Main Street
Tigard, OR 97223
[T] 503-941-9484

DATE: 05/10/2024

REVISIONS

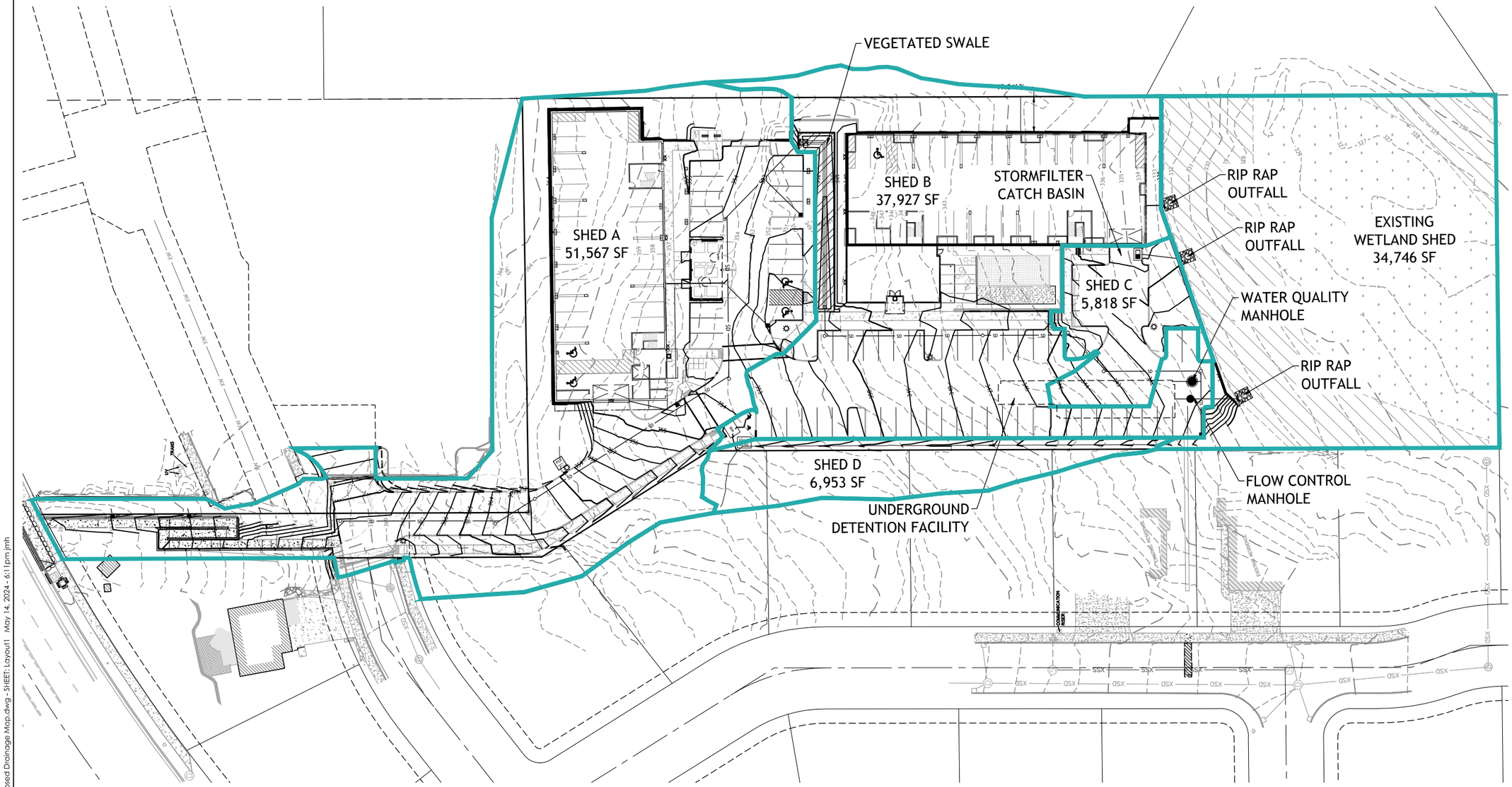
NO.	DATE	DESCRIPTION

SCHOLLS FERRY MULTIFAMILY

EXISTING DRAINAGE MAP

PROJECT NO.: 136-007
TYPE: CONSTRUCTION
REVIEWED BY: JMH

A1



N:\proj\136-007\09 Drawings\04 Civil\Exhibits - Hydrology\136007 [A2] Proposed Drainage Map.dwg - SHEET: Layout1 May 14, 2024 - 6:11pm jmh

PACIFIC COMMUNITY DESIGN
12564 SW Main Street
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DATE: 05/10/2024

REVISIONS

NO.	DATE	DESCRIPTION

SCHOLLS FERRY MULTIFAMILY

PROPOSED DRAINAGE MAP

PROJECT NO.: 136-007
TYPE: CONSTRUCTION
REVIEWED BY: JMH

A2

APPENDIX B

United States Department of Agriculture

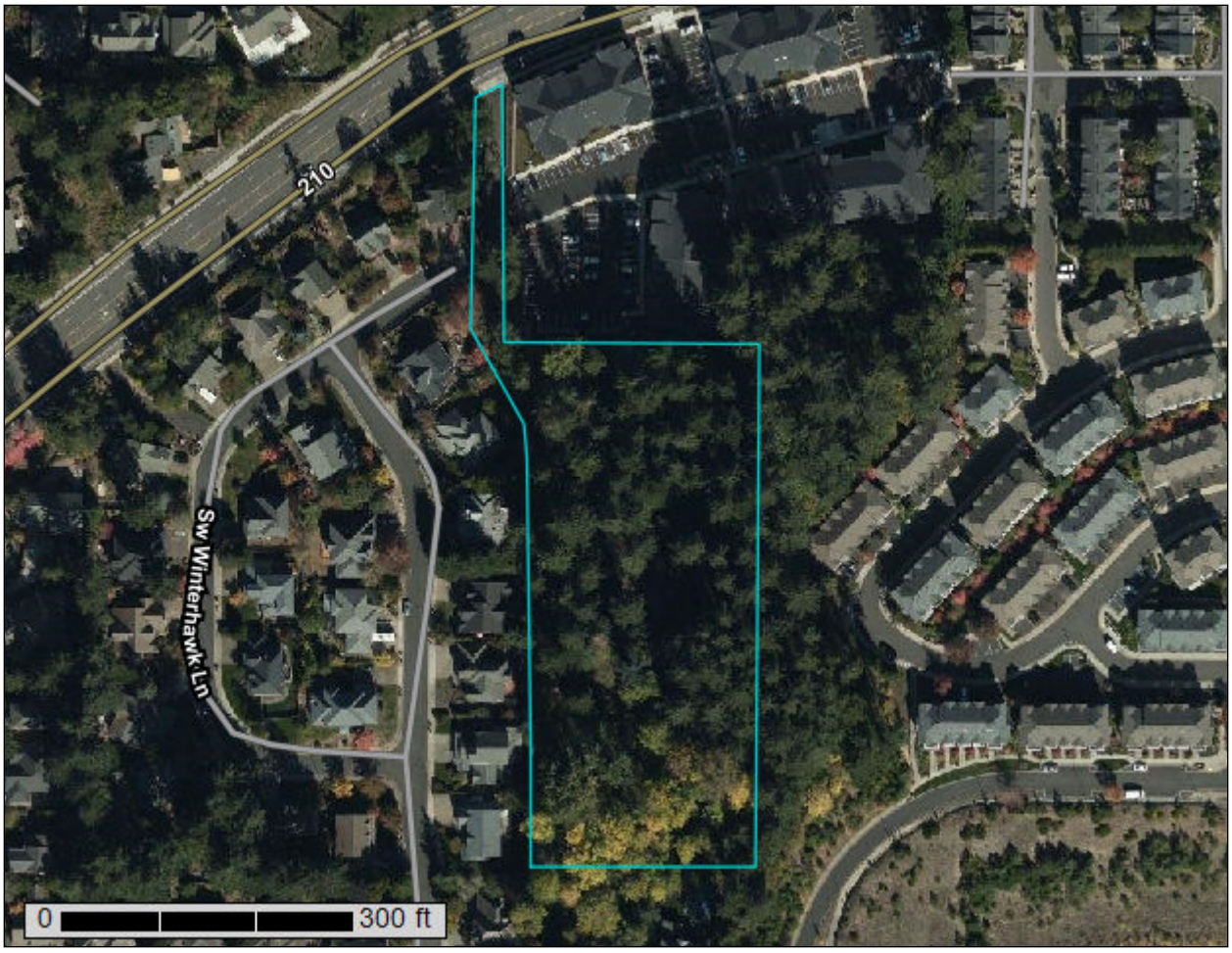
NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Washington County, Oregon

Scholls Ferry Apartments



January 16, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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

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

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

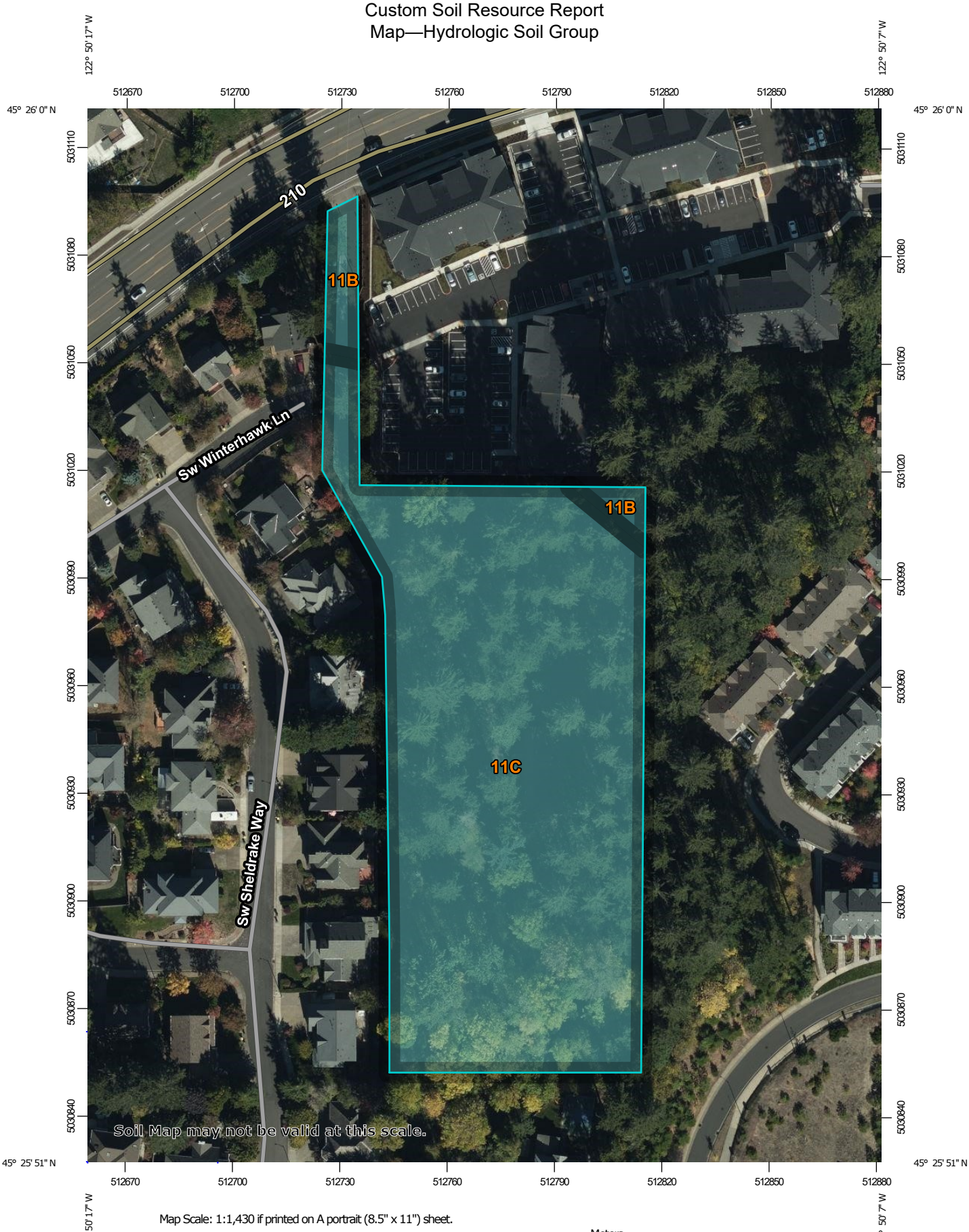
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:1,430 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 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Washington County, Oregon
Survey Area Data: Version 17, Sep 10, 2019

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

Date(s) aerial images were photographed: Sep 19, 2018—Oct 20, 2018

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11B	Cornelius and Kinton silt loams, 2 to 7 percent slopes	C	0.1	4.4%
11C	Cornelius and Kinton silt loams, 7 to 12 percent slopes	C	3.0	95.6%
Totals for Area of Interest			**3.1**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

PREDEVELOPED TIME OF CONCENTRATION
SHED AREA A

JOB NUMBER: 136-007
PROJECT: Scholls Ferry Apartments
FILE: N:\proj\136-007\05 Reports\Hydrology Analysis\Engineering\136007.Hydrology Calcs-Prelim.2024-05-09

			Accum. Tc
LAG ONE: SHEET FLOW (FIRST 300 FEET)			
Tt = Travel time			
Manning's "n " =	0.17		
Flow Length, L =	300 ft	(300 ft. max.)	
P = 2-year, 24hr storm =	2.5 in		
Slope, S_0 =	0.079 ft/ft		
$T_T = \frac{(0.42)(n * L)^{0.8}}{(P)^{0.5}(S_0)^{0.4}}$	17.02 min.		17.02 min.
LAG TWO: SHALLOW CONCENTRATED FLOW (NEXT 200 FEET)			
Tc Velocity factor, k=	8		
Slope, S_0 =	0.070 ft/ft		
$V = k\sqrt{S_0}$	2.11 ft/s		
Flow Length, L =	200 ft		
$T = \frac{L}{(60)(V)}$	1.58 min.		18.60 min.
LAG THREE: SHALLOW CONCENTRATED FLOW (NEXT 155 FEET)			
Tc Velocity factor, k=	8		
Slope, S_0 =	0.074 ft/ft		
$V = k\sqrt{S_0}$	2.18 ft/s		
Flow Length, L =	155 ft		
$T = \frac{L}{(60)(V)}$	1.19 min.		19.79 min.
LAG FOUR: CHANNEL FLOW (NEXT 102 FEET)			
Tc Velocity factor, k=	27		
Slope, S_0 =	0.076 ft/ft		
$V = k\sqrt{S_0}$	7.46 ft/s		
Flow Length, L =	102 ft		
$T = \frac{L}{(60)(V)}$	0.23 min.		20.02 min.
TOTAL PREDEVELOPED TIME OF CONCENTRATION =			**20.02 min.**

DEVELOPED TIME OF CONCENTRATION

JOB NUMBER: 136-007
PROJECT: Scholls Ferry Apartments
FILE: N:\proj\136-007\05 Reports\Hydrology Analysis\Engineering\136007.Hydrology Calcs-Prelim.2024-05-09

SHED AREA A

Catchment Time	5	min.
Longest Run of Pipe	396.45	ft
Velocity of Flow	3	ft/s
Time in Pipe = (396.45 ft)/(3.00 ft/s) =	132.15	s
PIPE DEVELOPED Tc =	**7.20**	**min.**
Residence time in swale Tc =	9.00	min
TOTAL DEVELOPED Tc =	**16.20**	**min.**

SHED AREA B

Catchment Time	5	min.
Longest Run of Pipe	254.28	ft
Velocity of Flow	3	ft/s
Time in Pipe = (254.28 ft)/(3.00 ft/s) =	84.76	s
PIPE DEVELOPED Tc =	**6.41**	**min.**

SHED AREA C

Catchment Time	5	min.
Longest Run of Pipe	0	ft
Velocity of Flow	3	ft/s
Time in Pipe = (0 ft)/(3.00 ft/s) =	0.00	s
PIPE DEVELOPED Tc =	**5.00**	**min.**

SHED AREA D

			Accum. Tc
LAG ONE: SHEET FLOW (FIRST 37 FEET)			
Tt = Travel time			
Manning's "n " =	0.17		
Flow Length, L =	37 ft	(300 ft. max.)	
P = 2-year, 24hr storm =	2.5 in		
Slope, S_0 =	0.110 ft/ft		
$T_T = \frac{(0.42)(n * L)^{0.8}}{(P)^{0.5}(S_0)^{0.4}}$	2.80 min.		2.80 min.
LAG TWO: CHANNEL FLOW (NEXT 238.02 FEET)			
Tc Velocity factor, k=	27		
Slope, S_0 =	0.061 ft/ft		
$V = k\sqrt{S_0}$	6.68 ft/s		
Flow Length, L =	238.02 ft		
$T = \frac{L}{(60)(V)}$	0.59 min.		3.39 min.
TOTAL PREDEVELOPED TIME OF CONCENTRATION			**3.39 min.**
			5.00 min.

APPENDIX C

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SBUH Runoff	0.418	2	482	7,314	------	------	------	Basin A Pre
3	SBUH Runoff	0.364	2	480	6,284	------	------	------	Shed A Post
4	SBUH Runoff	0.392	2	478	5,620	------	------	------	Shed B Post
5	SBUH Runoff	0.063	2	476	882	------	------	------	Shed C Post
6	SBUH Runoff	0.018	2	480	403	------	------	------	Shed D Post
8	Combine	0.754	2	480	11,903	3, 4,	------	------	Shed A + B Post
11	Reservoir	0.170	2	700	11,901	8	337.24	3,210	Shed A + B Detained
12	Combine	0.202	2	480	13,186	5, 6, 11	------	------	Total Outfall

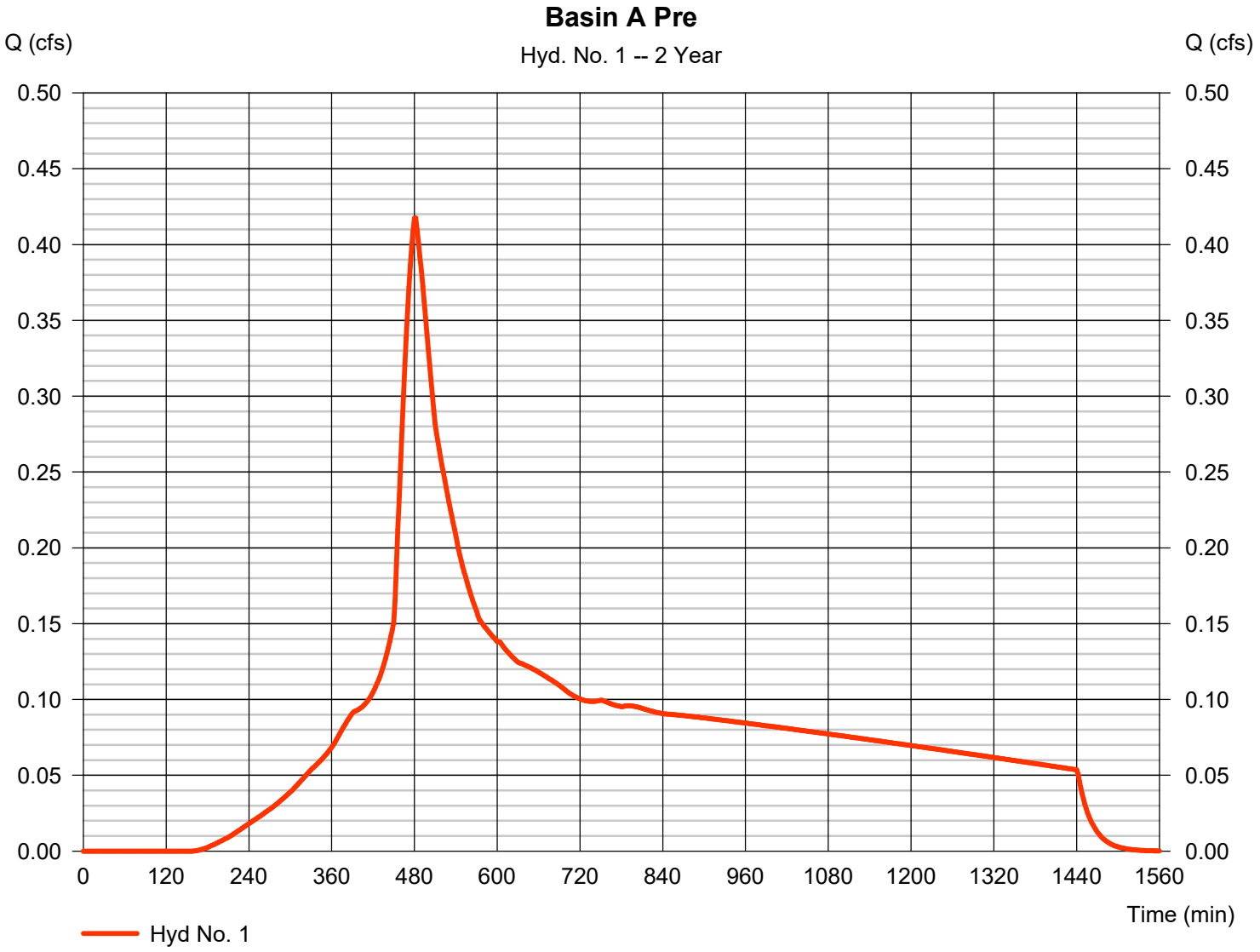
Hydrograph Report

Hyd. No. 1

Basin A Pre

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.418 cfs
Storm frequency	=	2 yrs	Time to peak	=	482 min
Time interval	=	2 min	Hyd. volume	=	7,314 cuft
Drainage area	=	1.190 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	20.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.320 x 98) + (2.010 x 76)] / 1.190



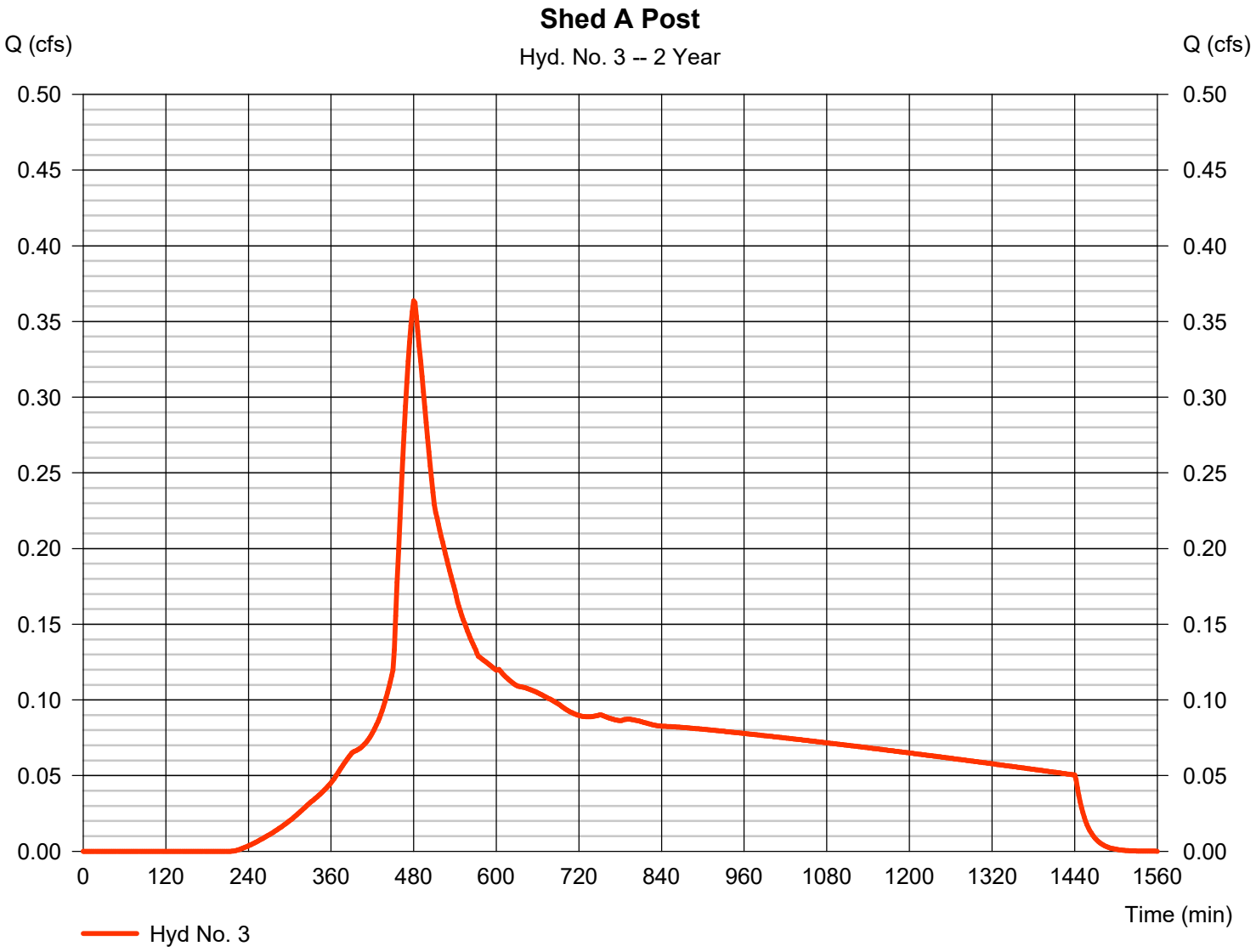
Hydrograph Report

Hyd. No. 3

Shed A Post

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.364 cfs
Storm frequency	= 2 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 6,284 cuft
Drainage area	= 1.190 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.20 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.680 x 98) + (0.090 x 86) + (0.420 x 76)] / 1.190



