V1 - CID-23-04

PARKERS RIDGE

82 SCHOOL STREET
ROLESVILLE, NC 27571

STORMWATER MANAGEMENT CALCULATIONS

PREPARED FOR:

LENNAR CORPORATION
11PP Perimeter Park Drive, Suite 112
Morrisville, NC 27560

PREPARED BY:

BGE, INC.
5440 Wade Park Boulevard, Suite 102
Raleigh, NC 27607

NORTH CAROLINA PROFESSIONAL
PRELIMINARY
ENGINEER
DEBRA M. FERM

1st Submittal: 4/3/2023
2nd Submittal: 6/1/2023

NC License #C-4397

TABLE OF CONTENTS

#184- appears to be missing

#185- Is the table of contents correct? This package is 150 pages long

INTRODUCTION

On behalf of our client, Lennar Corporation, BGE, Inc. (BGE) submits this Engineer's Report in support of Parker Ridge project. This report contains the approach and results of the stormwater design for the subject property. The subject property is located at 82 School Street in the Town of Rolesville (Town), North Carolina. The site is comprised of four (4) parcels identified by the following parcel identification numbers (PINs): 1758-98-8411, 1758-98-3710, 1758-88-4270 E, and 1758-88-4270 W. The project area is approximately 86.74-acre (see project aerial map).

EXISTING CONDITIONS

The existing site condition is primarily undeveloped and tree-covered with several existing ponds. The predominant soil types within the proposed limit of construction are Rawlings-Rion complex (RgD), Urban land (Ur), and Wake-Rolesville complex (WaD) as taken from the Web Soil Survey 2.1 – National Cooperative Soil Survey by NRCS).

For the western parcel most of the site drains to the stream that runs through the site and into the southwest corner shown as POA #3 on the Pre-Development Exhibit. For the east parcel majority of the site drains into the existing pond located in the center of the east parcel and flows into Harris Creek exiting south of our site with a small portion draining to a more southern stream connection. These areas are shown on the Pre-Development Exhibit as POA#1 and POA#2.

FLOODPLAIN, FLOODWAY AND WATERSHED

The proposed site does not lie within a 100-year floodplain boundary as determined by FEMA FIRM Panel(s): #3720176800K and #3720175800K dated July 18, 2022.

PROPOSED DEVELOPMENT

The overall proposed project will include the development of 114 attached townhouse lots and 161 single-family lots with associated infrastructure. The proposed impervious buildout for the development is as follows:

Table 1 Impervious Area

POST-DEVELOPMENT IMPERVIOUS AREAS		
PAVEMENT	7.44	AC
SIDEWALK	2.03	AC
LOTS - TOWNHOMES	5.7	AC
LOTS - SINGLE-FAMILY (MAX.)	9.66	AC
TOTAL ONSITE IMPERVIOUS AREA:	24.83	AC

The project will have 7 full access points, two from the roundabout on Redford Place Drive, one west and one east. Two south connecting to Long Melford Drive and one future connection northeast of Street H. There are also two access points from Alley 2 and Alley 3 just west of Redford Place Drive.

STORM DRAINAGE DESIGN

The existing topographic information was used to grade the property and identify the contributing drainage areas to the stormwater devices.

This project includes four (4) separate drainage systems that will drain to four (4) different proposed wet ponds located throughout the site. All four (4) of the proposed ponds will discharge to the existing Harris Creek located at the southern portion of both parcels. With Bypass also flowing into Harris Creek. The on-site storm sewer collection system was designed to capture and convey the 1-, 10, and 100- year storm event for the proposed development. Per local design standards, the Rational Method and Manning's Equation will be used for the storm sewer system design utilizing AutoDesk's Hydraflow Storm Sewers software. A Manning's n value of 0.013 will be used for the reinforced concrete pipe and 0.024 for HDPE. Runoff coefficients (C) used for open space and impervious cover were 0.35 and 0.95, respectively. The starting HGL used for the 10 yr calculations is the 10 yr WSE for the detention pond, and the starting HGL for the 100 yr WSE for the 100 yr calculations.

WATER QUALITY

The proposed wet detention ponds (SCM's) have been designed based on the town's water quantity requirements to attenuate the post-development peak runoff rates for the 1-, 10-, and 100-year storm events to pre-developed rates. The ponds are designed with weirs to safely pass the 100-year storm event and provides a minimum of one foot of freeboard above the peak stage to the top of the embankment.

The pre-development drainage area that was established for the project area includes stormwater runoff that will be conveyed to 3 points of analysis (POA's). The post-development drainage area was established based on proposed grading conditions, where all stormwater is either conveyed into a pond, and into a post-POA. The curve numbers (CN) and time of concentration (Tc) for each drainage basin were calculated based on existing and proposed conditions using the TR-55 method. The 4 proposed ponds (SCM's) were analyzed with Hydraflow modeling software for verification that the proposed design meets the Town of Rolesville's and NCDEQ's minimum requirements.

WATER QUANTITY

The proposed wet detention ponds (SCM's) have been designed based on both the NCDEQ's MDC and the town's water quantity requirements to attenuate the post-development peak runoff rates for the 1-, 10, and 100- year, 24-hour storm events. The post development flows are required to be less than the pre-developed rates by means of stormwater detention. The wet pond is designed to reduce the flows of each storm event mentioned above with a weir, the riser and an emergency spillway to safely pass the 100-year storm event.

The post-development drainage area was established based on existing and proposed site conditions. The curve numbers (CN) and time of concentration (Tc) for each drainage basin were calculated based on existing and proposed conditions using the TR-55 method. The 4 proposed ponds (SCM's) were analyzed with Hydraflow modeling software for verification that the proposed design meets the Town of Rolesville and NCDEQ's minimum requirements. For the pre-development condition and the tree save areas, the curve # of roughly 77 was used while 80 was used for the open space (grass) and 98 was used for the impervious areas. Information on Peak Flow Analysis is available below in Table 2.

Table 2 Peak Flow Analysis

	Pre-Development (cfs)			Post-Development (cfs)			Percent Difference		
POA #	**1-yr**	**10-yr**	**100-yr**	**1-yr**	**10-yr**	**100-yr**	**1-yr**	**10-yr**	**100-yr**
POA #1	34.25	89.35	157.92	17.23	54.36	134.51	-50%	-39%	-15%
POA #2	41.38	97.64	164.45	7.821	54.59	140.19	-81%	-44%	-15%
POA #3	81.28	208.92	367.67	28.10	131.98	286.72	-65%	-37%	-22%
POA #4	10.01	25.45	44.48	1.021	2.701	4.793	-90%	-89%	-89%

SUMMARY

Based on the results of the stormwater models, all points of analysis are reduced in the post development condition. As a result, the proposed design meets the requirements for the Town of Rolesville and NCDEQ for stormwater conveyance, and stormwater treatment and detention. The stormwater detention information is as follows:

SCM #1

Drainage Area:	9.00 ac
Impervious Area:	5.13 ac
Average Pond Depth:	3.5 feet
Surface Area Required:	7237 sf
Surface Area Proposed:	8489 sf
1” Detention Volume:	18393 cf
Top of Dam El:	390 at 10’ wide

SCM #2

Drainage Area:	19.99 ac
Impervious Area:	10.03 ac
Average Pond Depth:	3.5 feet
Surface Area Required:	18309 sf
Surface Area Proposed:	20453 sf
1” Detention Volume:	36396 cf
Top of Dam El:	357 at 10’ wide