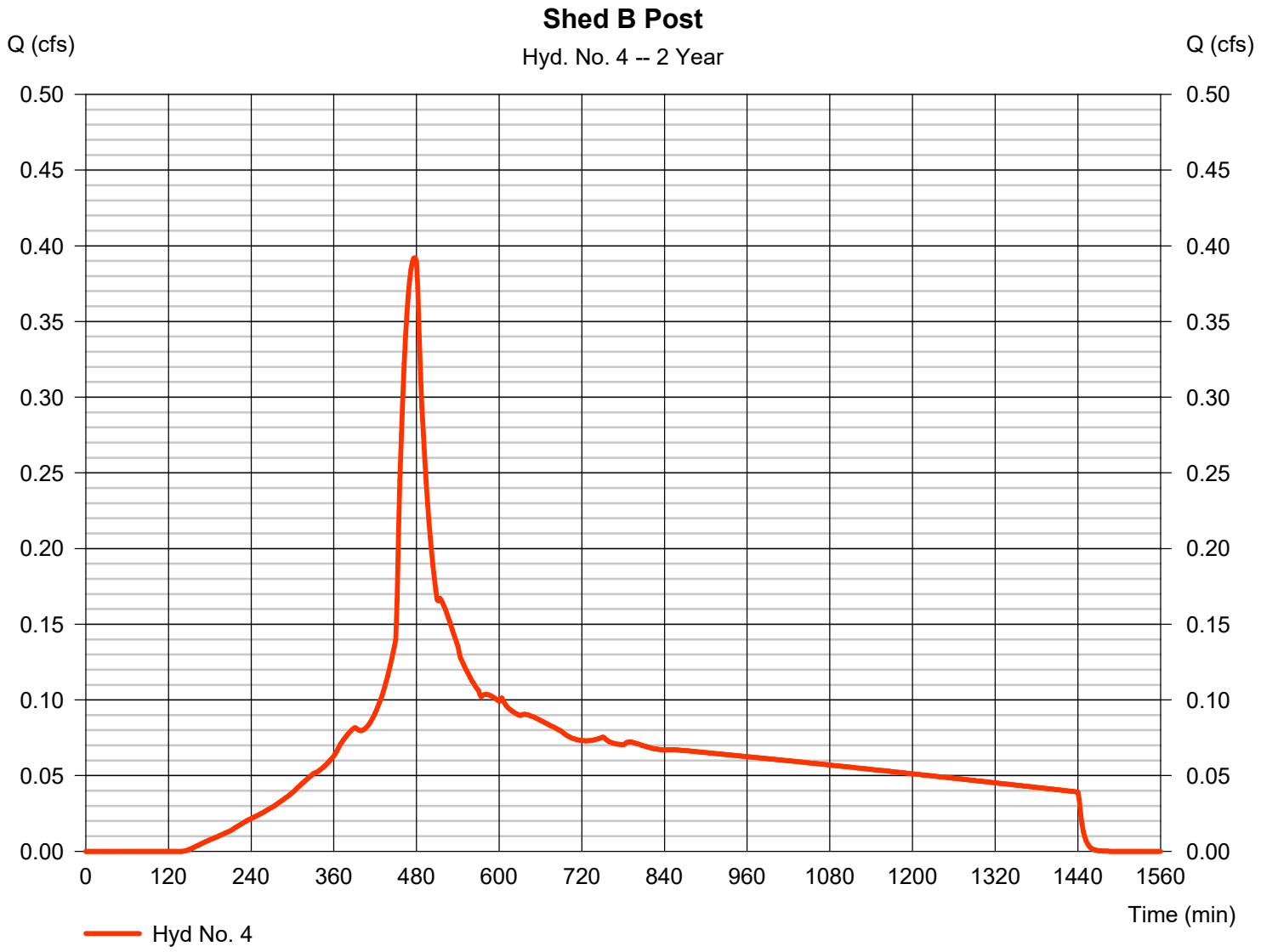
Hydrograph Report

Hyd. No. 4

Shed B Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.392 cfs
Storm frequency	=	2 yrs	Time to peak	=	478 min
Time interval	=	2 min	Hyd. volume	=	5,620 cuft
Drainage area	=	0.870 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.40 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.620 x 98) + (0.120 x 86) + (0.130 x 76)] / 0.870



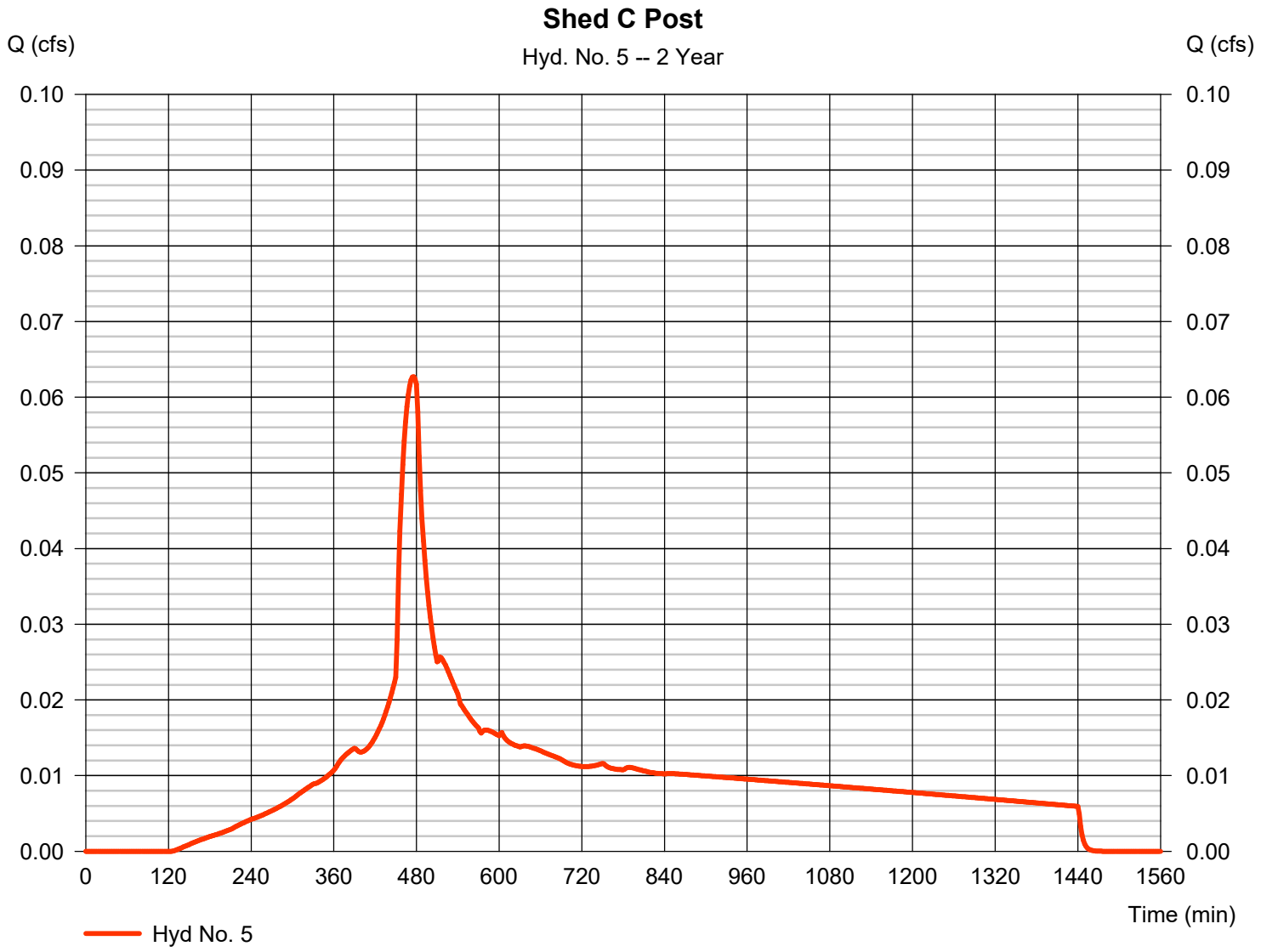
Hydrograph Report

Hyd. No. 5

Shed C Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.063 cfs
Storm frequency	=	2 yrs	Time to peak	=	476 min
Time interval	=	2 min	Hyd. volume	=	882 cuft
Drainage area	=	0.130 ac	Curve number	=	94*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.090 x 98) + (0.040 x 86)] / 0.130



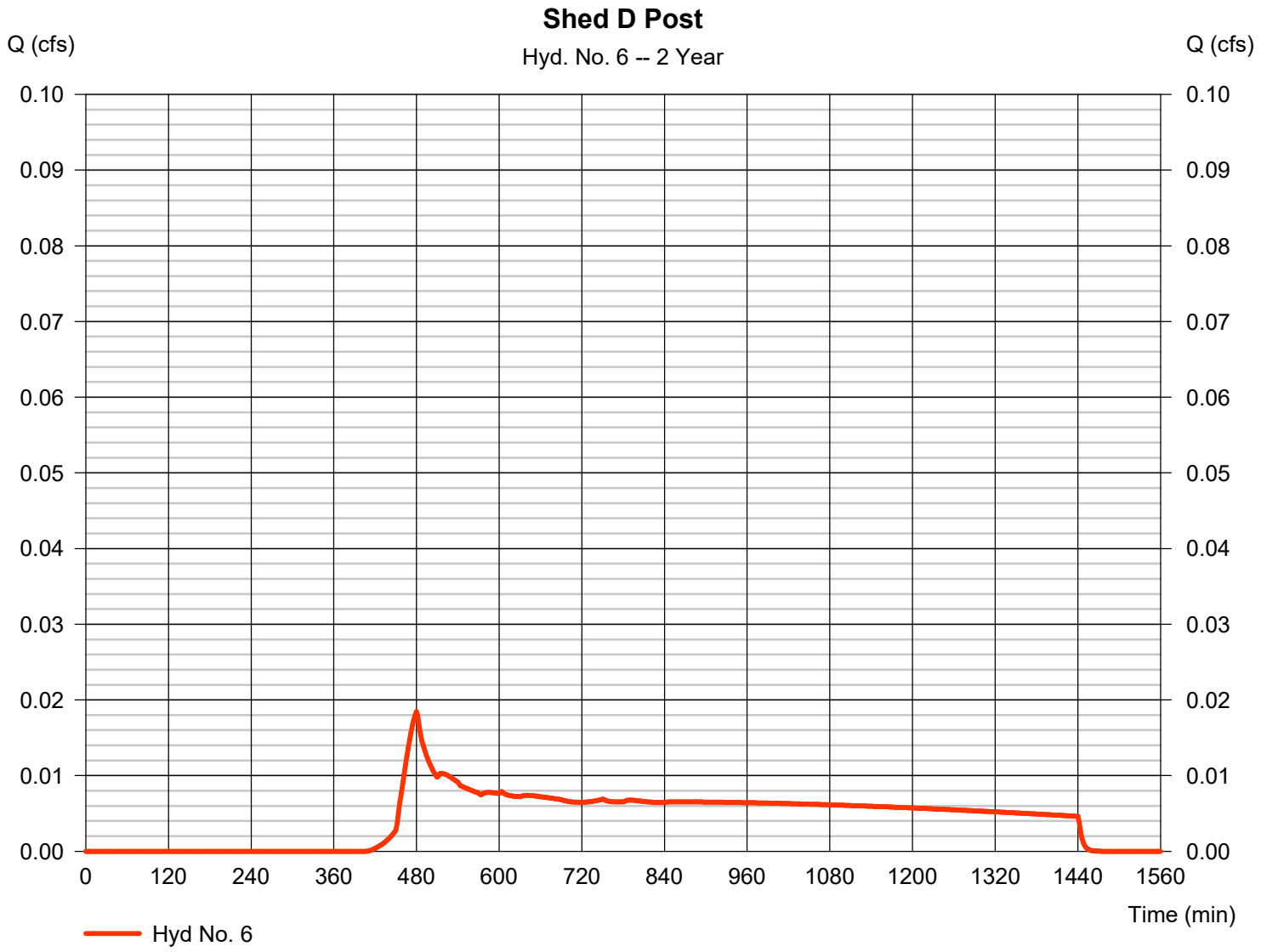
Hydrograph Report

Hyd. No. 6

Shed D Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.018 cfs
Storm frequency	=	2 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	403 cuft
Drainage area	=	0.160 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = + (0.160 x 76)] / 0.160

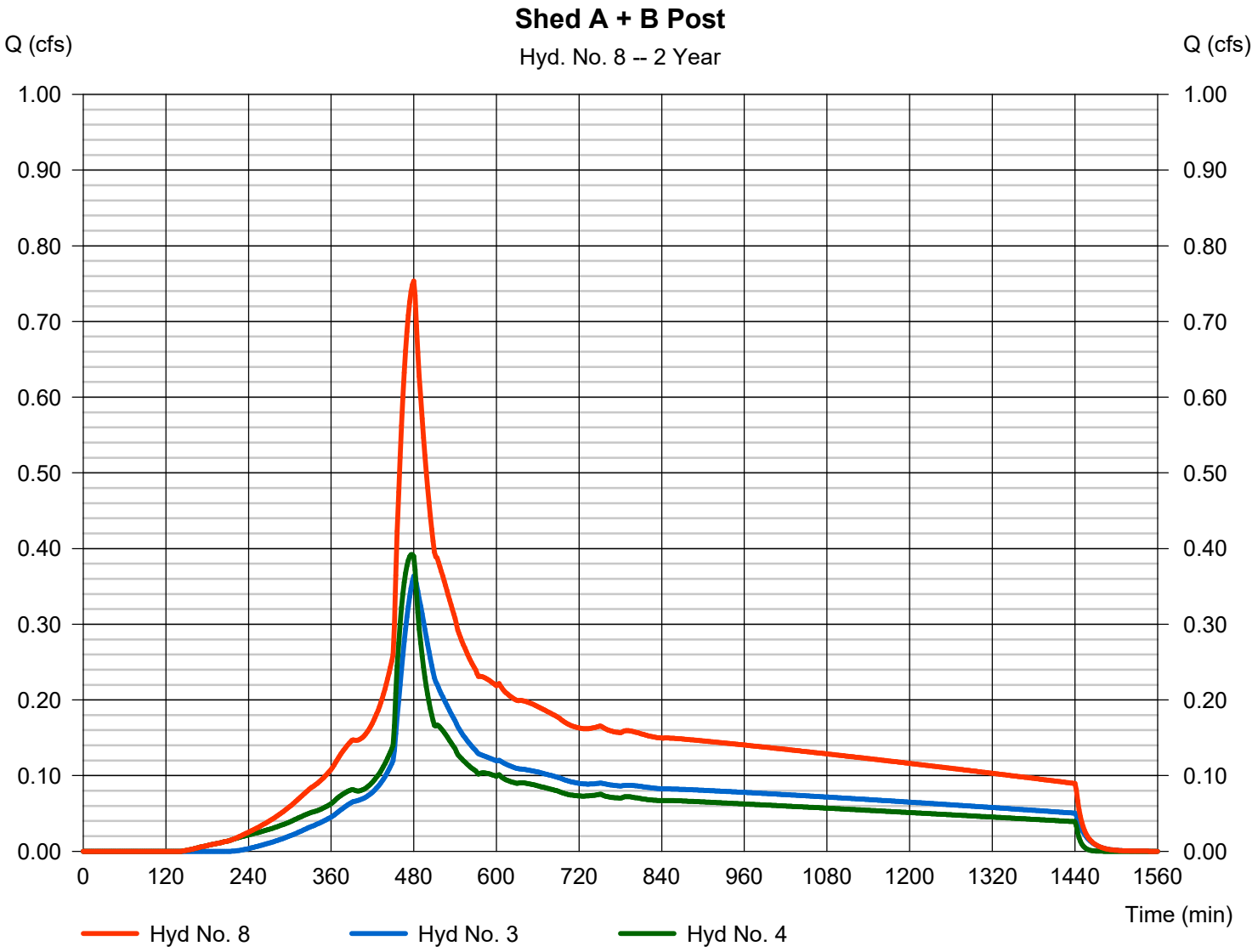


Hydrograph Report

Hyd. No. 8

Shed A + B Post

Hydrograph type	= Combine	Peak discharge	= 0.754 cfs
Storm frequency	= 2 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 11,903 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.060 ac



Hydrograph Report

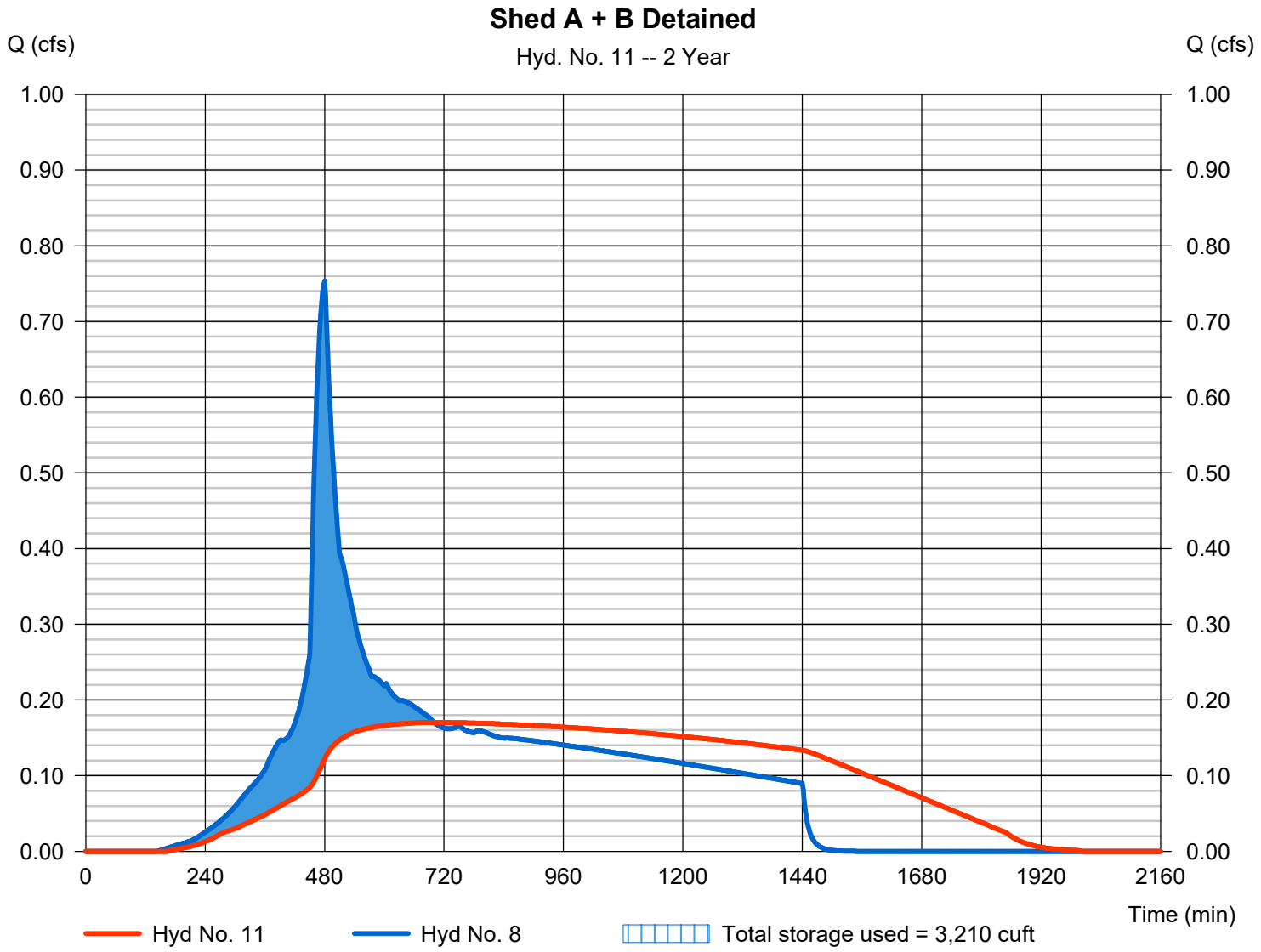
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 05 / 15 / 2024

Hyd. No. 11

Shed A + B Detained

Hydrograph type	=	Reservoir	Peak discharge	=	0.170 cfs
Storm frequency	=	2 yrs	Time to peak	=	700 min
Time interval	=	2 min	Hyd. volume	=	11,901 cuft
Inflow hyd. No.	=	8 - Shed A + B Post	Max. Elevation	=	337.24 ft
Reservoir name	=	R Tanks	Max. Storage	=	3,210 cuft

Storage Indication method used.



Pond No. 6 - R Tanks

Pond Data

UG Chambers -Invert elev. = 335.60 ft, Rise x Span = 3.58 x 23.00 ft, Barrel Len = 85.00 ft, No. Barrels = 1, Slope = 0.00%, Headers = No

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	335.60	n/a	0	0
0.36	335.96	n/a	700	700
0.72	336.32	n/a	700	1,400
1.07	336.67	n/a	700	2,100
1.43	337.03	n/a	700	2,800
1.79	337.39	n/a	700	3,500
2.15	337.75	n/a	700	4,200
2.51	338.11	n/a	700	4,900
2.86	338.46	n/a	700	5,600
3.22	338.82	n/a	700	6,300
3.58	339.18	n/a	700	7,000

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	2.25	5.00	0.00
Span (in)	= 12.00	2.25	5.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 334.67	334.75	337.75	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

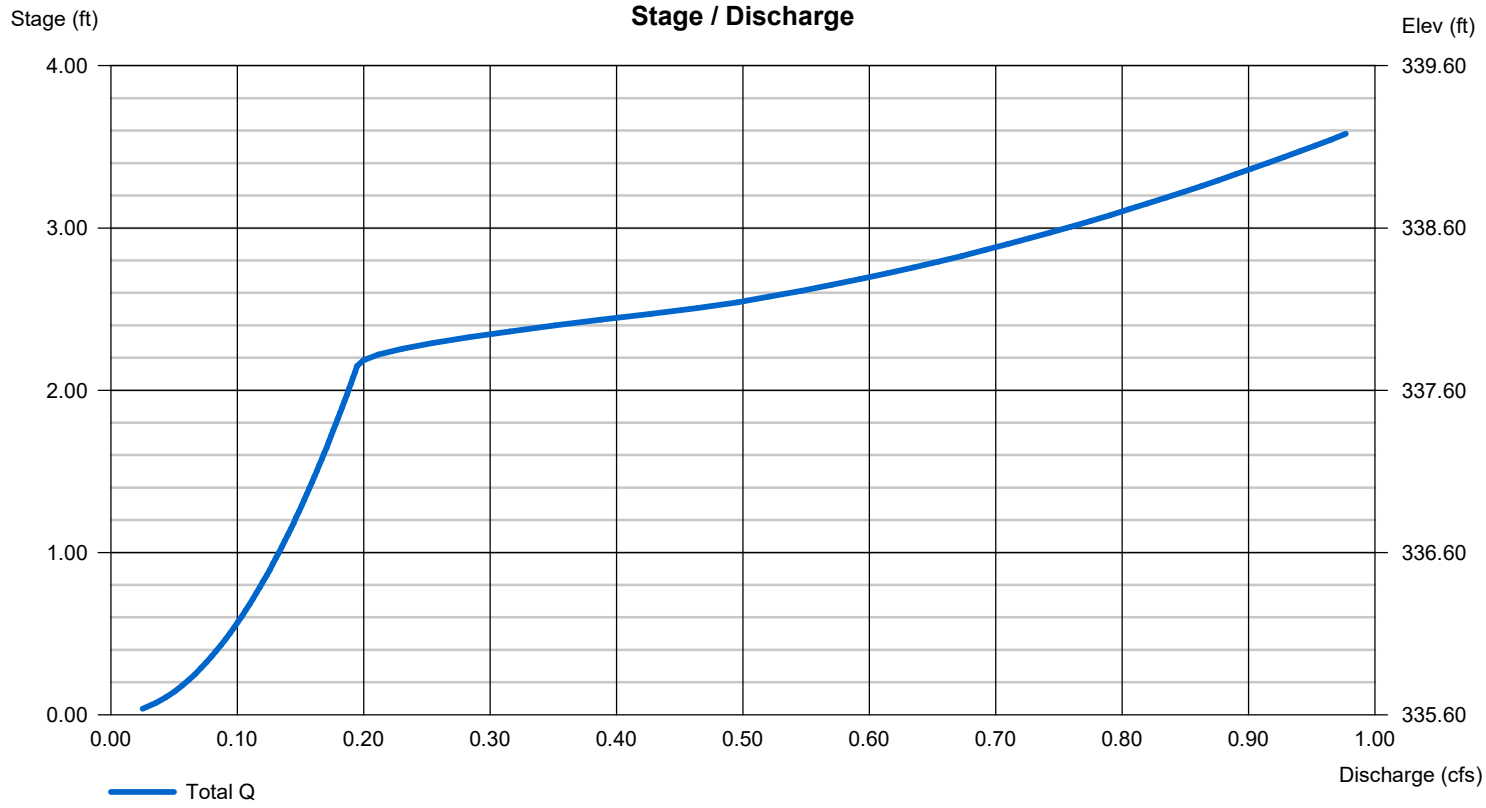
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	0.00	0.00	0.00
Crest El. (ft)	= 340.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

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

TW Elev. (ft) = 0.00

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

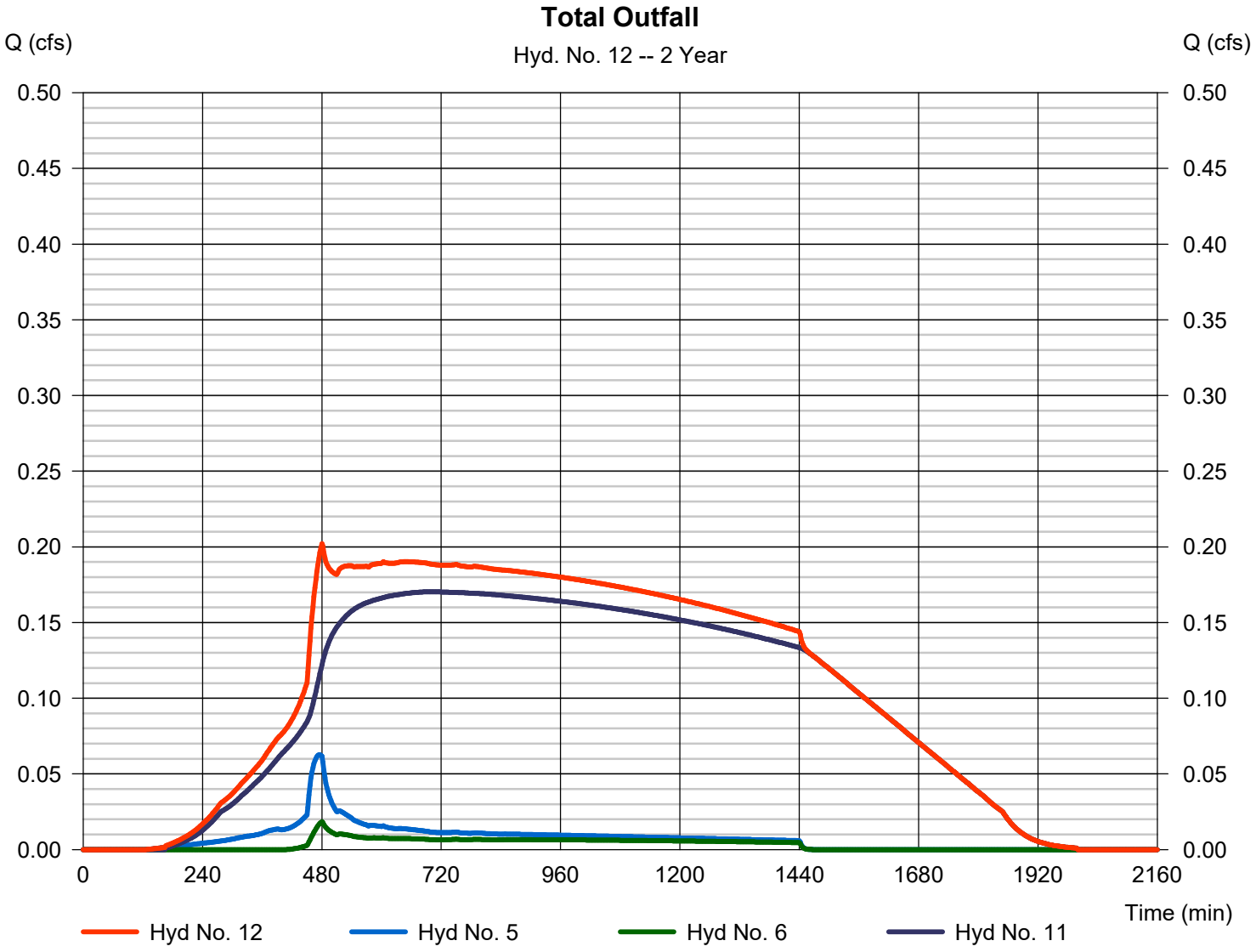


Hydrograph Report

Hyd. No. 12

Total Outfall

Hydrograph type	= Combine	Peak discharge	= 0.202 cfs
Storm frequency	= 2 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 13,186 cuft
Inflow hyds.	= 5, 6, 11	Contrib. drain. area	= 0.290 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SBUH Runoff	0.565	2	480	9,744	------	------	------	Basin A Pre
3	SBUH Runoff	0.514	2	480	8,598	------	------	------	Shed A Post
4	SBUH Runoff	0.522	2	476	7,421	------	------	------	Shed B Post
5	SBUH Runoff	0.082	2	474	1,155	------	------	------	Shed C Post
6	SBUH Runoff	0.034	2	480	629	------	------	------	Shed D Post
8	Combine	1.031	2	480	16,019	3, 4,	------	------	Shed A + B Post
11	Reservoir	0.266	2	626	16,016	8	337.91	4,507	Shed A + B Detained
12	Combine	0.295	2	622	17,800	5, 6, 11	------	------	Total Outfall

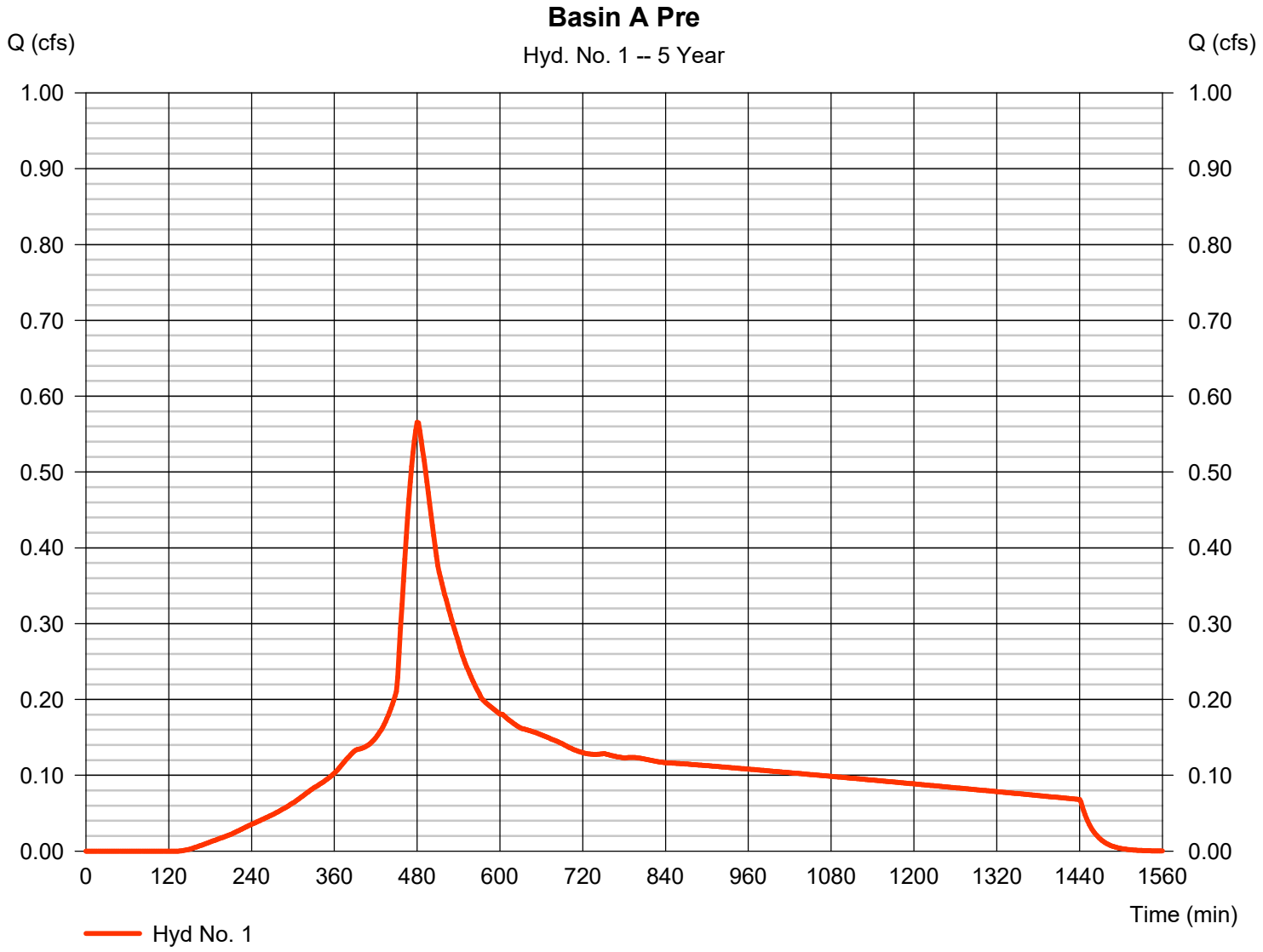
Hydrograph Report

Hyd. No. 1

Basin A Pre

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.565 cfs
Storm frequency	=	5 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	9,744 cuft
Drainage area	=	1.190 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	20.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.320 x 98) + (2.010 x 76)] / 1.190



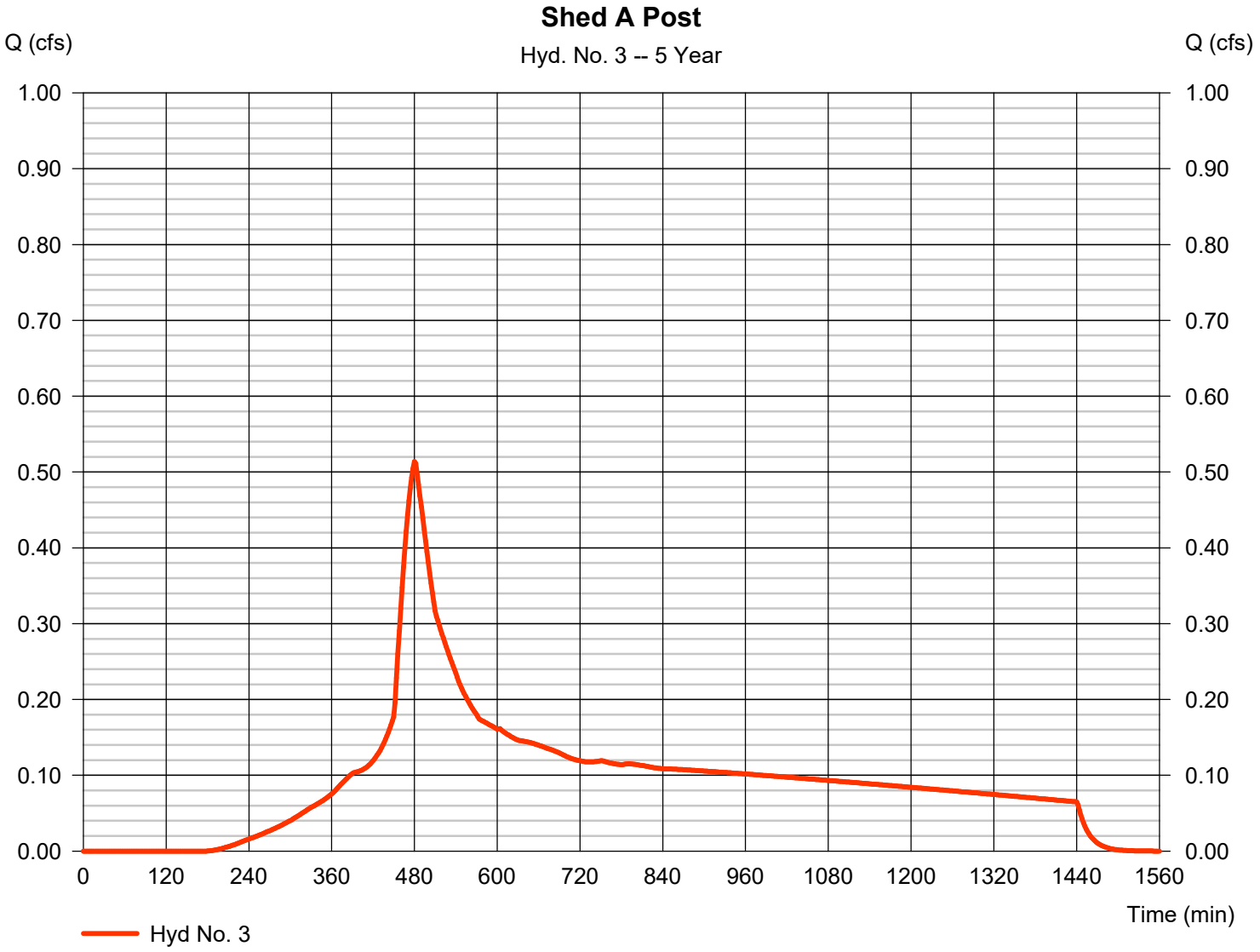
Hydrograph Report

Hyd. No. 3

Shed A Post

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.514 cfs
Storm frequency	= 5 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 8,598 cuft
Drainage area	= 1.190 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.20 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.680 x 98) + (0.090 x 86) + (0.420 x 76)] / 1.190



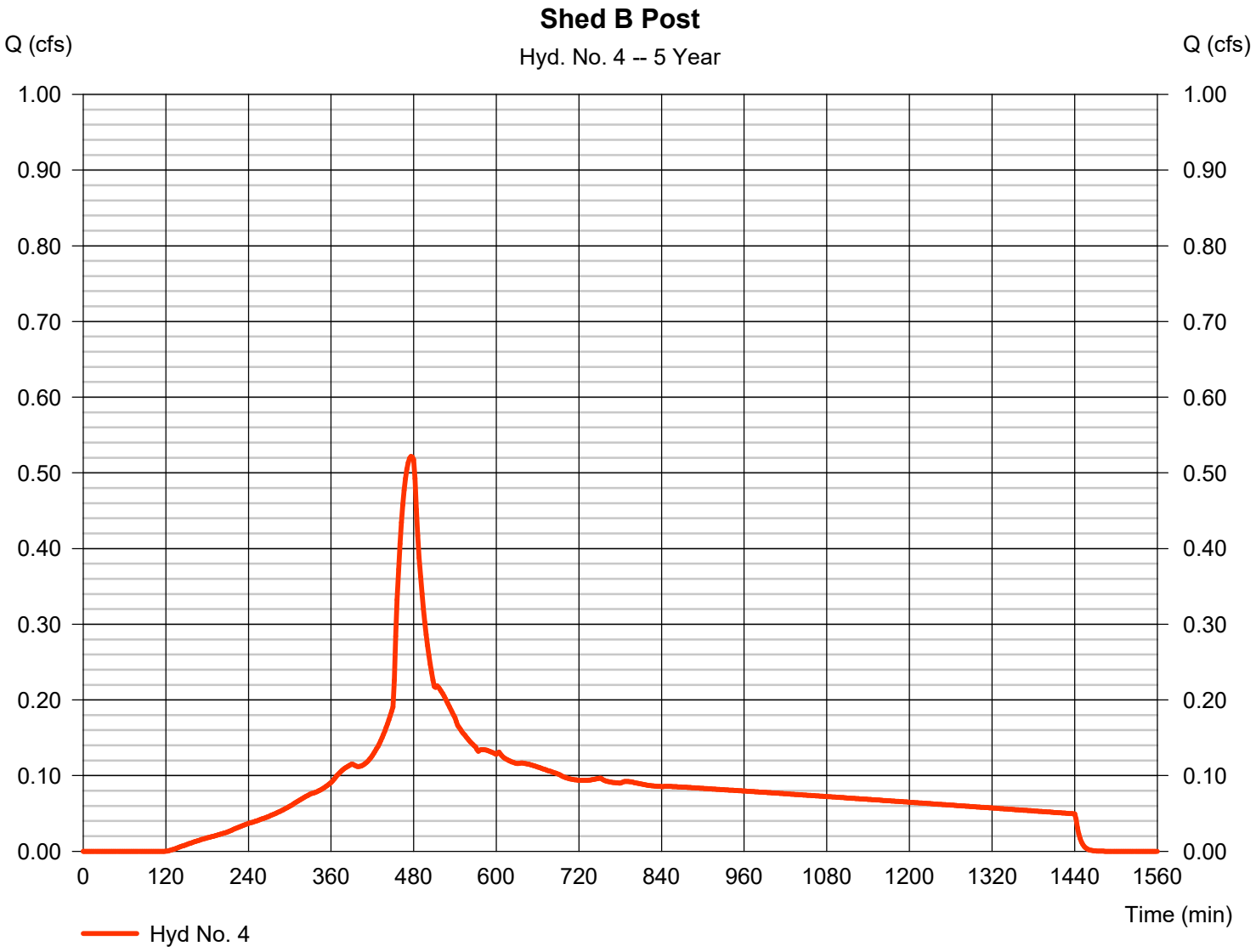
Hydrograph Report

Hyd. No. 4

Shed B Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.522 cfs
Storm frequency	=	5 yrs	Time to peak	=	476 min
Time interval	=	2 min	Hyd. volume	=	7,421 cuft
Drainage area	=	0.870 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.40 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.620 x 98) + (0.120 x 86) + (0.130 x 76)] / 0.870



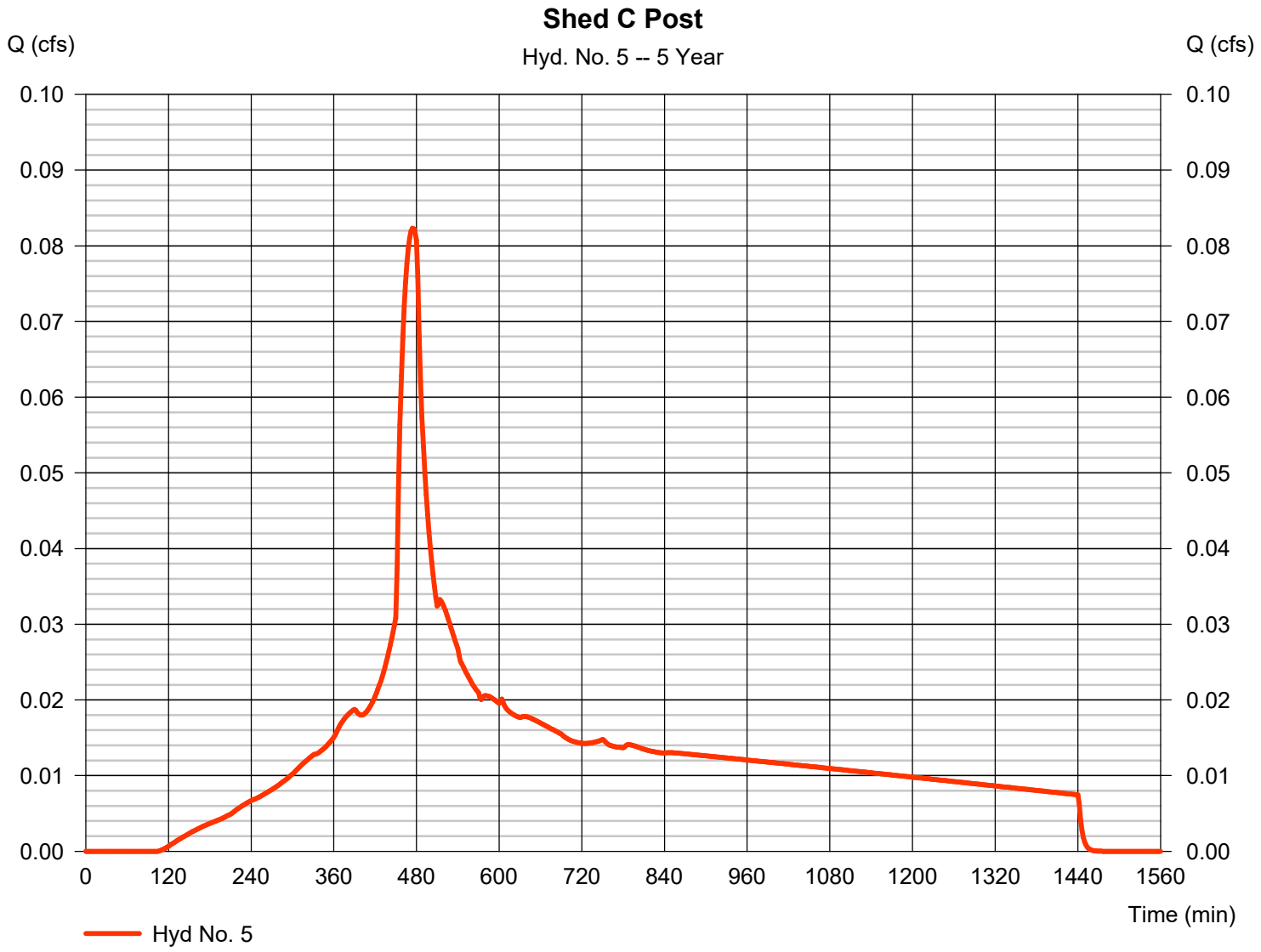
Hydrograph Report

Hyd. No. 5

Shed C Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.082 cfs
Storm frequency	=	5 yrs	Time to peak	=	474 min
Time interval	=	2 min	Hyd. volume	=	1,155 cuft
Drainage area	=	0.130 ac	Curve number	=	94*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.090 x 98) + (0.040 x 86)] / 0.130



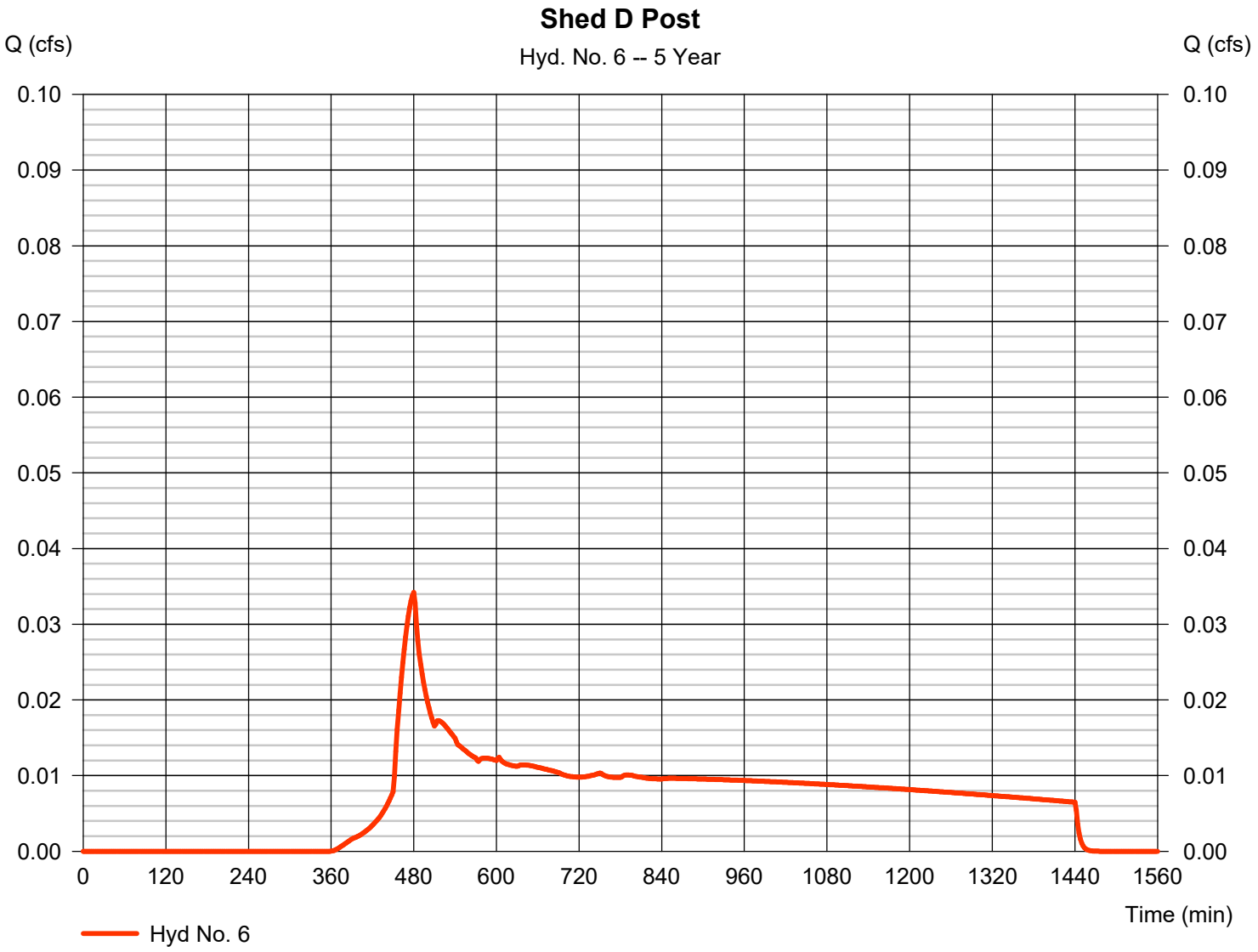
Hydrograph Report

Hyd. No. 6

Shed D Post

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.034 cfs
Storm frequency	= 5 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 629 cuft
Drainage area	= 0.160 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = + (0.160 x 76)] / 0.160