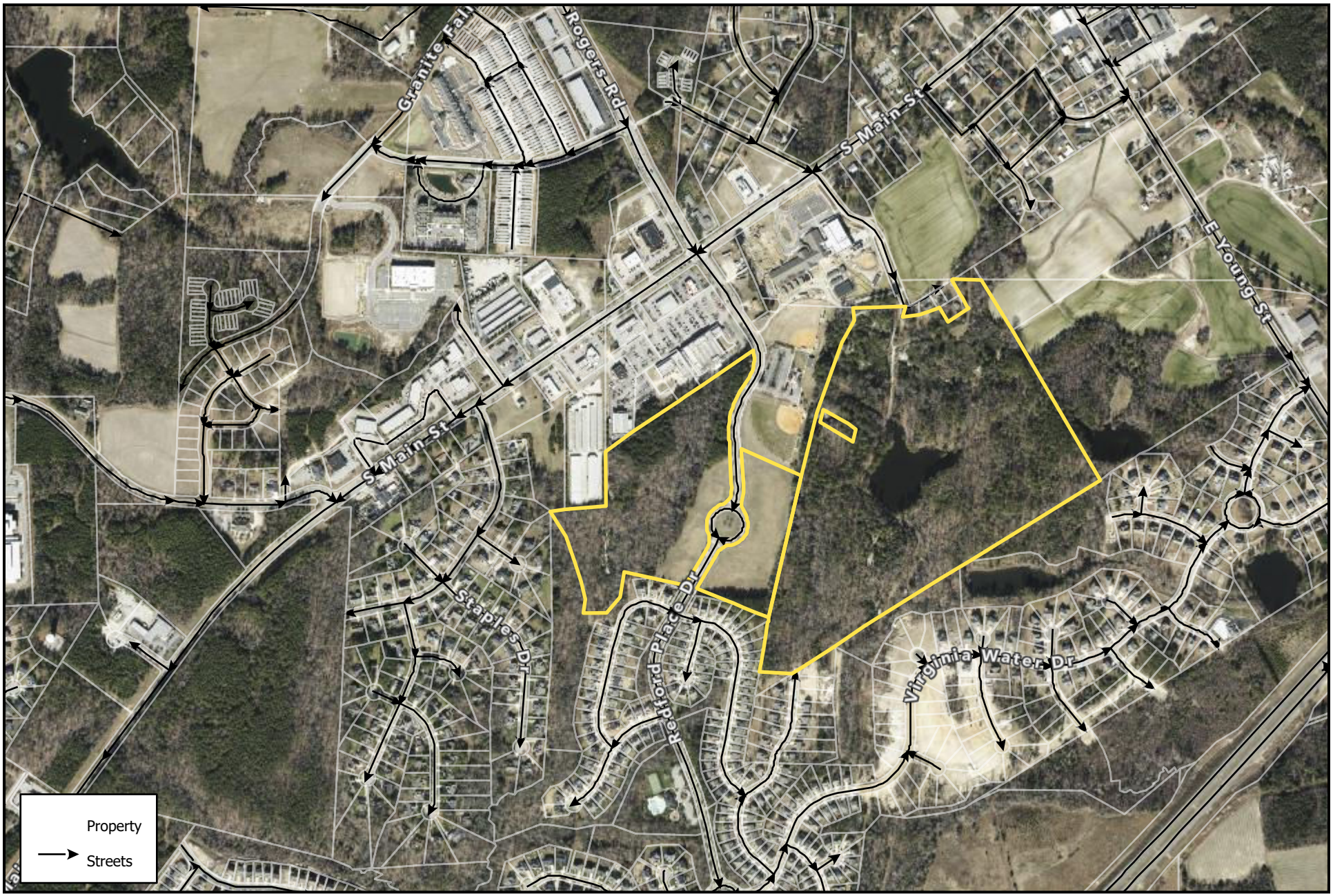
SCM #3

Drainage Area:	14.11 ac
Impervious Area:	4.65 ac
Average Pond Depth:	3.5 feet
Surface Area Required:	7066 sf
Surface Area Proposed:	7226 sf
1” Detention Volume:	17753 cf
Top of Dam El:	390 at 10’ wide

SCM #4

Drainage Area:	11.66 ac
Impervious Area:	5.02 ac
Average Pond Depth:	3.5 feet
Surface Area Required:	10172 sf
Surface Area Proposed:	12694 sf
1” Detention Volume:	18517 cf
Top of Dam El:	386 at 10’ wide

ATTACHMENT 1: PROJECT AERIAL MAP



N

0 400 800 1600 ft

1 inch equals 800 feet

Disclaimer

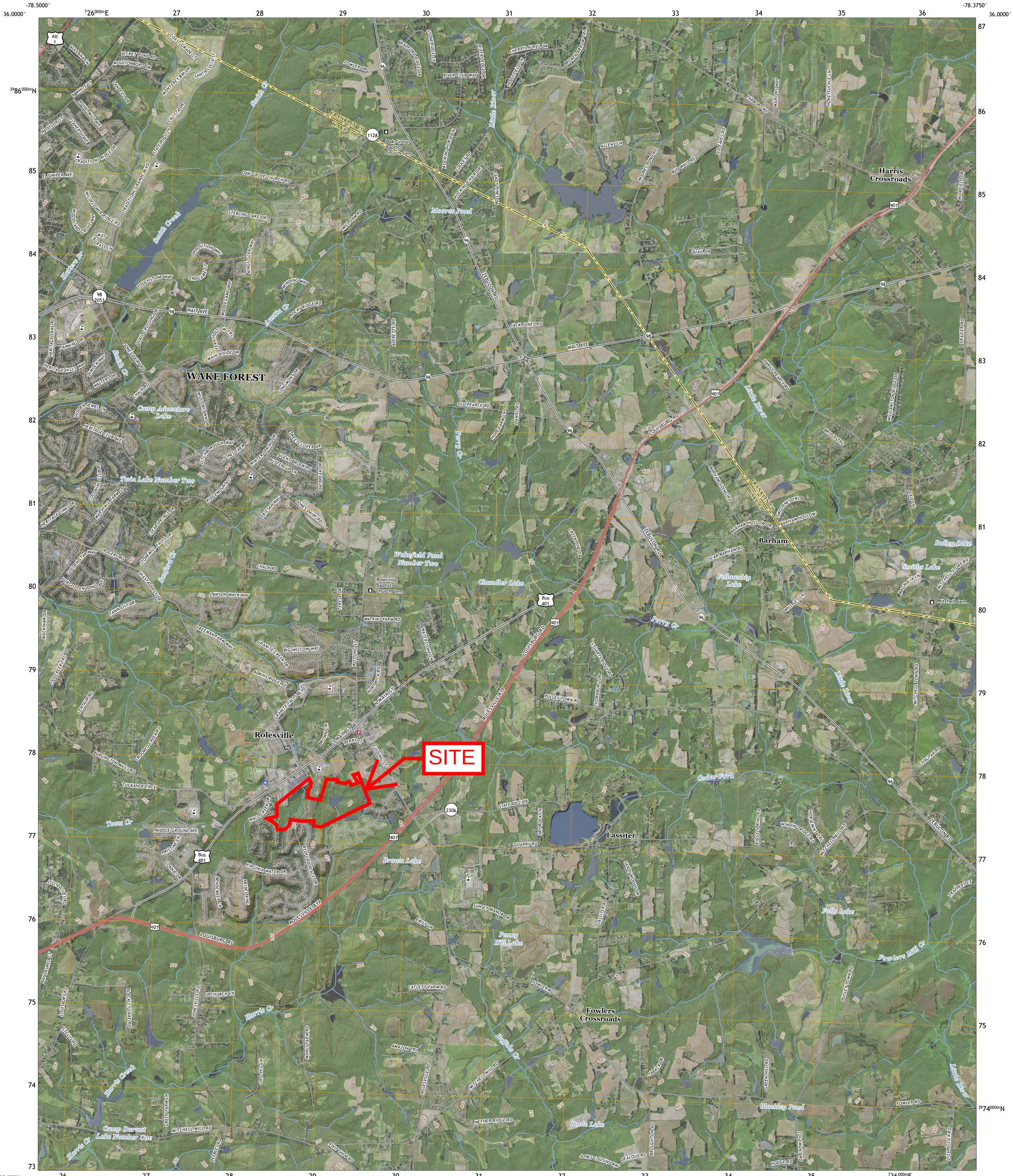
*iMaps makes every effort to produce and publish the most current and accurate information possible. However, the maps are produced for information purposes, and are **NOT** surveys. No warranties, expressed or implied ,are provided for the data therein, its use,or its interpretation.*