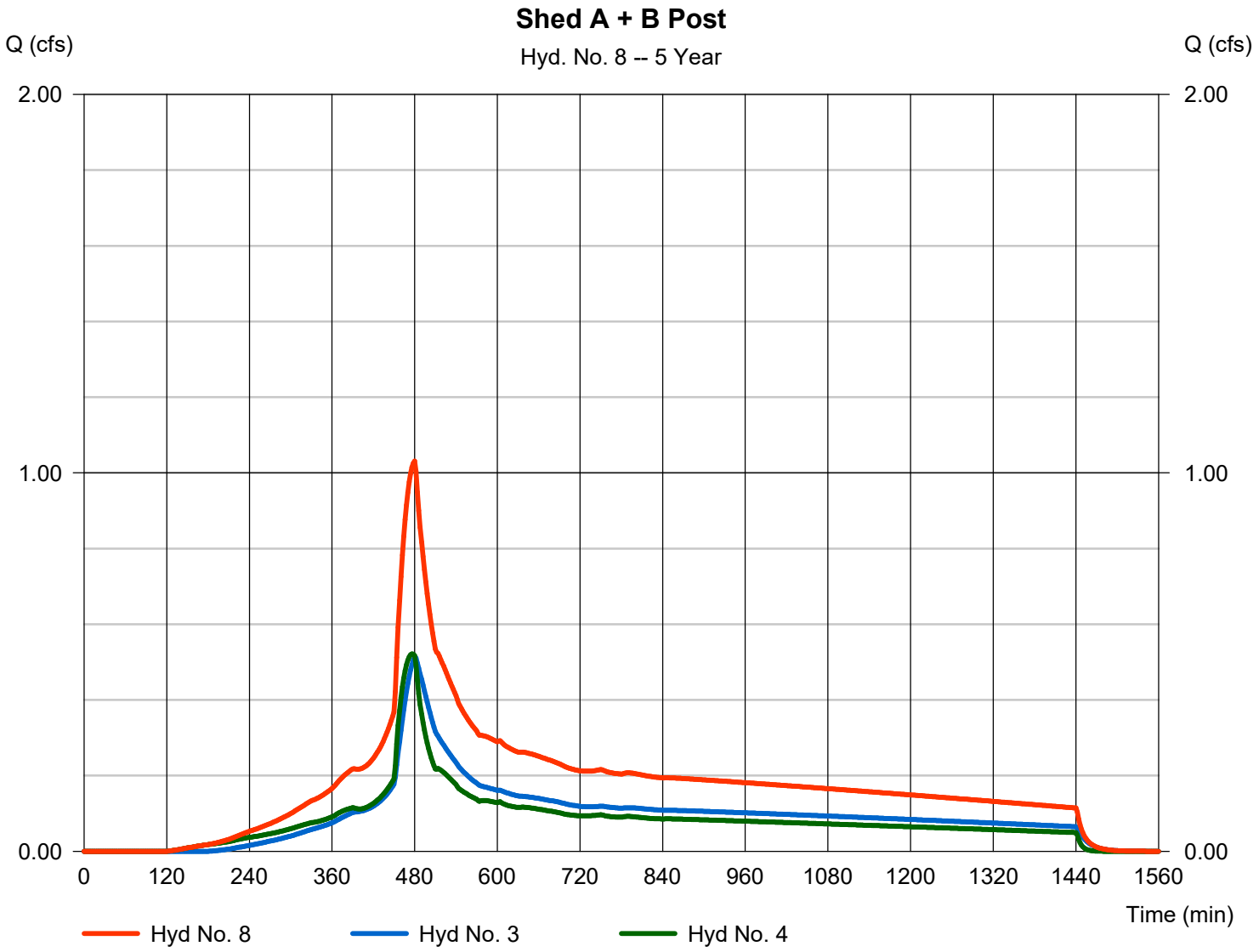


Hydrograph Report

Hyd. No. 8

Shed A + B Post

Hydrograph type	= Combine	Peak discharge	= 1.031 cfs
Storm frequency	= 5 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 16,019 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.060 ac



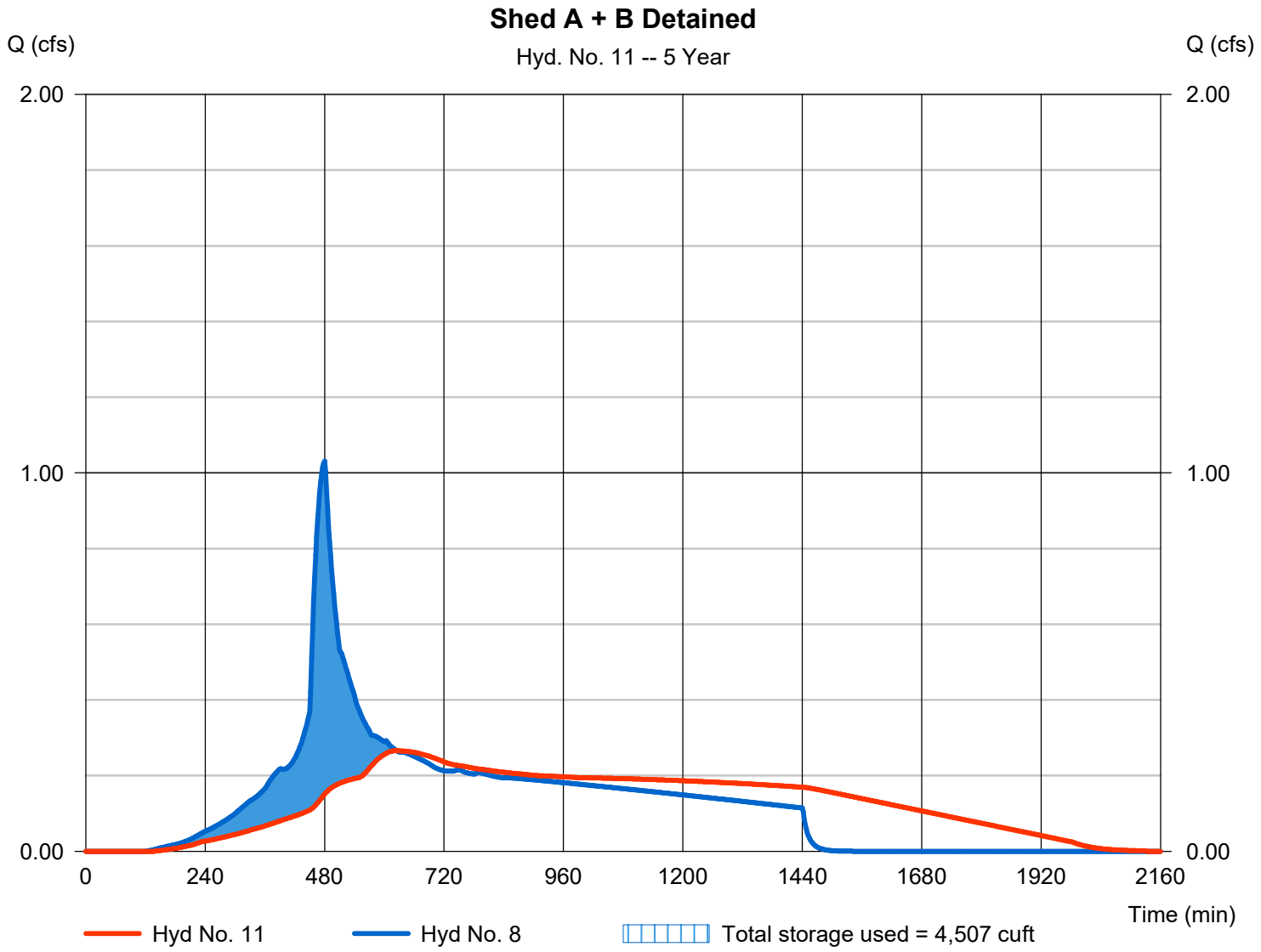
Hydrograph Report

Hyd. No. 11

Shed A + B Detained

Hydrograph type	=	Reservoir	Peak discharge	=	0.266 cfs
Storm frequency	=	5 yrs	Time to peak	=	626 min
Time interval	=	2 min	Hyd. volume	=	16,016 cuft
Inflow hyd. No.	=	8 - Shed A + B Post	Max. Elevation	=	337.91 ft
Reservoir name	=	R Tanks	Max. Storage	=	4,507 cuft

Storage Indication method used.

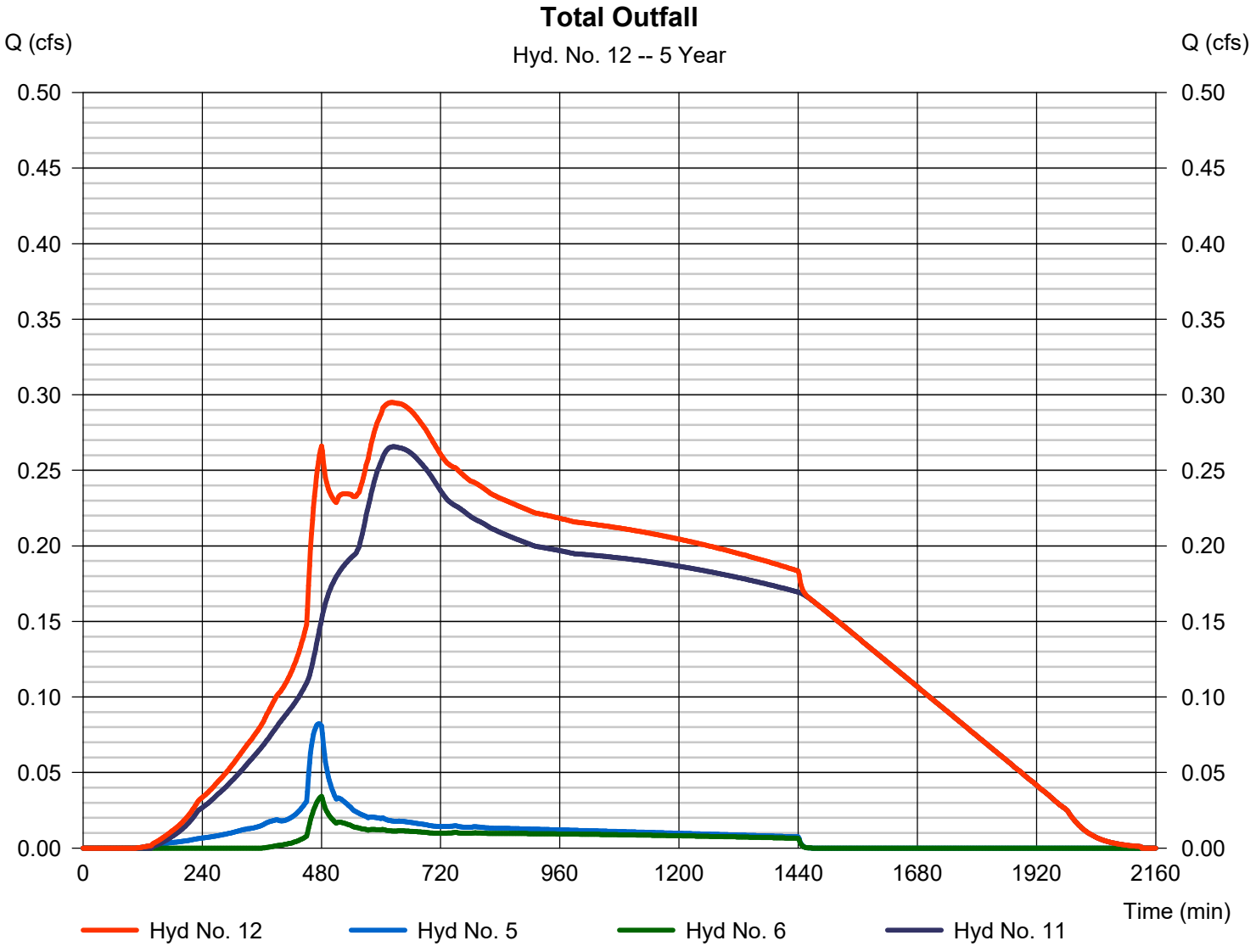


Hydrograph Report

Hyd. No. 12

Total Outfall

Hydrograph type	= Combine	Peak discharge	= 0.295 cfs
Storm frequency	= 5 yrs	Time to peak	= 622 min
Time interval	= 2 min	Hyd. volume	= 17,800 cuft
Inflow hyds.	= 5, 6, 11	Contrib. drain. area	= 0.290 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SBUH Runoff	0.653	2	480	11,183	------	------	------	Basin A Pre
3	SBUH Runoff	0.604	2	480	9,983	------	------	------	Shed A Post
4	SBUH Runoff	0.597	2	476	8,485	------	------	------	Shed B Post
5	SBUH Runoff	0.094	2	474	1,315	------	------	------	Shed C Post
6	SBUH Runoff	0.044	2	480	772	------	------	------	Shed D Post
8	Combine	1.195	2	480	18,467	3, 4,	------	------	Shed A + B Post
11	Reservoir	0.402	2	556	18,465	8	338.05	4,786	Shed A + B Detained
12	Combine	0.445	2	554	20,552	5, 6, 11	------	------	Total Outfall

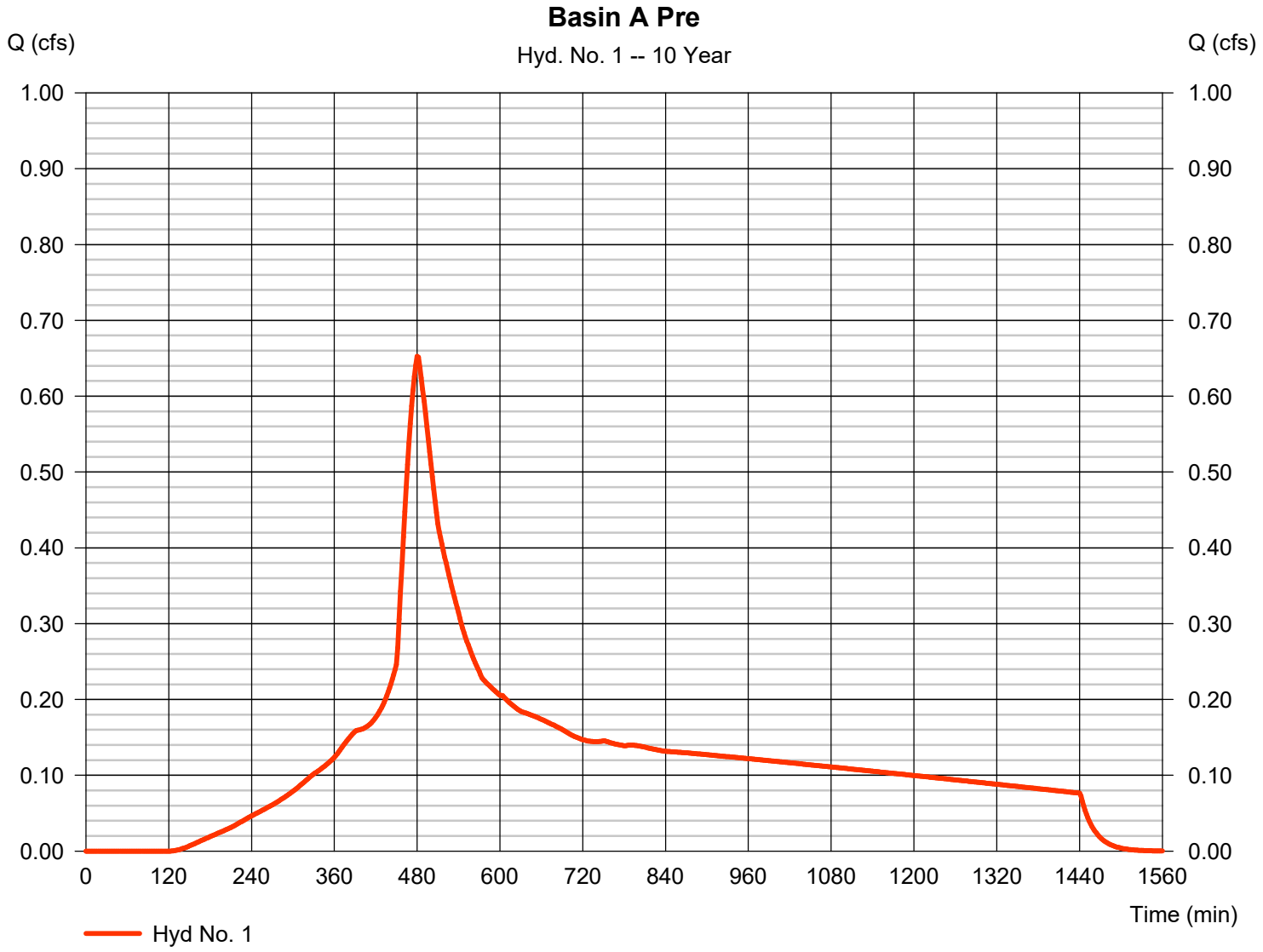
Hydrograph Report

Hyd. No. 1

Basin A Pre

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.653 cfs
Storm frequency	=	10 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	11,183 cuft
Drainage area	=	1.190 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	20.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.320 x 98) + (2.010 x 76)] / 1.190



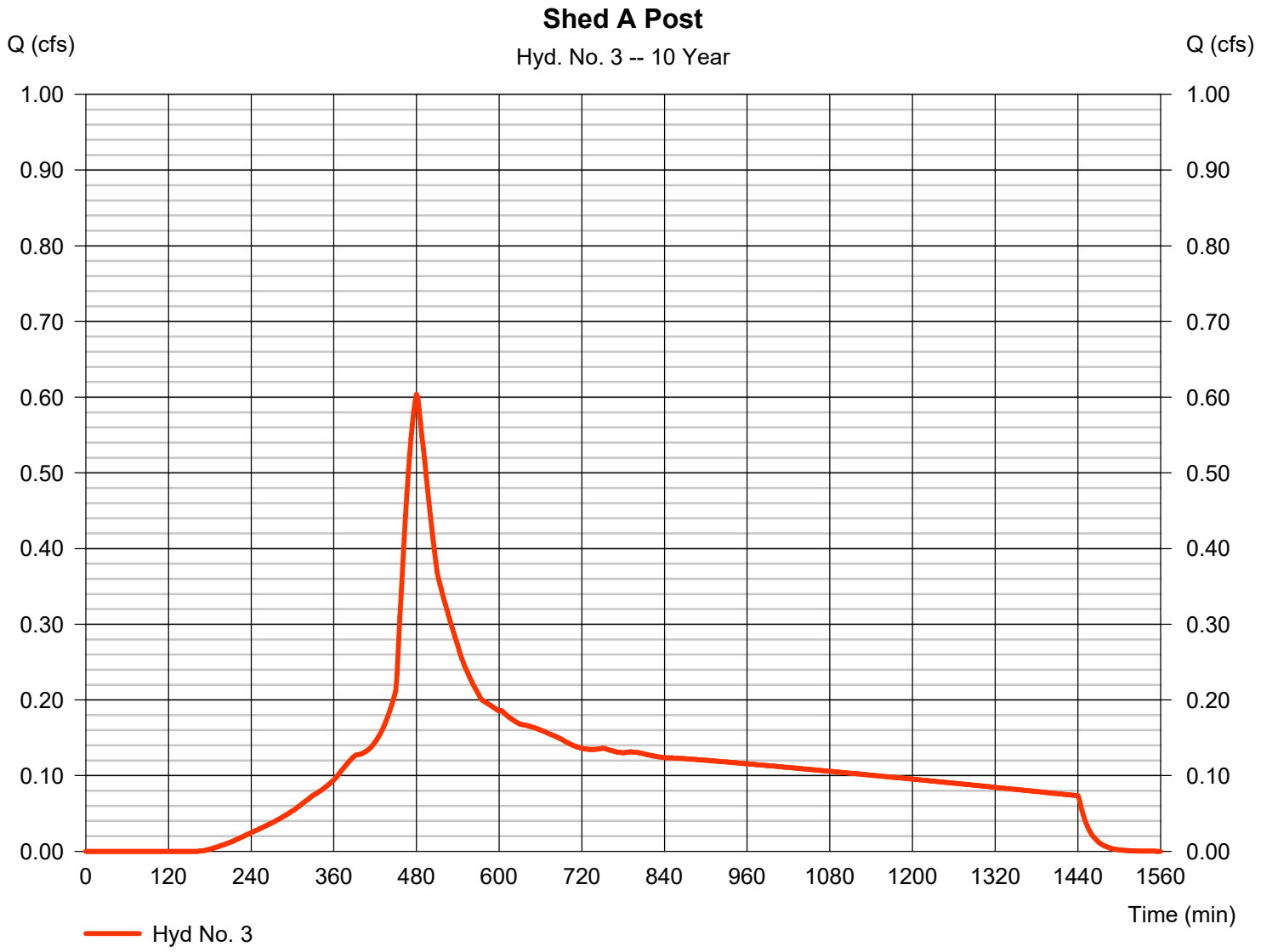
Hydrograph Report

Hyd. No. 3

Shed A Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.604 cfs
Storm frequency	=	10 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	9,983 cuft
Drainage area	=	1.190 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	16.20 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.680 x 98) + (0.090 x 86) + (0.420 x 76)] / 1.190



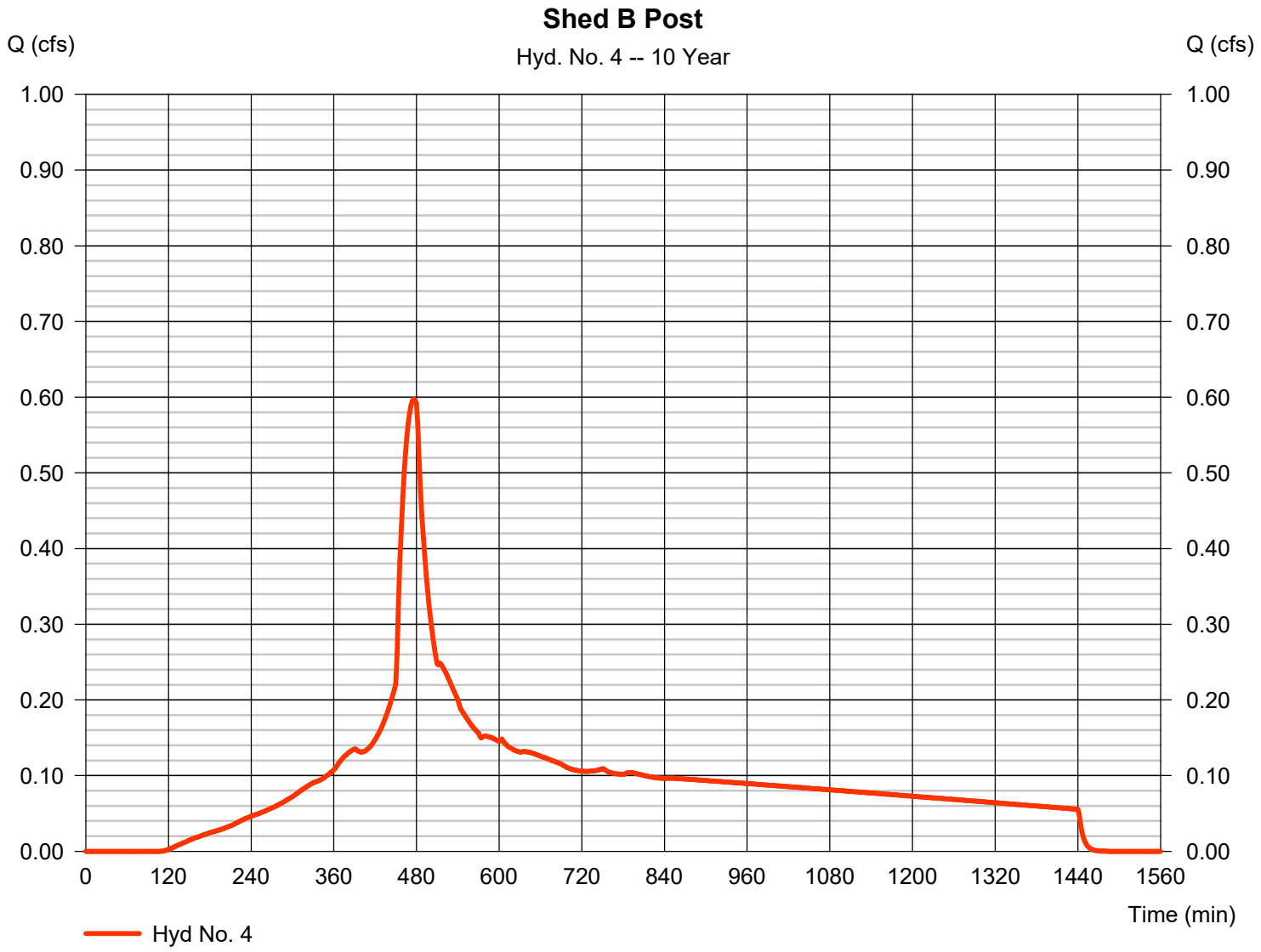
Hydrograph Report

Hyd. No. 4

Shed B Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.597 cfs
Storm frequency	=	10 yrs	Time to peak	=	476 min
Time interval	=	2 min	Hyd. volume	=	8,485 cuft
Drainage area	=	0.870 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.40 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.620 x 98) + (0.120 x 86) + (0.130 x 76)] / 0.870