ATTACHMENT 2: USGS TOPO MAP

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

ROLESVILLE QUADRANGLE
NORTH CAROLINA
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 17S

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery	NAIP,	July 2020 - July 2020
Roads	U.S. Census Bureau,	2016
Names	GNIS,	1980 - 2022
Hydrography	National Hydrography Dataset,	2001 - 2021
Contours	National Elevation Dataset,	2008
Boundaries	Multiple sources; see metadata file	2019 - 2021

Wetlands FWS National Wetlands Inventory Not Available

MN
GN
9°23′ 167 MILS
1½° 27 MILS
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
QV
Grid Zone Designation 17S

SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

1 Grissom
2 Franklinton
3 Louisburg
4 Wake Forest
5 Bunn West
6 Raleigh East
7 Knightdale
8 Zebulon

ADJOINING QUADRANGLES

ROAD CLASSIFICATION

Expressway	Local Connector
Secondary Hwy	Local Road
Ramp	4WD
Interstate Route	US Route / State Route

ROLESVILLE, NC
2022

NSN 7643016379170
NGA REF NO. USGSX24K38453

ATTACHMENT 3: SOIL SURVEY REPORT

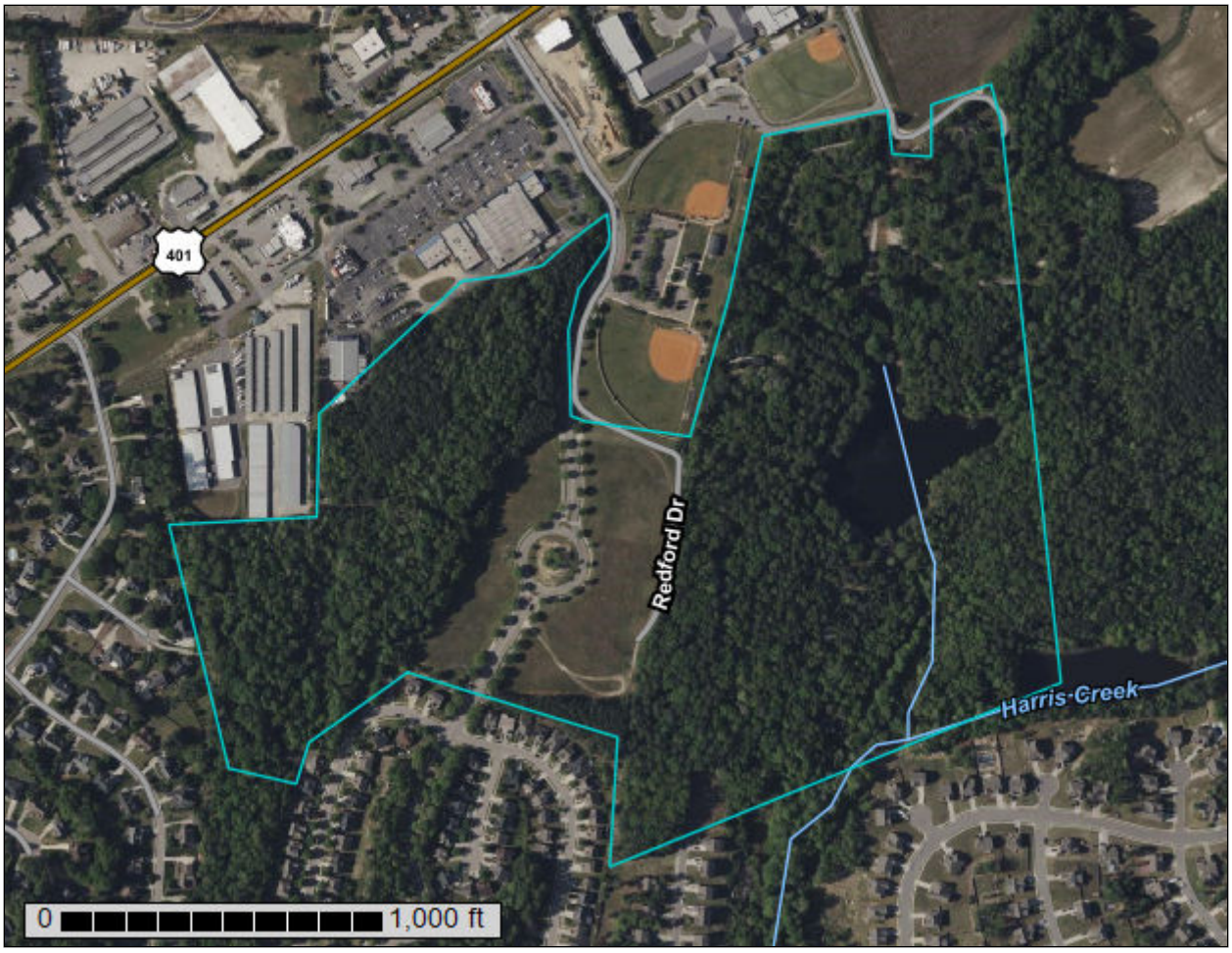
United States Department of Agriculture

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 Wake County, North Carolina



March 29, 2023

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

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:6,270 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Wake County, North Carolina
Survey Area Data: Version 23, Sep 12, 2022

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

Date(s) aerial images were photographed: Apr 24, 2022—May 9, 2022

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
HeB	Helena sandy loam, 2 to 6 percent slopes	11.1	13.2%
RgB	Rawlings-Rion complex, 2 to 6 percent slopes	6.1	7.2%
RgC	Rawlings-Rion complex, 6 to 10 percent slopes	0.6	0.7%
RgD	Rawlings-Rion complex, 10 to 15 percent slopes	17.4	20.5%
Ur	Urban land	16.4	19.4%
W	Water	3.9	4.6%
WaD	Wake-Rolesville complex, 10 to 15 percent slopes, very rocky	13.4	15.8%
WaE	Wake-Rolesville complex, 15 to 25 percent slopes, very rocky	11.6	13.7%
WfB	Wedowee-Saw complex, 2 to 6 percent slopes	1.2	1.4%
WgB	Wedowee-Urban land complex, 2 to 6 percent slopes	2.8	3.4%
WgC	Wedowee-Urban land complex, 6 to 15 percent slopes	0.1	0.2%
Totals for Area of Interest		**84.7**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Wake County, North Carolina

HeB—Helena sandy loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2qqgq
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Helena and similar soils: 92 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Helena

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 12 inches: sandy loam
BE - 12 to 19 inches: sandy clay loam
Bt1 - 19 to 39 inches: clay
Bt2 - 39 to 43 inches: clay loam
BCg - 43 to 46 inches: clay loam
C - 46 to 80 inches: sandy loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Ecological site: F136XY810SC - Acidic upland forest, seasonally wet
Hydric soil rating: No

RgB—Rawlings-Rion complex, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2xhb9
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Rawlings and similar soils: 55 percent
Rion and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rawlings

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 20 inches: sandy clay loam
C - 20 to 40 inches: gravelly sandy loam
R - 40 to 80 inches: bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F136XY830NC - Acidic upland forest, dry-moist
Hydric soil rating: No

Description of Rion

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Saprolite derived from granite and gneiss

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt1 - 8 to 17 inches: sandy clay loam
Bt2 - 17 to 38 inches: sandy loam
C - 38 to 80 inches: sandy loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F136XY820GA - Acidic upland forest, moist
Hydric soil rating: No

RgC—Rawlings-Rion complex, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: 2xhbb
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Rawlings and similar soils: 55 percent
Rion and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rawlings

Setting

Landform: Interfluves
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 20 inches: sandy clay loam
C - 20 to 40 inches: gravelly sandy loam
R - 40 to 80 inches: bedrock

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F136XY830NC - Acidic upland forest, dry-moist
Hydric soil rating: No

Description of Rion

Setting

Landform: Interfluves
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Saprolite derived from granite and gneiss

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt1 - 8 to 17 inches: sandy clay loam
Bt2 - 17 to 38 inches: sandy loam
C - 38 to 80 inches: sandy loam

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: F136XY820GA - Acidic upland forest, moist
Hydric soil rating: No

RgD—Rawlings-Rion complex, 10 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2xhb8
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Rawlings and similar soils: 55 percent
Rion and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rawlings

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 20 inches: sandy clay loam
C - 20 to 40 inches: gravelly sandy loam
R - 40 to 80 inches: bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F136XY830NC - Acidic upland forest, dry-moist
Hydric soil rating: No

Description of Rion

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Saprolite derived from granite and gneiss

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt1 - 8 to 17 inches: sandy clay loam
Bt2 - 17 to 38 inches: sandy loam
C - 38 to 80 inches: sandy loam

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F136XY820GA - Acidic upland forest, moist
Hydric soil rating: No

Ur—Urban land

Map Unit Setting

National map unit symbol: 2qwpc
Elevation: 70 to 1,400 feet
Mean annual precipitation: 39 to 51 inches
Mean annual air temperature: 54 to 63 degrees F
Frost-free period: 190 to 250 days

Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting
Parent material: Impervious layers over human-transported material