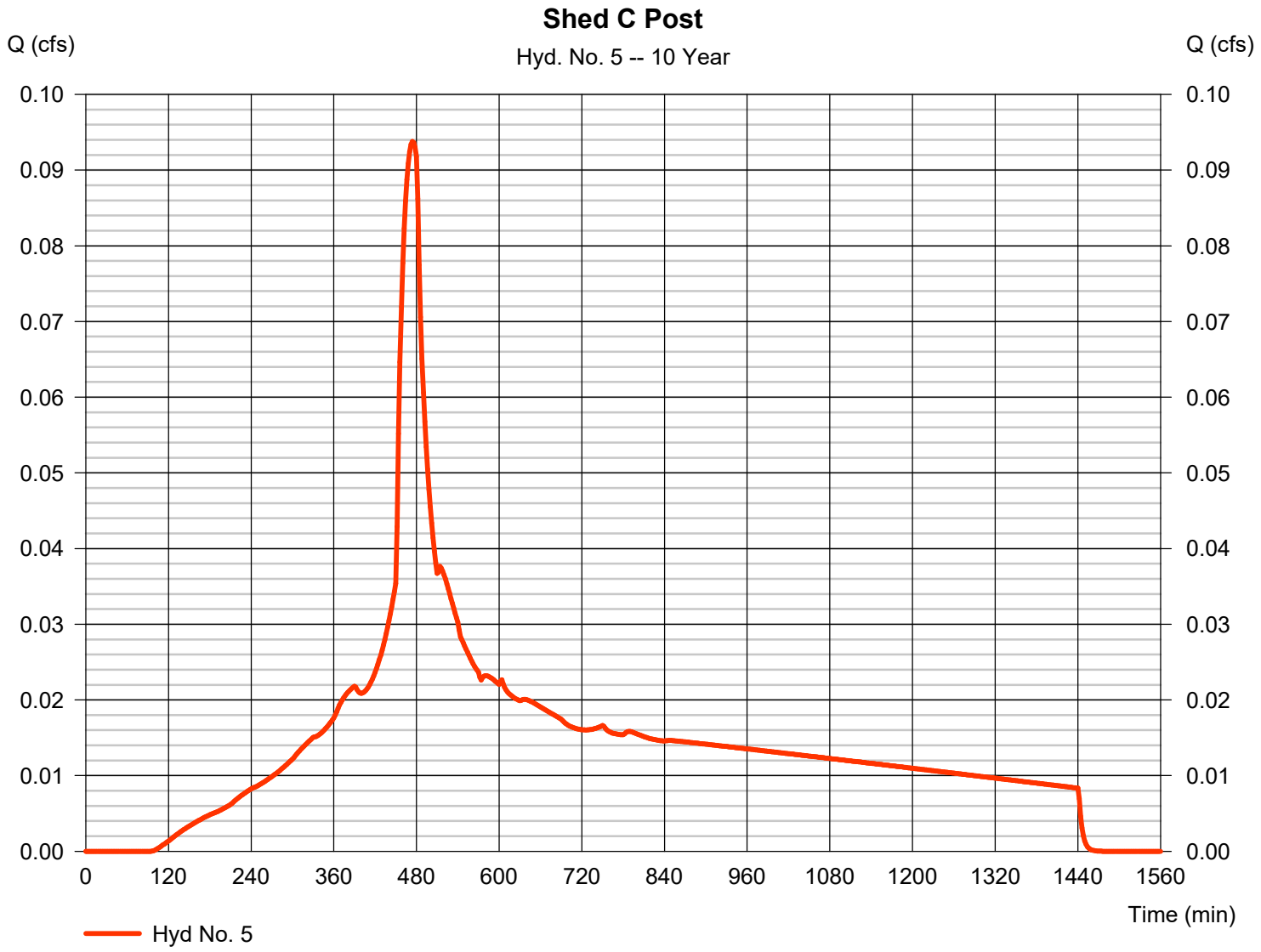
Hydrograph Report

Hyd. No. 5

Shed C Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.094 cfs
Storm frequency	=	10 yrs	Time to peak	=	474 min
Time interval	=	2 min	Hyd. volume	=	1,315 cuft
Drainage area	=	0.130 ac	Curve number	=	94*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.090 x 98) + (0.040 x 86)] / 0.130



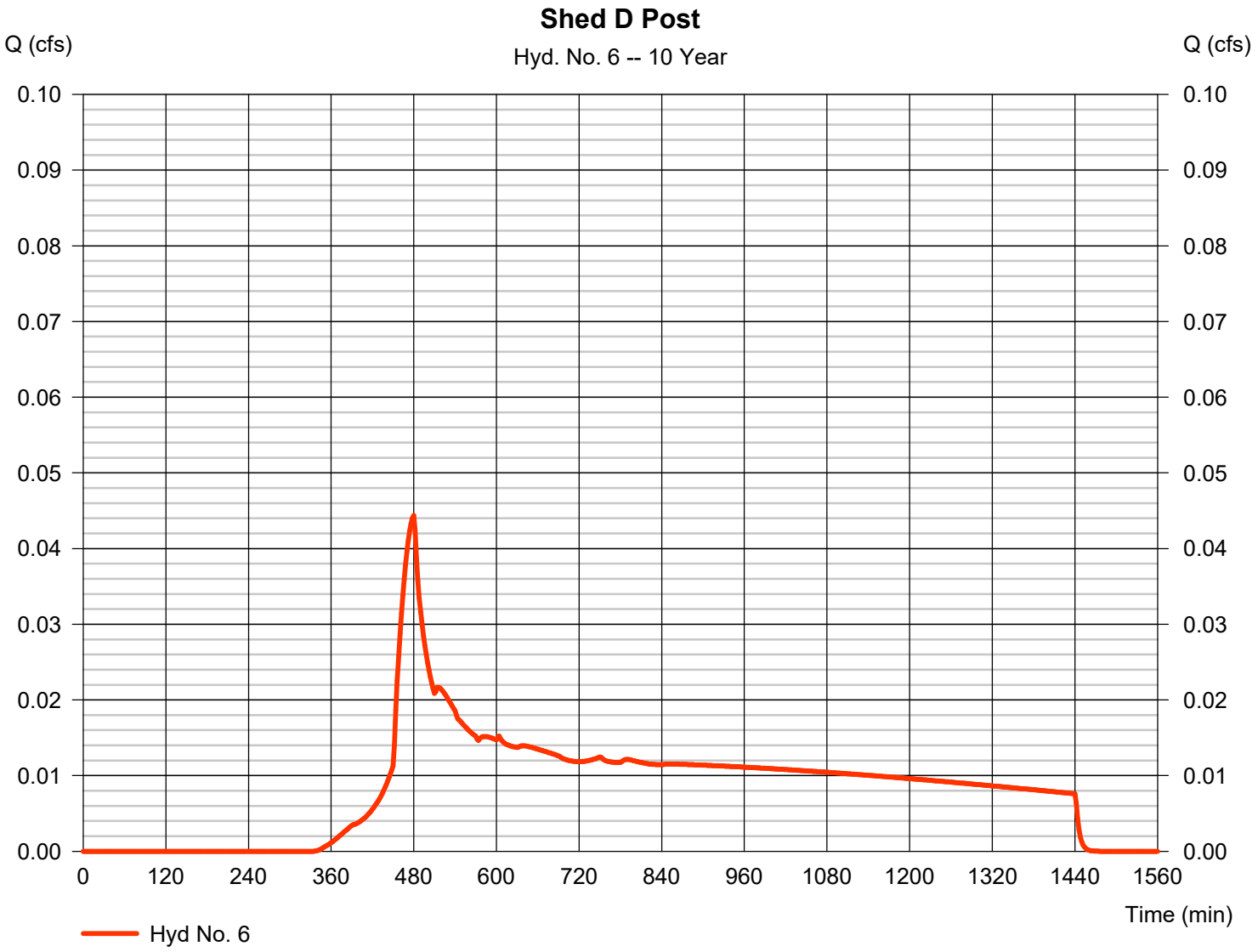
Hydrograph Report

Hyd. No. 6

Shed D Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.044 cfs
Storm frequency	=	10 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	772 cuft
Drainage area	=	0.160 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = + (0.160 x 76)] / 0.160

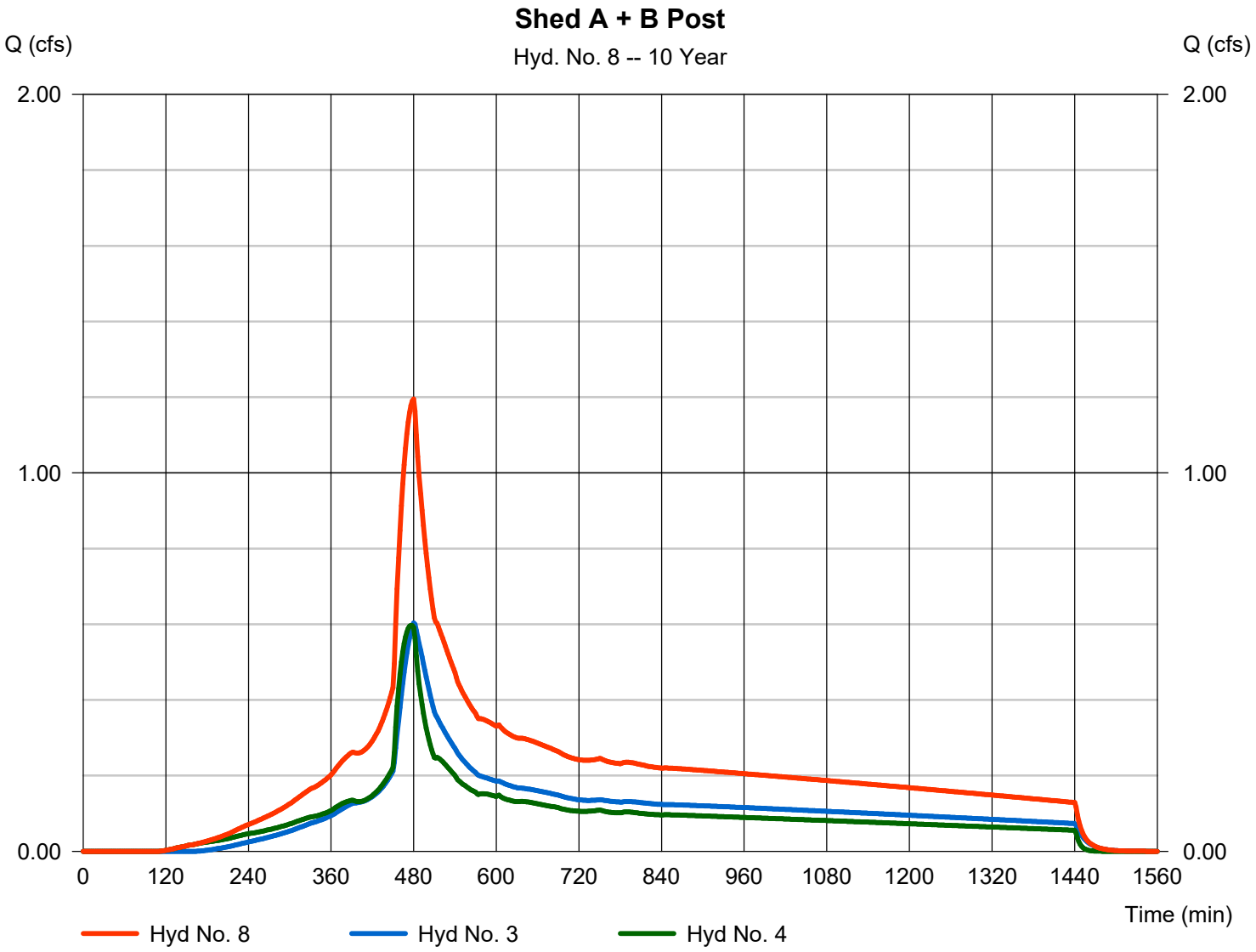


Hydrograph Report

Hyd. No. 8

Shed A + B Post

Hydrograph type	= Combine	Peak discharge	= 1.195 cfs
Storm frequency	= 10 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 18,467 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.060 ac



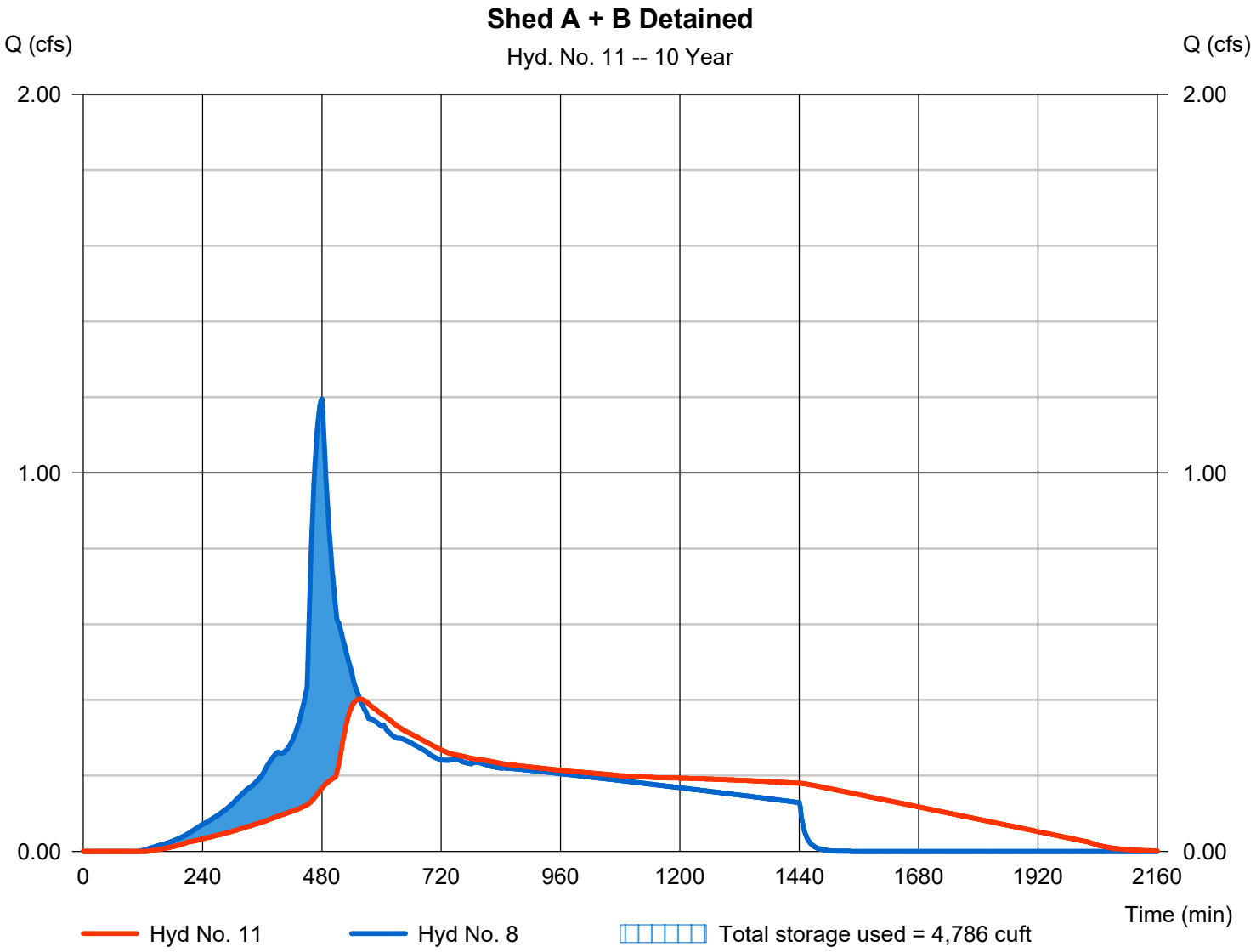
Hydrograph Report

Hyd. No. 11

Shed A + B Detained

Hydrograph type	=	Reservoir	Peak discharge	=	0.402 cfs
Storm frequency	=	10 yrs	Time to peak	=	556 min
Time interval	=	2 min	Hyd. volume	=	18,465 cuft
Inflow hyd. No.	=	8 - Shed A + B Post	Max. Elevation	=	338.05 ft
Reservoir name	=	R Tanks	Max. Storage	=	4,786 cuft

Storage Indication method used.

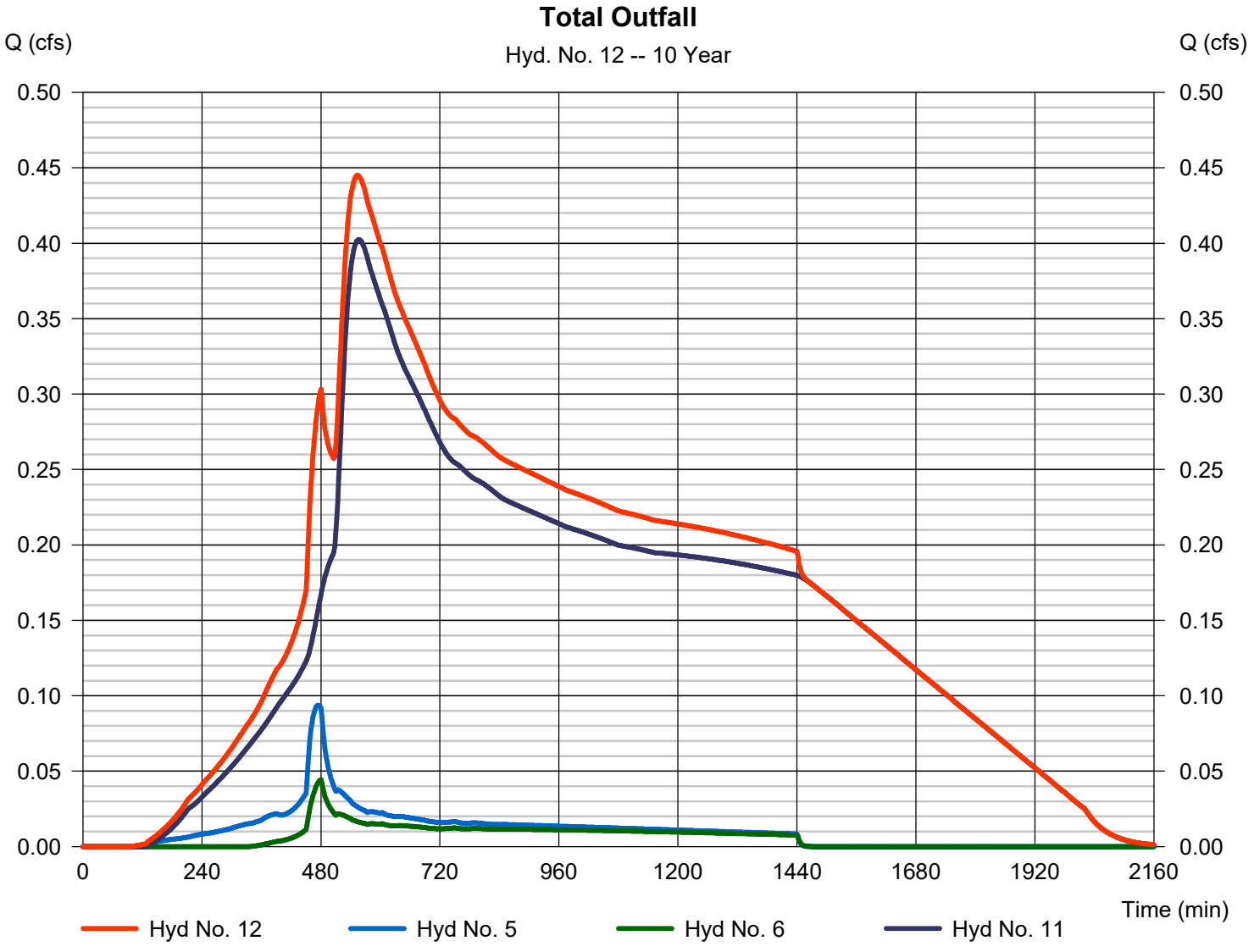


Hydrograph Report

Hyd. No. 12

Total Outfall

Hydrograph type	= Combine	Peak discharge	= 0.445 cfs
Storm frequency	= 10 yrs	Time to peak	= 554 min
Time interval	= 2 min	Hyd. volume	= 20,552 cuft
Inflow hyds.	= 5, 6, 11	Contrib. drain. area	= 0.290 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SBUH Runoff	0.765	2	480	13,050	------	------	------	Basin A Pre
3	SBUH Runoff	0.720	2	480	11,790	------	------	------	Shed A Post
4	SBUH Runoff	0.695	2	476	9,862	------	------	------	Shed B Post
5	SBUH Runoff	0.108	2	474	1,523	------	------	------	Shed C Post
6	SBUH Runoff	0.058	2	480	965	------	------	------	Shed D Post
8	Combine	1.407	2	480	21,651	3, 4,	------	------	Shed A + B Post
11	Reservoir	0.575	2	536	21,649	8	338.26	5,193	Shed A + B Detained
12	Combine	0.636	2	530	24,137	5, 6, 11	------	------	Total Outfall