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

W—Water

Map Unit Setting
National map unit symbol: 2qqjv
Elevation: 70 to 450 feet
Mean annual precipitation: 39 to 51 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

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

WaD—Wake-Rolesville complex, 10 to 15 percent slopes, very rocky

Map Unit Setting
National map unit symbol: 2xhbf
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Wake, very rocky, and similar soils: 50 percent
Rolesville, very rocky, and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wake, Very Rocky

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 7 inches: gravelly loamy coarse sand
C - 7 to 11 inches: gravelly loamy sand
R - 11 to 80 inches: bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: F136XY870GA - Outer piedmont acidic upland woodlands and glades, dry
Hydric soil rating: No

Description of Rolesville, Very Rocky

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 12 inches: loamy sand
Bw - 12 to 26 inches: loamy sand
C - 26 to 32 inches: loamy coarse sand
Cr - 32 to 38 inches: bedrock
R - 38 to 80 inches: bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock; 20 to 80 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F136XY870GA - Outer piedmont acidic upland woodlands and glades, dry
Hydric soil rating: No

WaE—Wake-Rolesville complex, 15 to 25 percent slopes, very rocky

Map Unit Setting

National map unit symbol: 2xhbg
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Wake, very rocky, and similar soils: 50 percent
Rolesville, very rocky, and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wake, Very Rocky

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 7 inches: gravelly loamy coarse sand
C - 7 to 11 inches: gravelly loamy sand
R - 11 to 80 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: F136XY870GA - Outer piedmont acidic upland woodlands and glades, dry
Hydric soil rating: No

Description of Rolesville, Very Rocky

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 12 inches: loamy sand
Bw - 12 to 26 inches: loamy sand
C - 26 to 32 inches: loamy coarse sand
Cr - 32 to 38 inches: bedrock
R - 38 to 80 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock; 20 to 80 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F136XY870GA - Outer piedmont acidic upland woodlands and glades, dry
Hydric soil rating: No

WfB—Wedowee-Saw complex, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2xn42
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Wedowee and similar soils: 60 percent
Saw and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wedowee

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Saprolite residuum weathered from granite and gneiss and/or saprolite residuum weathered from schist

Typical profile

Ap - 0 to 4 inches: sandy loam
E - 4 to 7 inches: sandy loam
BC - 23 to 35 inches: clay loam
C - 35 to 80 inches: sandy clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F136XY820GA - Acidic upland forest, moist
Hydric soil rating: No

Description of Saw

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

Ap - 0 to 8 inches: sandy loam
Bt - 8 to 20 inches: clay
BC - 20 to 26 inches: sandy clay loam
C - 26 to 29 inches: sandy loam
R - 29 to 80 inches: bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F136XY830NC - Acidic upland forest, dry-moist
Hydric soil rating: No

WgB—Wedowee-Urban land complex, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2xn43
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Wedowee and similar soils: 55 percent
Urban land: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wedowee

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Saprolite residuum weathered from granite and gneiss and/or saprolite residuum weathered from schist

Typical profile

Ap - 0 to 4 inches: sandy loam
E - 4 to 7 inches: sandy loam
BC - 23 to 35 inches: clay loam
C - 35 to 80 inches: sandy clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F136XY820GA - Acidic upland forest, moist
Hydric soil rating: No

Description of Urban Land

Setting

Parent material: Impervious layers over human transported material

Interpretive groups

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

WgC—Wedowee-Urban land complex, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2xn44
Elevation: 70 to 560 feet
Mean annual precipitation: 39 to 47 inches

Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Wedowee and similar soils: 55 percent
Urban land: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wedowee

Setting

Landform: Interfluves
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Saprolite residuum weathered from granite and gneiss and/or saprolite residuum weathered from schist

Typical profile

Ap - 0 to 4 inches: sandy loam
E - 4 to 7 inches: sandy loam
BC - 23 to 35 inches: clay loam
C - 35 to 80 inches: sandy clay loam

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F136XY820GA - Acidic upland forest, moist
Hydric soil rating: No

Description of Urban Land

Setting

Parent material: Impervious layers over human transported material

Interpretive groups

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

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

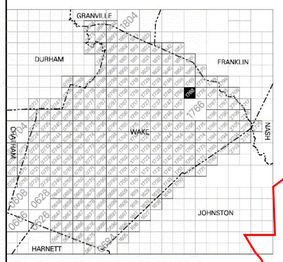
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

ATTACHMENT 4: FEMA FLOOD MAP

STATE OF NORTH CAROLINA FIRM PANEL LOCATOR DIAGRAM



DATUM INFORMATION

The **projection** used in the preparation of this map was the North Carolina State Plane (FIPSZONE 3200). The **horizontal datum** was the North American Datum of 1983, GRS80 ellipsoid. Differences in datum, ellipsoid, projection, or Universal Transverse Mercator zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdictional boundaries. These differences do not affect the accuracy of this FIRM. All coordinates on this map are in U.S. Survey Feet, where 1 U.S. Survey Foot = 1200/3937 Meters.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. An average offset between NAVD 88 and the National Geodetic Vertical Datum of 1929 (NGVD 29) has been computed for each North Carolina county. This offset was then applied to the NGVD 29 flood elevations that were not revised during the creation of this statewide format FIRM. The offsets for each county shown on this FIRM panel are shown in the vertical datum offset table below. Where a county boundary and a flooding source with unrevised NGVD 29 flood elevations are coincident, an individual offset has been calculated and applied during the creation of this statewide format FIRM. See Section 6.1 of the accompanying Flood Insurance Study report to obtain further information on the conversion of elevations between NAVD 88 and NGVD 29. To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the North Carolina Geodetic Survey at the address shown below. You may also contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at www.ngs.noaa.gov.

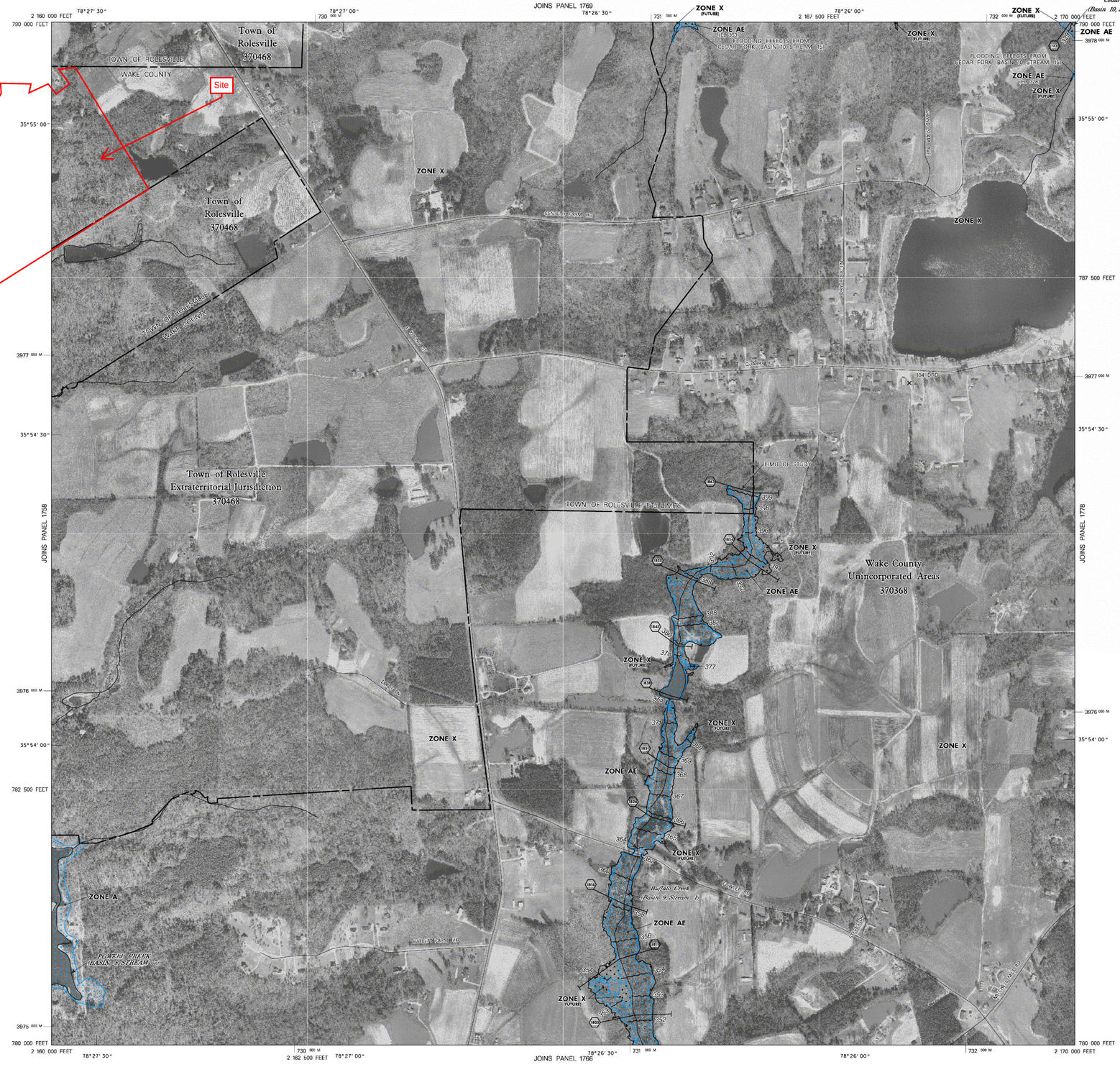
North Carolina Geodetic Survey
121 West Jones Street
Raleigh, NC 27601
(919) 733-3836
www.ncgs.state.nc.us

County Average Vertical Datum Offset Table

County	Vertical Datum Offset (ft)
Wake	– 0.88

Example: NAVD 88 = NGVD 29 + (–0.88)

All streams listed in the **Flood Hazard Data Table** below were studied by detailed methods using field survey. Other flood hazard data shown on this map may have been derived using either a coastal analysis or limited detailed riverine analysis. More information on the flooding sources studied by these analyses is contained in the Flood Insurance Study report.