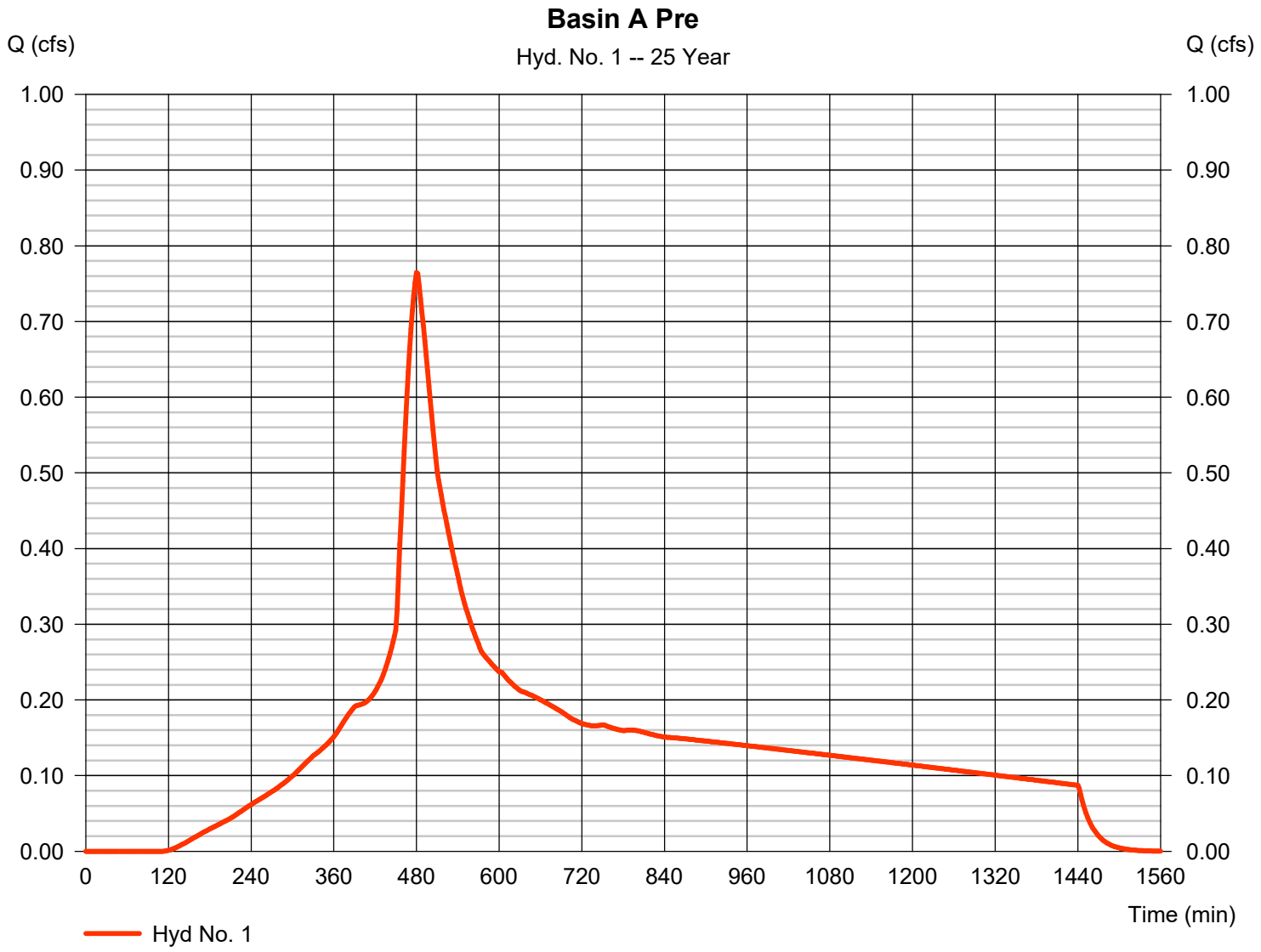
Hydrograph Report

Hyd. No. 1

Basin A Pre

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.765 cfs
Storm frequency	=	25 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	13,050 cuft
Drainage area	=	1.190 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	20.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.320 x 98) + (2.010 x 76)] / 1.190



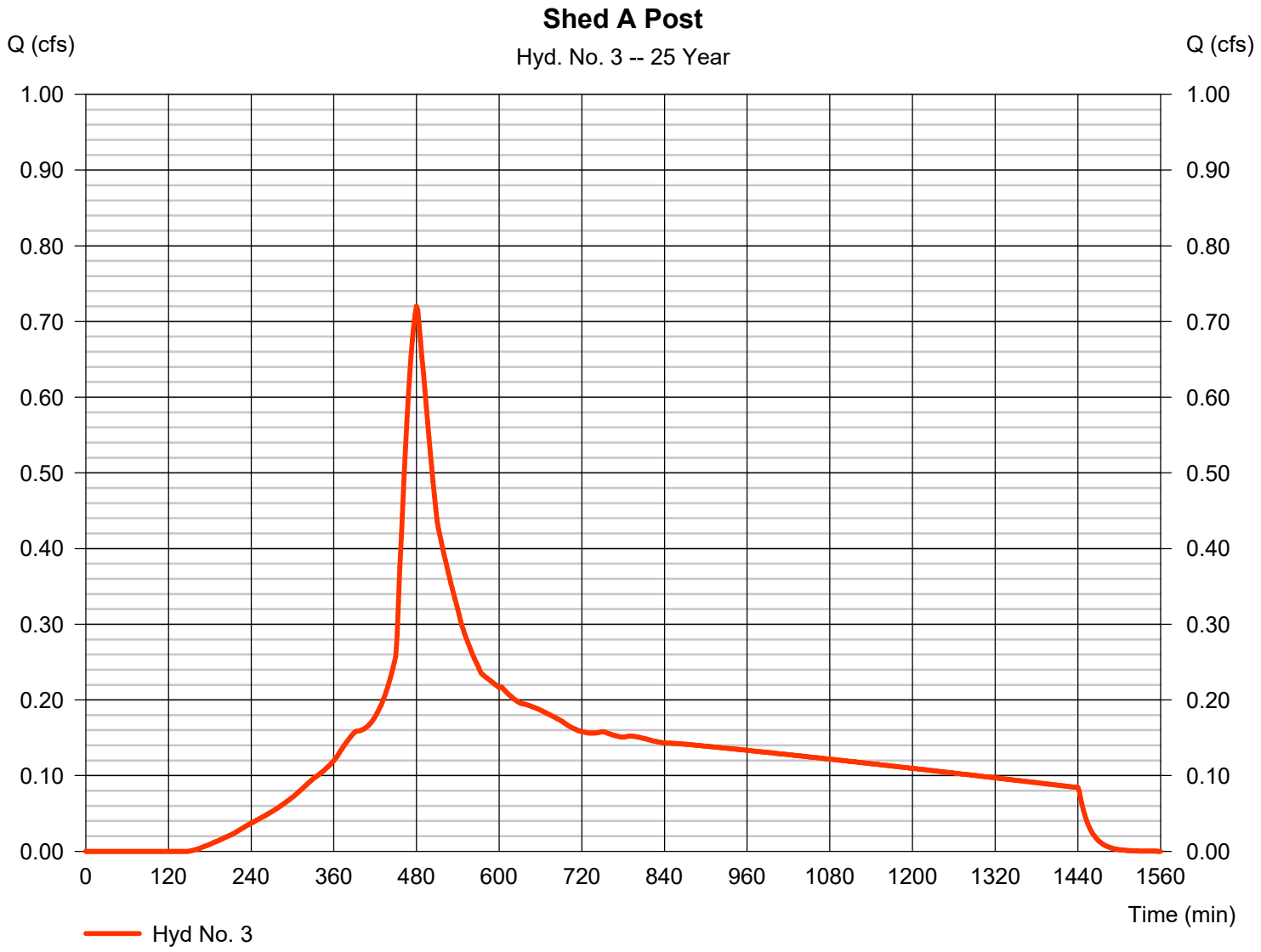
Hydrograph Report

Hyd. No. 3

Shed A Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.720 cfs
Storm frequency	=	25 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	11,790 cuft
Drainage area	=	1.190 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	16.20 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.680 x 98) + (0.090 x 86) + (0.420 x 76)] / 1.190



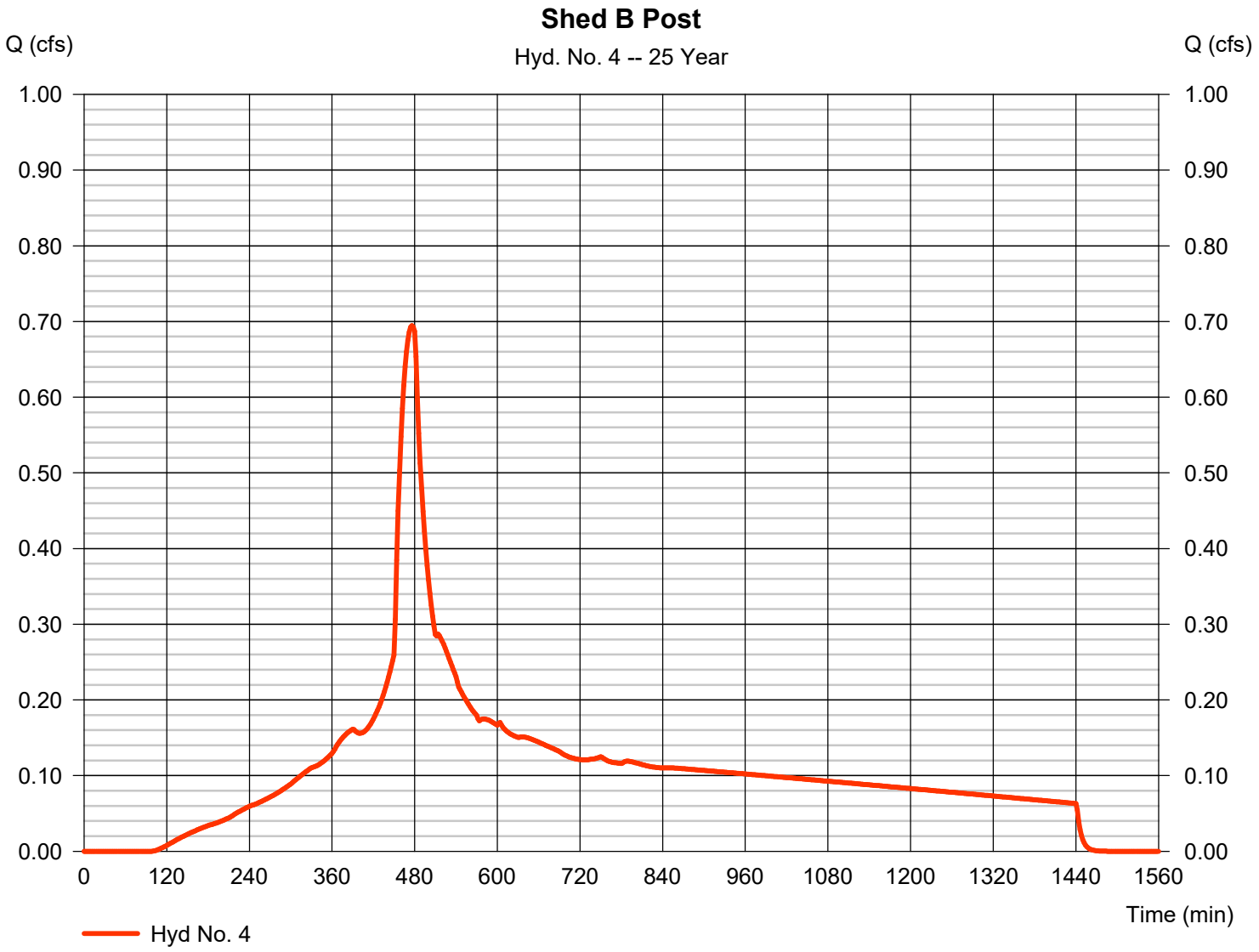
Hydrograph Report

Hyd. No. 4

Shed B Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.695 cfs
Storm frequency	=	25 yrs	Time to peak	=	476 min
Time interval	=	2 min	Hyd. volume	=	9,862 cuft
Drainage area	=	0.870 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.40 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.620 x 98) + (0.120 x 86) + (0.130 x 76)] / 0.870



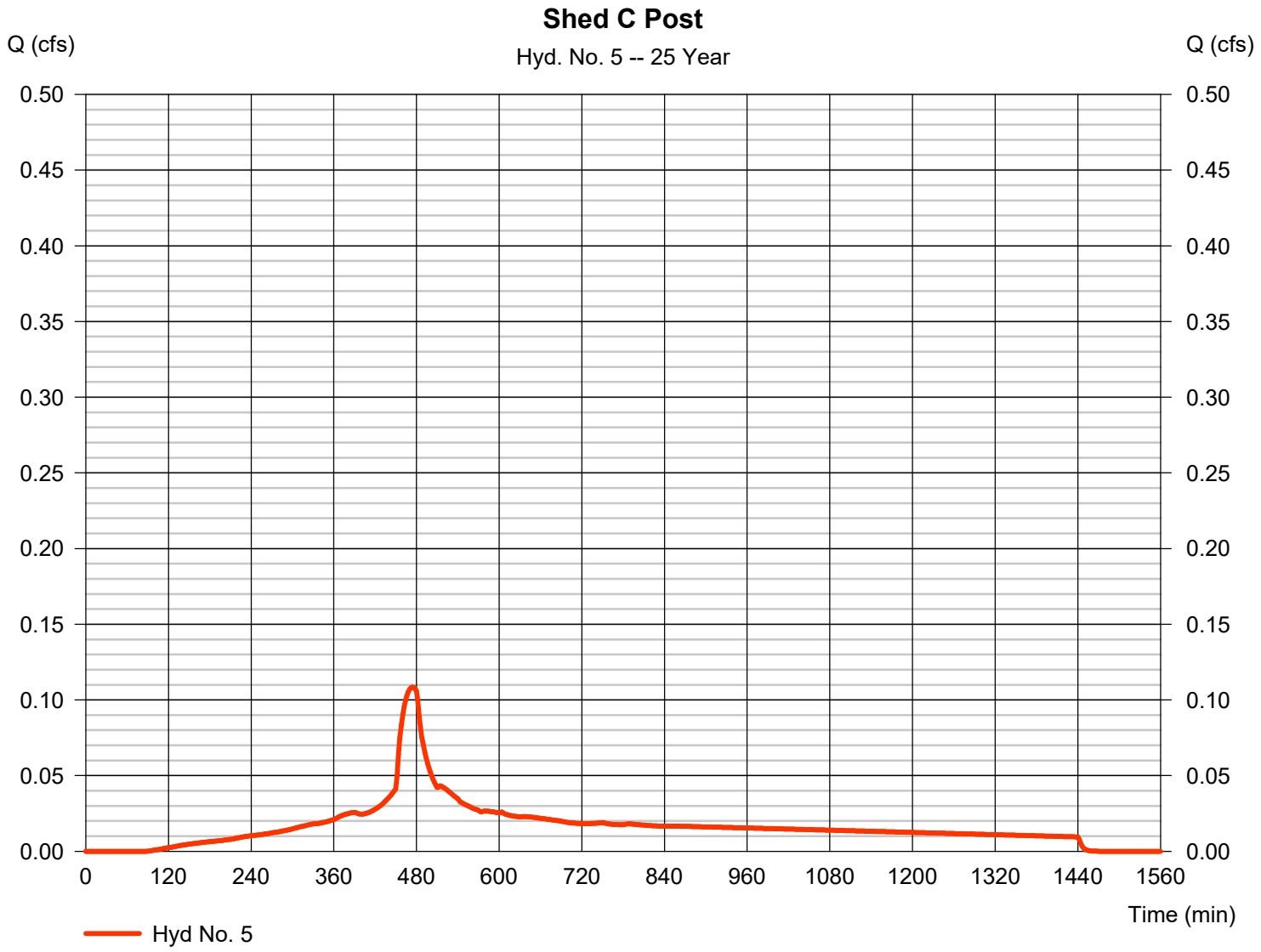
Hydrograph Report

Hyd. No. 5

Shed C Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.108 cfs
Storm frequency	=	25 yrs	Time to peak	=	474 min
Time interval	=	2 min	Hyd. volume	=	1,523 cuft
Drainage area	=	0.130 ac	Curve number	=	94*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.090 x 98) + (0.040 x 86)] / 0.130



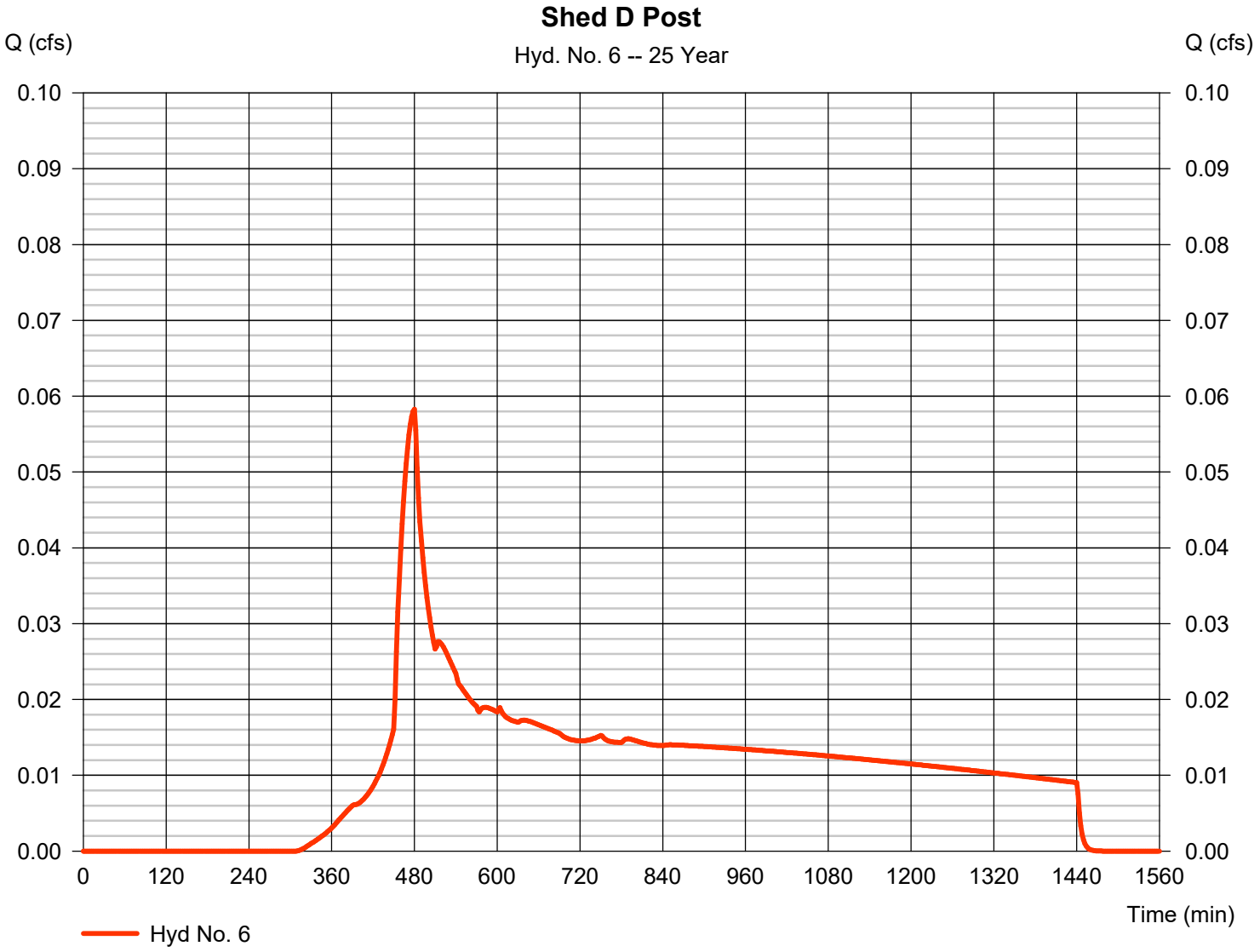
Hydrograph Report

Hyd. No. 6

Shed D Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.058 cfs
Storm frequency	=	25 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	965 cuft
Drainage area	=	0.160 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = + (0.160 x 76)] / 0.160

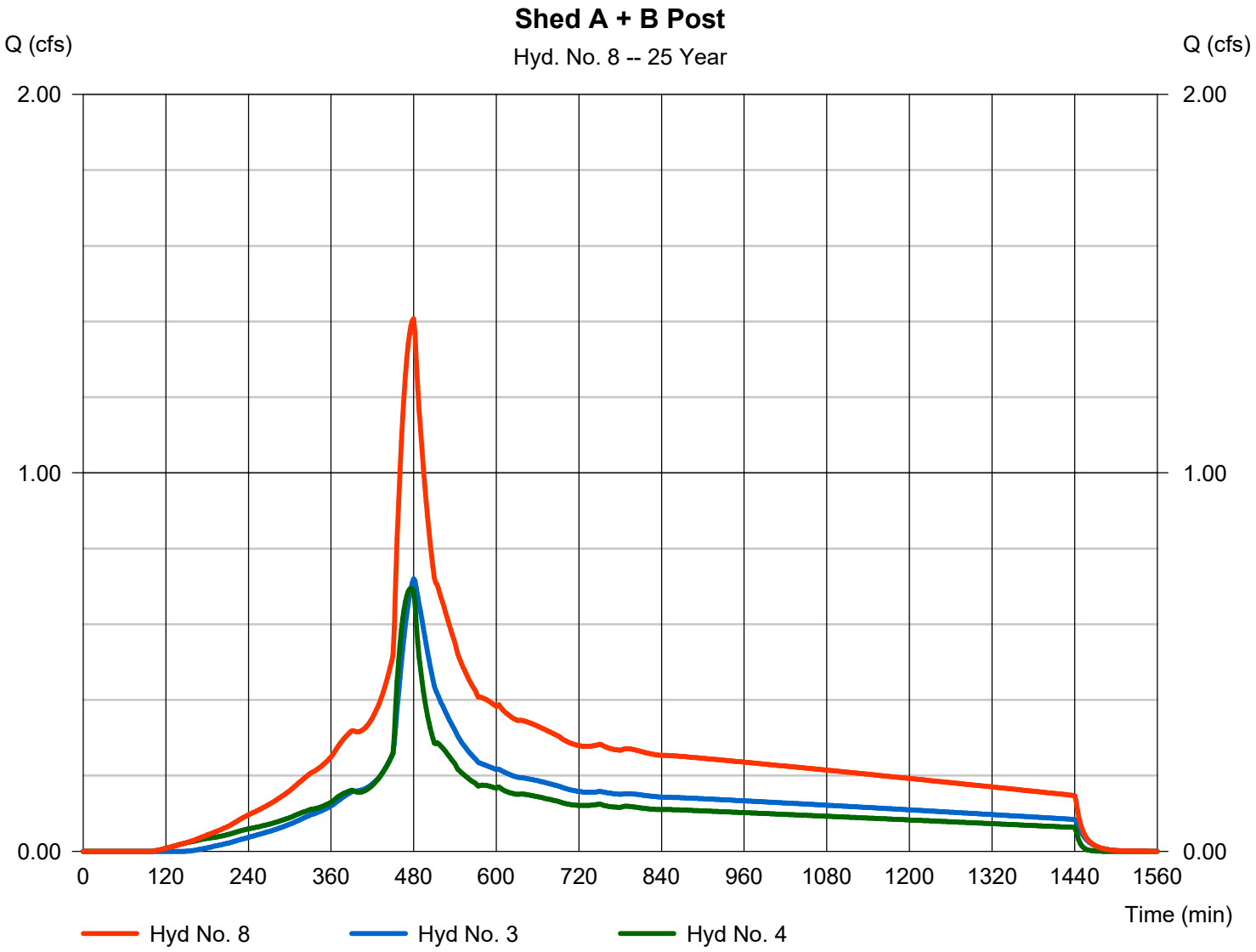


Hydrograph Report

Hyd. No. 8

Shed A + B Post

Hydrograph type	= Combine	Peak discharge	= 1.407 cfs
Storm frequency	= 25 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 21,651 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.060 ac



Hydrograph Report

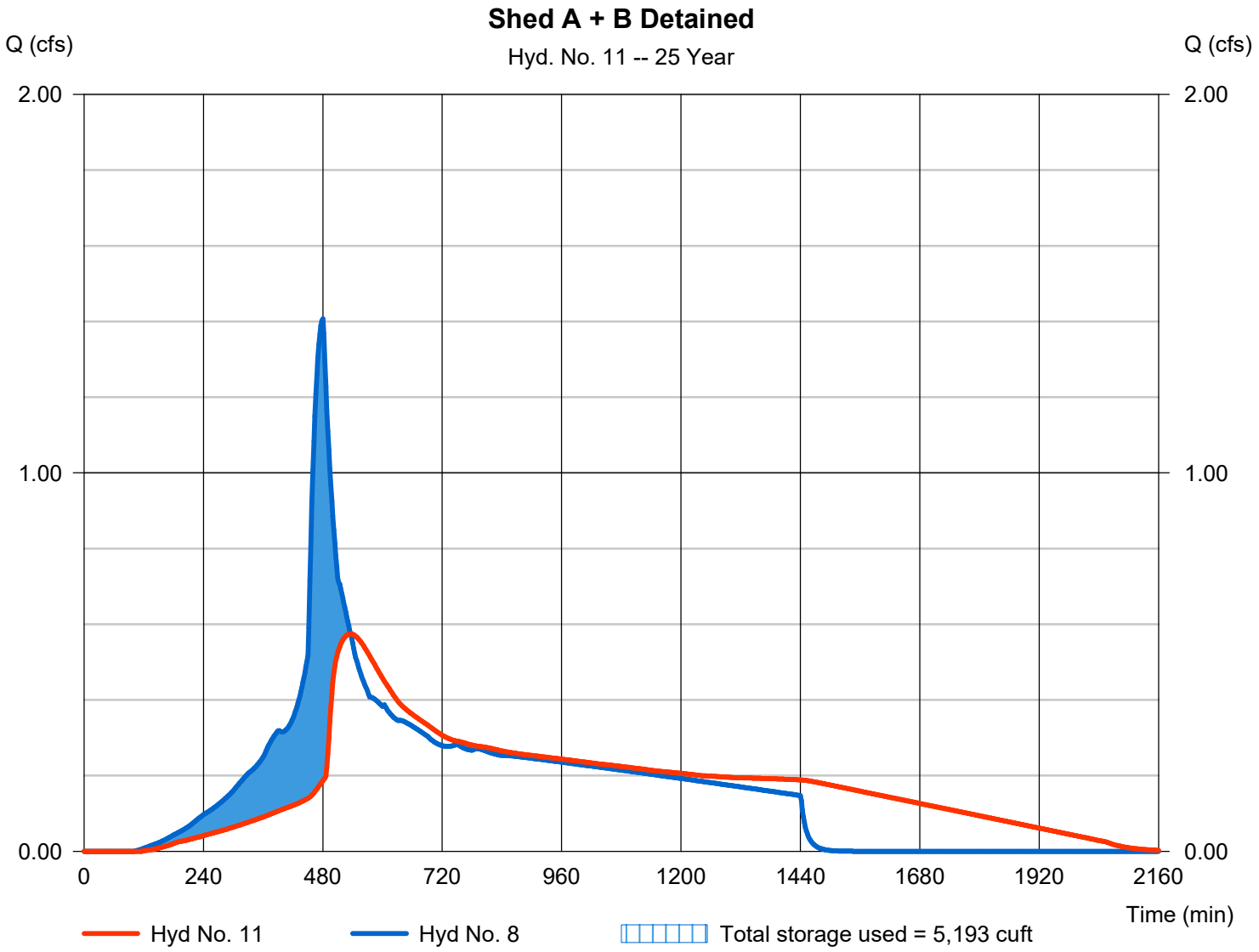
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 05 / 15 / 2024

Hyd. No. 11

Shed A + B Detained

Hydrograph type	=	Reservoir	Peak discharge	=	0.575 cfs
Storm frequency	=	25 yrs	Time to peak	=	536 min
Time interval	=	2 min	Hyd. volume	=	21,649 cuft
Inflow hyd. No.	=	8 - Shed A + B Post	Max. Elevation	=	338.26 ft
Reservoir name	=	R Tanks	Max. Storage	=	5,193 cuft

Storage Indication method used.

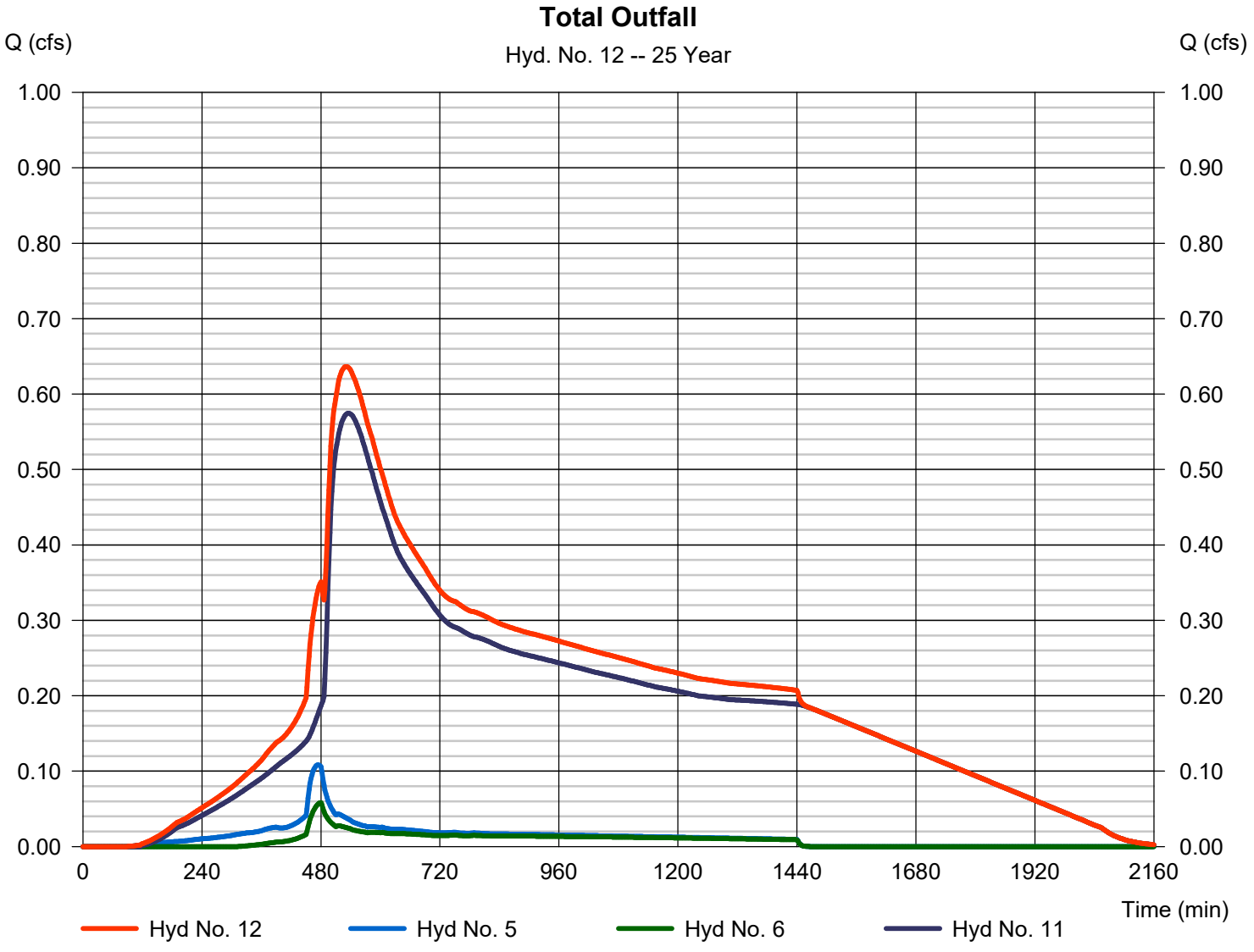


Hydrograph Report

Hyd. No. 12

Total Outfall

Hydrograph type	=	Combine	Peak discharge	=	0.636 cfs
Storm frequency	=	25 yrs	Time to peak	=	530 min
Time interval	=	2 min	Hyd. volume	=	24,137 cuft
Inflow hyds.	=	5, 6, 11	Contrib. drain. area	=	0.290 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SBUH Runoff	0.889	2	480	15,140	------	------	------	Basin A Pre
3	SBUH Runoff	0.851	2	480	13,824	------	------	------	Shed A Post
4	SBUH Runoff	0.802	2	476	11,401	------	------	------	Shed B Post
5	SBUH Runoff	0.125	2	474	1,754	------	------	------	Shed C Post
6	SBUH Runoff	0.075	2	480	1,191	------	------	------	Shed D Post
8	Combine	1.643	2	480	25,225	3, 4,	------	------	Shed A + B Post
11	Reservoir	0.738	2	526	25,222	8	338.56	5,787	Shed A + B Detained
12	Combine	0.818	2	520	28,167	5, 6, 11	------	------	Total Outfall

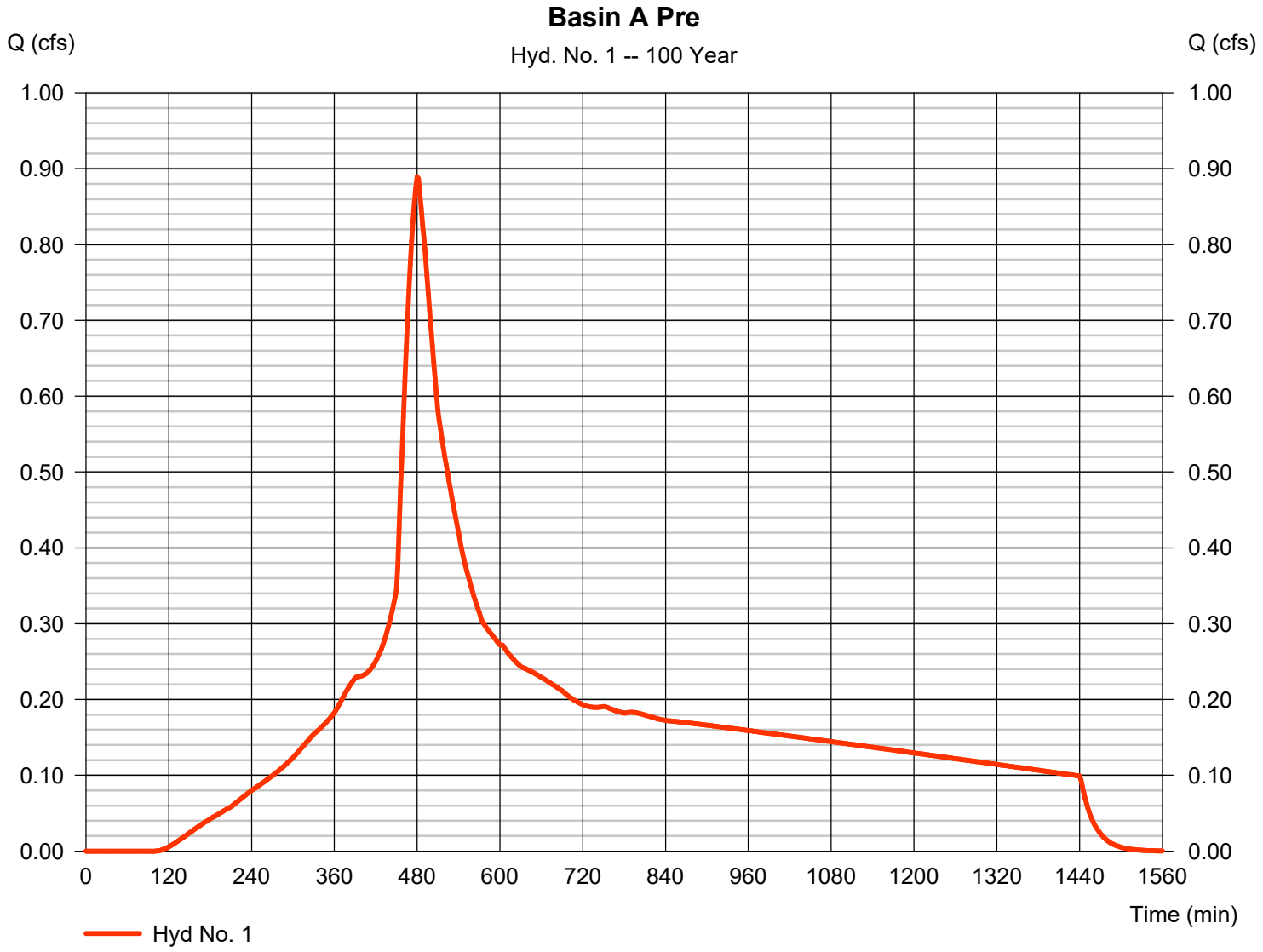
Hydrograph Report

Hyd. No. 1

Basin A Pre

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.889 cfs
Storm frequency	=	100 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	15,140 cuft
Drainage area	=	1.190 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	20.00 min
Total precip.	=	4.40 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.320 x 98) + (2.010 x 76)] / 1.190



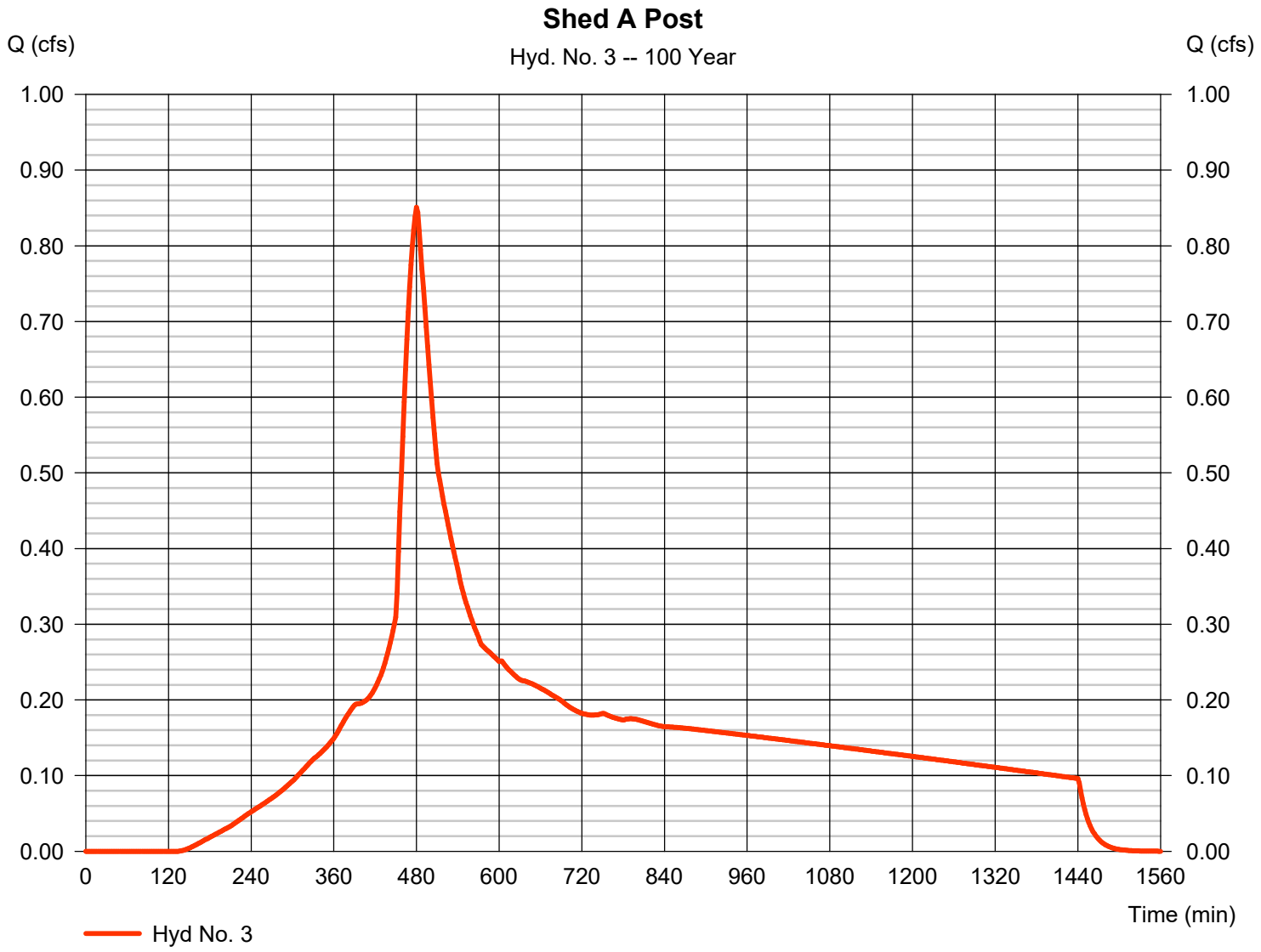
Hydrograph Report

Hyd. No. 3

Shed A Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.851 cfs
Storm frequency	=	100 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	13,824 cuft
Drainage area	=	1.190 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	16.20 min
Total precip.	=	4.40 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.680 x 98) + (0.090 x 86) + (0.420 x 76)] / 1.190



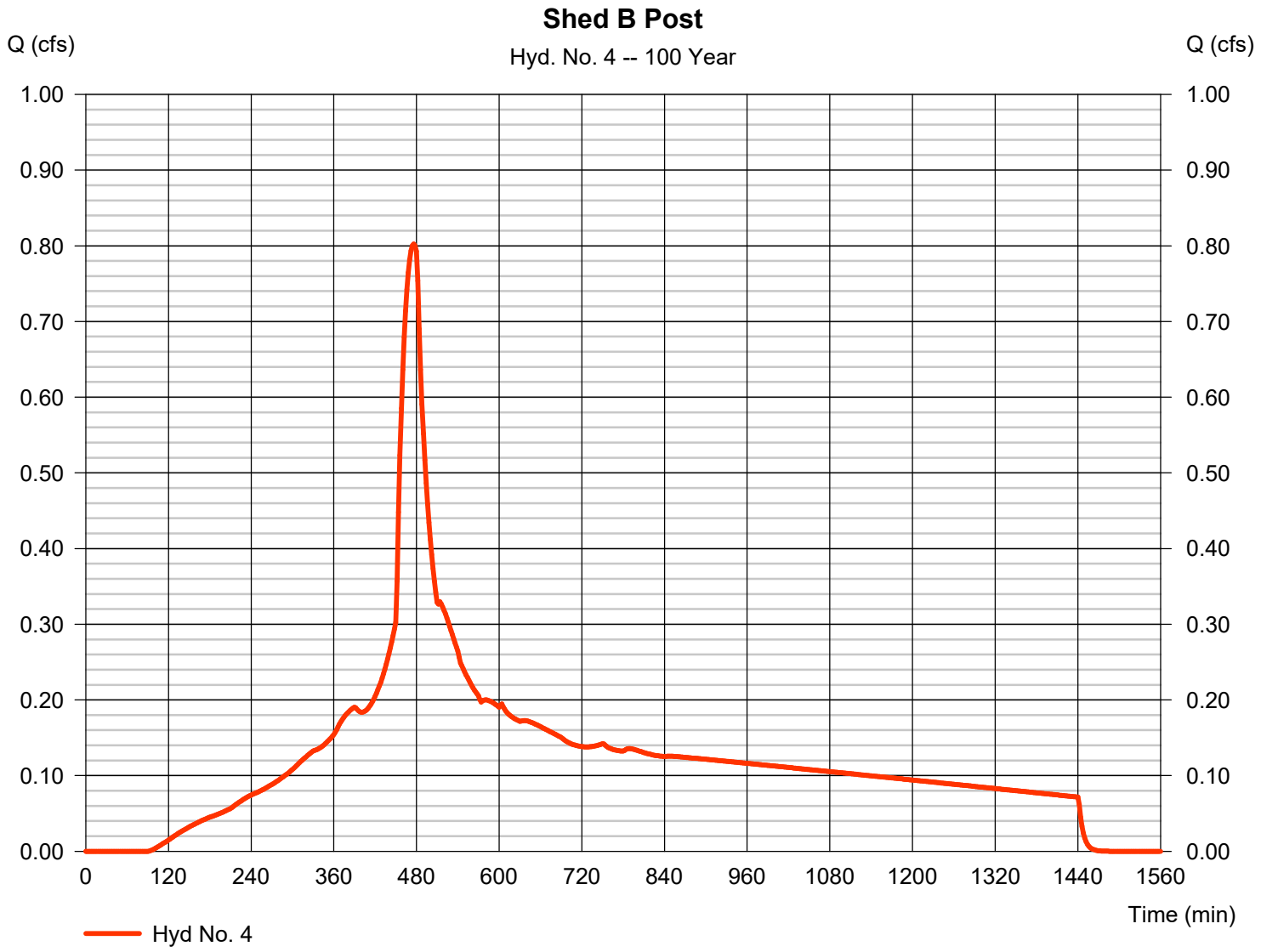
Hydrograph Report

Hyd. No. 4

Shed B Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.802 cfs
Storm frequency	=	100 yrs	Time to peak	=	476 min
Time interval	=	2 min	Hyd. volume	=	11,401 cuft
Drainage area	=	0.870 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.40 min
Total precip.	=	4.40 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.620 x 98) + (0.120 x 86) + (0.130 x 76)] / 0.870



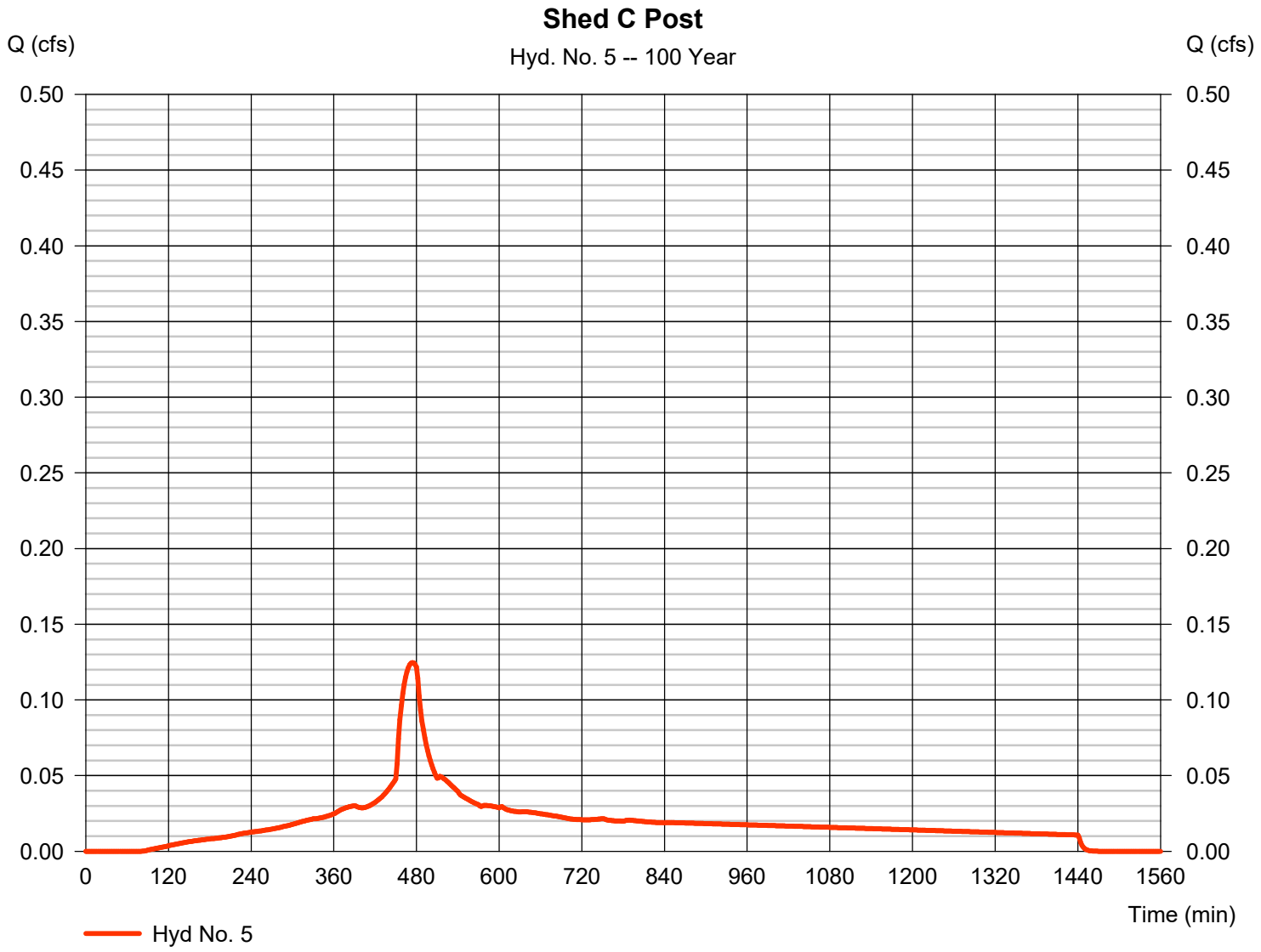
Hydrograph Report

Hyd. No. 5

Shed C Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.125 cfs
Storm frequency	=	100 yrs	Time to peak	=	474 min
Time interval	=	2 min	Hyd. volume	=	1,754 cuft
Drainage area	=	0.130 ac	Curve number	=	94*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	4.40 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.090 x 98) + (0.040 x 86)] / 0.130



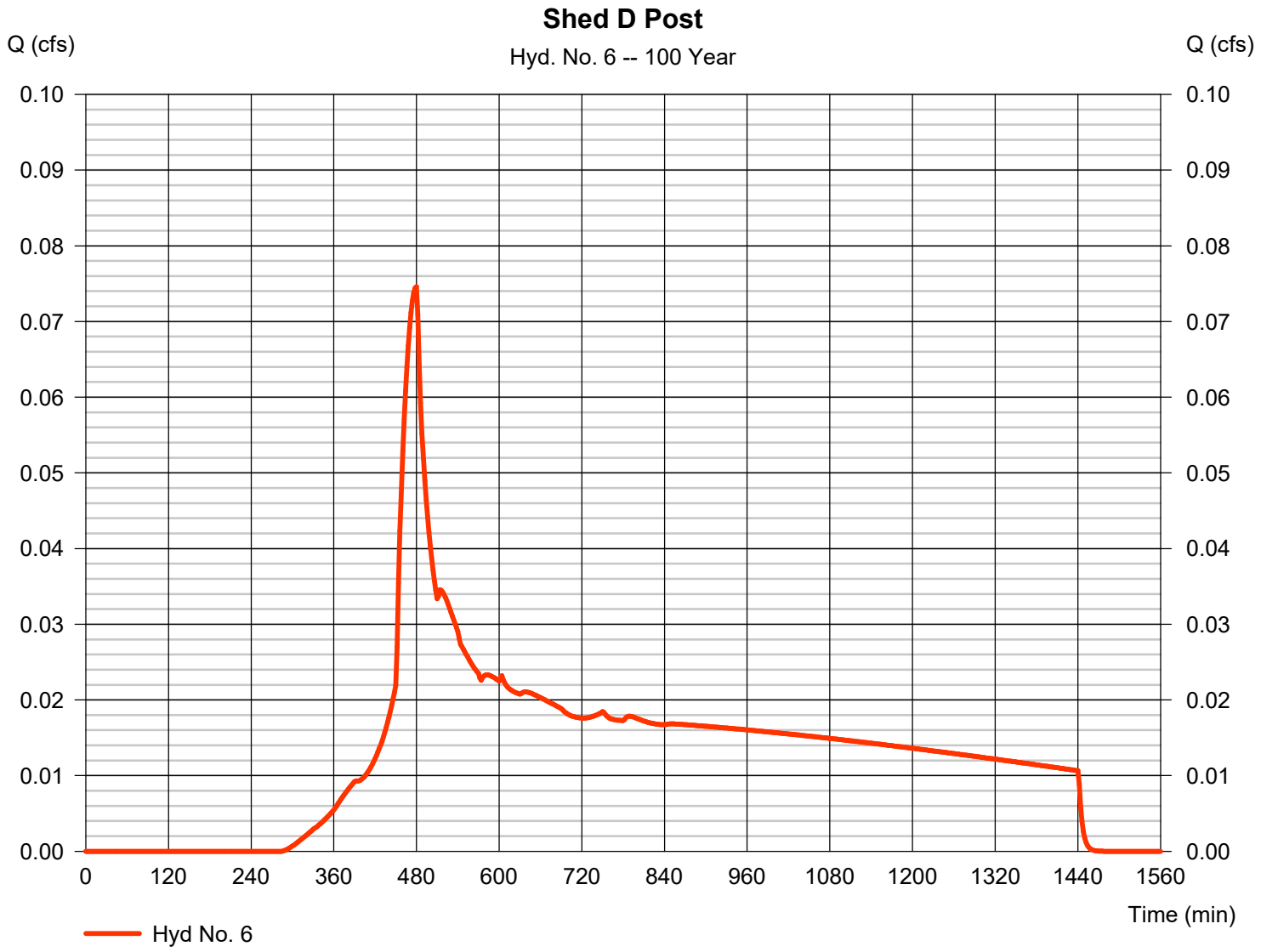
Hydrograph Report

Hyd. No. 6

Shed D Post

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.075 cfs
Storm frequency	=	100 yrs	Time to peak	=	480 min
Time interval	=	2 min	Hyd. volume	=	1,191 cuft
Drainage area	=	0.160 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	4.40 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = + (0.160 x 76)] / 0.160

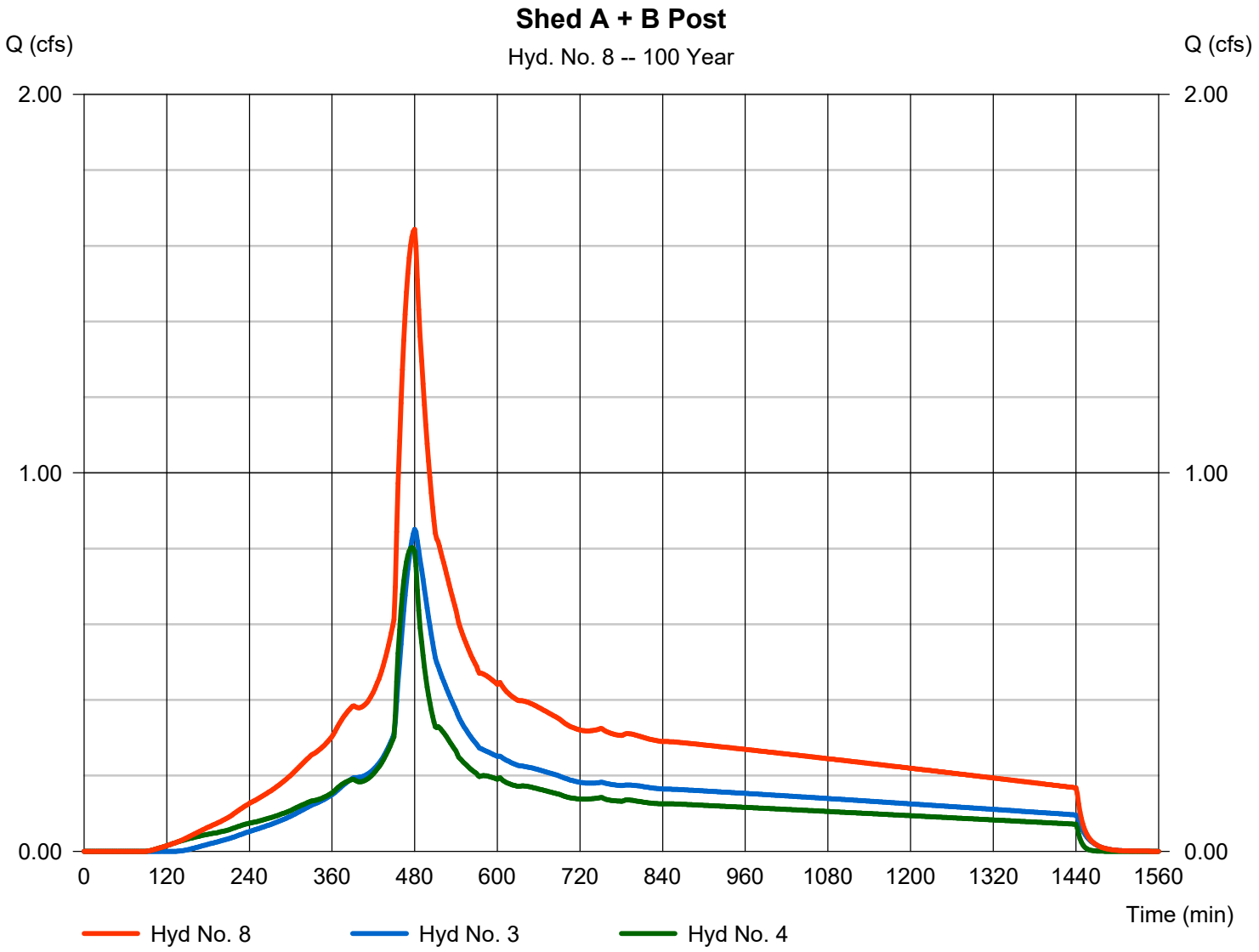


Hydrograph Report

Hyd. No. 8

Shed A + B Post

Hydrograph type	= Combine	Peak discharge	= 1.643 cfs
Storm frequency	= 100 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 25,225 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.060 ac



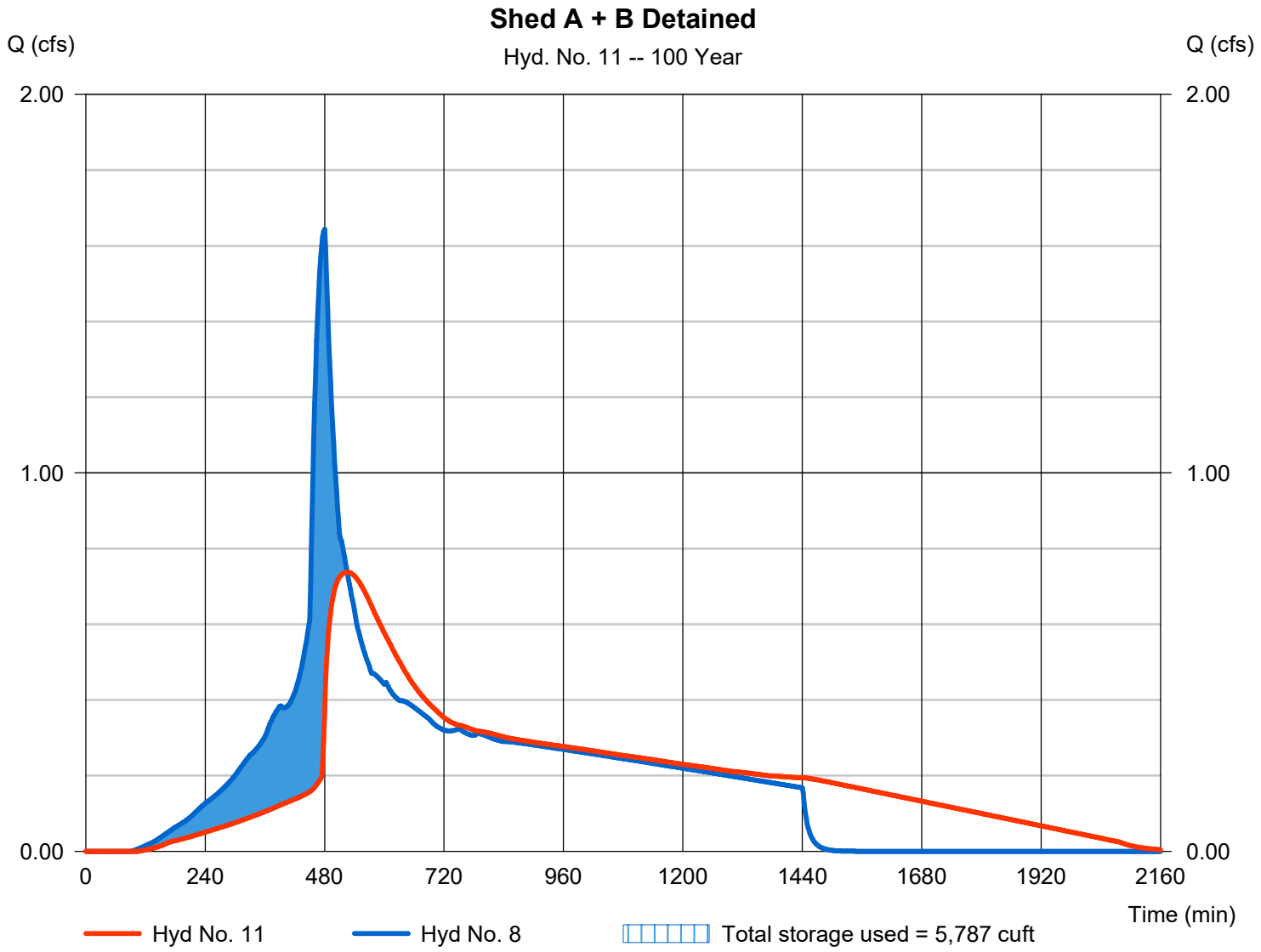
Hydrograph Report

Hyd. No. 11

Shed A + B Detained

Hydrograph type	=	Reservoir	Peak discharge	=	0.738 cfs
Storm frequency	=	100 yrs	Time to peak	=	526 min
Time interval	=	2 min	Hyd. volume	=	25,222 cuft
Inflow hyd. No.	=	8 - Shed A + B Post	Max. Elevation	=	338.56 ft
Reservoir name	=	R Tanks	Max. Storage	=	5,787 cuft

Storage Indication method used.

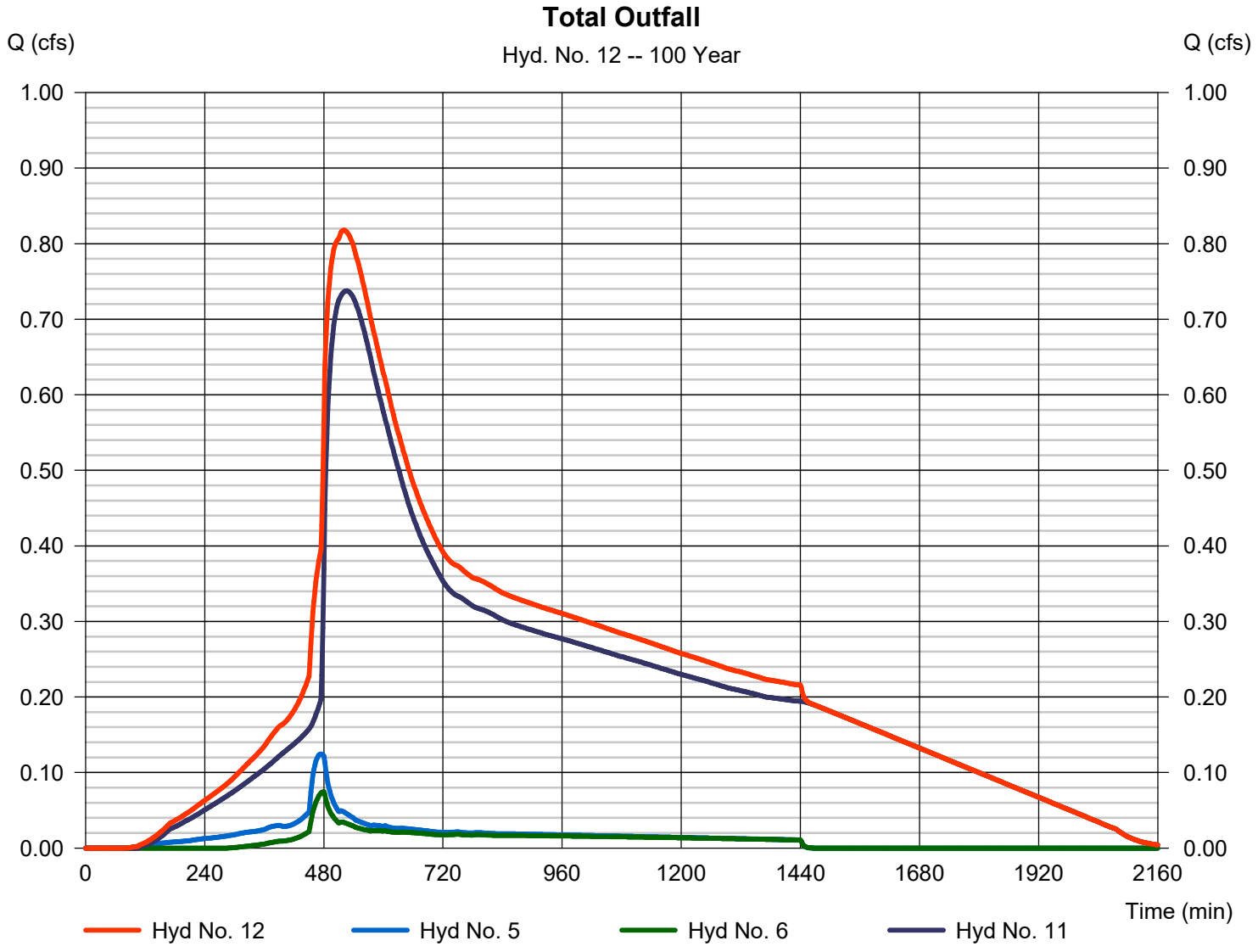


Hydrograph Report

Hyd. No. 12

Total Outfall

Hydrograph type	=	Combine	Peak discharge	=	0.818 cfs
Storm frequency	=	100 yrs	Time to peak	=	520 min
Time interval	=	2 min	Hyd. volume	=	28,167 cuft
Inflow hyds.	=	5, 6, 11	Contrib. drain. area	=	0.290 ac



APPENDIX D

PACIFIC COMMUNITY DESIGN

Project: Scholls Ferry Apartments

Subject: Water quality manhole Job: 1316-007

By: Jake Date: 5/14/24 Page: 1 of 1

Shed B - post developed impervious

buildings = 12,247 sf
sidewalks = 747 sf
plaza = 1,872 sf
pavement = 12,078 sf
26,944 sf

Water quality manhole → StormFilter manhole + cartridge system

assumptions: 18" cartridge
specific flow rate = 1 gpm/ft2
cartridge flow rate = 7.5 gpm

water quality volume: $\frac{(0.36 in) \times (26{,}944 sf)}{12 in/hr} = 808.3 cf$

water quality flow: $\frac{808.3 cf}{14{,}400 sec} = 0.056 cfs$

cartridges = $\frac{\text{design flow}}{\text{cartridge flowrates}}$

$= \left(\frac{0.056 cfs}{7.5 gal/min}\right)\left(\frac{7.5 gal}{1 ft^3}\right)\left(\frac{60 sec}{1 min}\right) = 3.4 =$ 4 cartridges

WATER QUALITY SWALE CALCULATIONS

JOB NUMBER: 136-007
PROJECT: Scholls Ferry Apartments
FILE: N:\proj\136-007\05 Reports\Hydrology Analysis\Engineering\136007.Hydrology Calcs-Prelim.2024-05-09

REFERENCES:
1. Clean Water Services R&O 17-05.
2. Discussions with Clean Water Services.

REQUIRED WATER QUALITY TREATMENT: 65% Phosphorus Removal.

PROPOSED TREATMENT METHODS:

1. Sumped Catch Basins		15%
2. Bio-Filtration Swale		50%
	total	65%

DESIGN STORM:

Precipitation:	0.36	inches
Storm Duration:	4	hours
Storm Return Period:	96	hours
Storm Window:	2	weeks

IMPERVIOUS AREA:

Watershed Area:	1.39	acres
Percent imp:	49	%
Impervious Area:	0.68	acres

Design Inflow = (0.68 ac)*(43560 ft^2/ac)*(0.36 in / 4.0 hrs) = **0.06 cfs**

BIOFILTRATION SWALE DESIGN CRITERIA:

Max Velocity:	0.9	ft/s
Side Slopes:	4	:1 (treatment area)
Base:	2	feet (2' min)
n Factor:	0.24	(plantings)

SWALE CHARACTERISTICS:

Q=	0.06	Design Storm Discharge (determined above
N=	0.24	Plantings
B=	2 ft	Base width of channel
Z=	4 :1	Side slopes
SLOPE=	0.01 ft/ft	Slope of channel (0.005 minimum)
ASS. Y=	0.5 ft	Assumed depth to begin analysis (0.5 ft maximum)

ITERATIVE SOLUTION OF MANNING'S EQUATION FOR NORMAL DEPTH:

ITERATION	Y (FT)	P (FT)	A(FT^2)	R	Q (CFS)	% ERROR	V (FPS)
1	0.50	6.12	2.00	0.33	0.59	881.51	0.29
2	0.11	2.90	0.27	0.09	0.03	-44.11	0.13
3	0.16	3.33	0.42	0.13	0.07	11.51	0.16
4	0.15	3.23	0.39	0.12	0.06	-2.16	0.15
5	0.15	3.25	0.40	0.12	0.06	0.43	0.15
6	0.15	3.25	0.39	0.12	0.06	-0.09	0.15
7	0.15	3.25	0.39	0.12	0.06	0.02	0.15
8	0.15	3.25	0.39	0.12	0.06	0.00	0.15
9	0.15	3.25	0.39	0.12	0.06	0.00	0.15
10	0.15	3.25	0.39	0.12	0.06	0.00	0.15
11	0.15	3.25	0.39	0.12	0.06	0.00	0.15
12	0.15	3.25	0.39	0.12	0.06	0.00	0.15
13	0.15	3.25	0.39	0.12	0.06	0.00	0.15
14	0.15	3.25	0.39	0.12	0.06	0.00	0.15
15	0.15	3.25	0.39	0.12	0.06	0.00	0.15

NORMAL DEPTH =	0.15 ft
FLOW WIDTH =	3.21 ft
VELOCITY =	0.15 ft/s
TREATMENT TIME =	9.00 min
TREATMENT LENGTH =	**82.19 ft**

R-TANK SUBSURFACE STORAGE SYSTEM DESIGN TOOL

Project Name	**Scholls Ferry Apartments**			**Date**	**5/16/2024**
City/County	**Beaverton**	**State**	**OR**	**Designed By**	**JKB**

R-Unit Inputs

Primary Units

Primary Unit	HD Double+Mini

Secondary Units (Duel Height System)

Secondary Unit	SD Penta

Treatment Row Units

Treatment Row Unit	HD Access Double+Mini

Loading Criteria

Load Rating	HS-20
Finished Surface Type	Asphalt

Total R-Unit Footprint and Perimeter

R-Unit Footprint	1,601.03 sf
R-Unit Units	520.00
R-Unit Perimeter	221.00 ft.

Secondary R-Unit Footprint

R-Unit Footprint	135.47 sf
R-Unit Units	44.00

Excavation Footprint and Perimeter

Excavation Footprint	2,064.60 sf
Excavation Perimeter	237.00 ft.

Geogrid Footprint

Geogrid Footprint	2,811.10 sf
Geogrid Material	ACF BX-12

Geotextile Unit Wrap

Material	M200 Woven Geotextile
Optional Bottom	Yes

Geotextile Excavation Wrap

Material	M200 Woven Geotextile
Top	Yes
Bottom	Yes
Sides	Yes

Base and Top Backfill Material

Base Material	Stone
Base Thickness	3 in
Backfill Material	Stone

Primary Elevations

Primary Unit Invert	336.00
Top Backfill Thickness	12 in

Secondary Elevations

Secondary Unit Invert	336.00
Top Backfill Thickness	12 in

Access Unit Elevations

Access Unit Invert	336.00
Top Backfill Thickness	12 in

Stone Storage

Use Stone Storage	Yes
Use Stone Base for Storage	Yes
Use Stone Cover for Storage	Yes
Stone Void Ratio	40%

Treatment Row

Treatment Unit Footprint	83.13 sf
R-Unit Units	27.00
Treatment Unit Perimeter	129.25 ft.

Port Quantities

# of Maintenance Ports	0
# of Inspection Ports	6

Liner

Liner Material	30 mil. PVC
Location	
Top	
Bottom	
Sides	

R-TANK SUBSURFACE STORAGE SYSTEM DESIGN TOOL

Project Name Scholls Ferry Apartments
Location Beaverton, OR

Date 5/16/2024
Designed By JKB

System Elevations

Elevations

	Base Inv.	Unit Inv.	Unit Top	Top Stone	Min. Grade	Max Grade
Primary Units	335.75	336.00	339.54	340.54	341.21	346.53
Secondary Units	335.75	336.00	339.67	340.67	341.17	349.66
Treatment Units	335.75	336.00	339.54	340.54	341.21	346.53

System Storage Capacities

Storage Capcacity	Full Storage
Desired Storage Volume	7,000 cf

Full Storage Capacity

Total Volume Provided in R-Unit:	5,406.17 cf
Total Volume Provided in Stone:	1,689.33 cf
Provided Storage Volume:	**7,095.50 cf**

Stage Volume Capacity

Input Elev.	Elev.	Volume	Output Vol.

Difference =

Surplus Units 6

System Quantities

Number of Primary Units:	449	
Number of Secondary Units:	44	
# of Maintenance Ports:	0	
Number of Access Units:	27	
# of Inspection Ports:	6	
Required Backfill Material:	156 cy	
Estimated Geotextile Unit Wrap:	4,583 sf	(509 sy)
Estimated Geotextile Excavation Wrap:	6,091 sf	(677 sy)
Estimated Liner:	0 sf	(0 sy)
Estimated Geogrid:	3,233 sf	(359 sy)
Estimated Treatment Row Wrap:	622 sf	(69 sy)
Estimated Treatment Row Base Fabric:	208 sf	(23 sy)

R-TANK SUBSURFACE STORAGE SYSTEM DESIGN TOOL

Project Name Scholls Ferry Apartments | **Date** 5/16/2024
Location Beaverton, OR | **Designed By** JKB

System Storage Capacities

Total Volume Provided in R-Unit:	5,406.17 cf
Total Volume Provided in Stone:	1,689.33 cf
Provided Storage Volume:	**7,095.50 cf**

R-Unit Stage Storage Table

Stage Storage Increment: 0.25 ft

Elevation	Volume						
335.75	0.00						
336.00	206.46						
336.25	633.06						
336.50	1,059.66						
336.75	1,486.26						
337.00	1,912.87						
337.25	2,339.47						
337.50	2,766.07						
337.75	3,192.67						
338.00	3,619.27						
338.25	4,045.87						
338.50	4,472.48						
338.75	4,899.08						
339.00	5,325.68						
339.25	5,752.28						
339.50	6,178.88						
339.75	6,269.66						
340.00	6,639.71						
340.25	6,846.17						
340.50	7,052.63						
340.67	7,095.50						

PACIFIC COMMUNITY DESIGN

Project: Scholls Ferry Apartments

Subject: Storm filter catch basin Job: 130-057

By: bk Date: 5/14/24 Page: 1 of 1

Shed C: total area = 5818 sf
impervious = 4,053.6 sf

water quality storm: $\frac{0.3 \text{ in}}{4 \text{ hr}}$

water quality volume: $\frac{(0.3 \text{ in} \times 4053.6 \text{ sf})}{12 \text{ in/ft}} = 121.6 \text{ cf}$

water quality flow: $\frac{121.6 \text{ cf}}{14,400 \text{ sec}} = \underline{0.008 \text{ cfs}}$

cartridges = $\frac{\text{design flow}}{\text{cartridge flow rate}}$ → use 18" cartridge
1 gpm/ft²
flow = 7.5 gpm

$= \left(\frac{0.008 \text{ cfs}}{7.5 \text{ gpm}} \times \frac{7.5 \text{ gal}}{1 \text{ ft}^3} \times \frac{60 \text{ sec}}{\text{min}}\right) = 0.48 = \underline{1 \text{ cartridge}}$