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 Area 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 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 future conditions 1% 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 and future conditions 1% 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 and future conditions 1% 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

- 103 — Cross section line
- 23 — 23 — Transect line
- 97°07' 30", 32°22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4278 000 M — 1000-meter Universal Transverse Mercator grid ticks, zone 17
- 1 477 500 FEET — 2500-foot grid values: North Carolina State Plane coordinate system (FIPSZONE 3200, State Plane NAD 83 feet)
- BM5510 — North Carolina Geodetic Survey bench mark (see explanation in the Datum Information section of this FIRM panel).
- BM5510 — National Geodetic Survey bench mark (see explanation in the Datum Information section of this FIRM panel).
- M1.5 — River Mile

GRID NORTH

MAP SCALE 1" = 500' (1 : 6,000)

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1768J

FIRM
FLOOD INSURANCE RATE MAP
NORTH CAROLINA

PANEL 1768

(SEE LOCATOR DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	CID No.	PANEL	SUFFIX
ROLESVILLE, TOWN OF	370468	1768	J
WAKE COUNTY	370368	1768	J

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.

EFFECTIVE DATE
MAY 2, 2006

MAP NUMBER
3720176800J

State of North Carolina
Federal Emergency Management Agency

NORTH CAROLINA Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map floodplain areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

www.ncfloodmaps.com

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, Floodway Data, Limited Detailed Flood Hazard 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 **regulatory floodways** shown on the FIRM for flooding sources studied by detailed methods 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 for flooding sources studied by detailed methods as well as **non-encroachment widths** for flooding sources studied by limited detailed methods are provided in the FIS report for this jurisdiction. The FIS report also provides instructions for determining a floodway using non-encroachment widths for flooding sources studied by limited detailed methods.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 4.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

Base map information and geospatial data used to develop this FIRM were obtained from various organizations, including the participating local community(ies), state and federal agencies, and/or other sources. The primary base for this FIRM is aerial imagery acquired by Wake County. The time period of collection for the imagery is 1999. Information and geospatial data supplied by the local community(ies) that met FEMA base map specifications were considered the preferred source for development of the base map. See geospatial metadata for the associated digital FIRM for additional information about base map preparation.

Base map features shown on this map, such as **corporate limits**, are based on the most up-to-date data available at the time of publication. **Changes in the corporate limits may have occurred since this map was published**. Map users should consult the appropriate community official or website to verify current conditions of jurisdictional boundaries and base map features. This map may contain roads that were not considered in the hydraulic analysis of streams where no new hydraulic model was created during the production of this statewide format FIRM.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

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.

If you have **questions about this map**, or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at www.fema.gov.

An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the **North Carolina Floodplain Mapping Program** website at www.ncfloodmaps.com, or contact the **FEMA Map Service Center** at 1-800-358-9616 for information on all related products associated with this FIRM. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at www.msc.fema.gov.

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index or visit www.ncfloodmaps.com.

EFFECTIVE DATE OF FLOOD INSURANCE RATE MAP PANEL
MAY 2, 2006

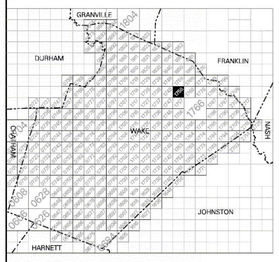
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to statewide 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, the North Carolina Division of Emergency Management or the National Flood Insurance Program at the following phone numbers or websites:

NC Division of Emergency Management (919) 715-8000 www.nccrimecontrol.org/nfip
National Flood Insurance Program 1-800-638-6620 www.fema.gov/nfip

STATE OF NORTH CAROLINA FIRM PANEL LOCATOR DIAGRAM



DATUM INFORMATION

The **projection** used in the preparation of this map was the North Carolina State Plane (FIPSZONE 3200). The **horizontal datum** was the North American Datum of 1983, GRS80 ellipsoid. Differences in datum, ellipsoid, projection, or Universal Transverse Mercator zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdictional boundaries. These differences do not affect the accuracy of this FIRM. All coordinates on this map are in U.S. Survey Feet, where 1 U.S. Survey Foot = 1200/3937 Meters.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. An average offset between NAVD 88 and the National Geodetic Vertical Datum of 1929 (NGVD 29) has been computed for each North Carolina county. This offset was then applied to the NGVD 29 flood elevations that were not revised during the creation of this statewide format FIRM. The offsets for each county shown on this FIRM panel are shown in the vertical datum offset table below. Where a county boundary and a flooding source with unrevised NGVD 29 flood elevations are coincident, an individual offset has been calculated and applied during the creation of this statewide format FIRM. See Section 6.1 of the accompanying Flood Insurance Study report to obtain further information on the conversion of elevations between NAVD 88 and NGVD 29. To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the North Carolina Geodetic Survey at the address shown below. You may also contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at www.ngs.noaa.gov.

North Carolina Geodetic Survey
121 West Jones Street
Raleigh, NC 27601
(919) 733-3836
www.ncgs.state.nc.us

County Average Vertical Datum Offset Table

County	Vertical Datum Offset (ft)
Wake	– 0.88

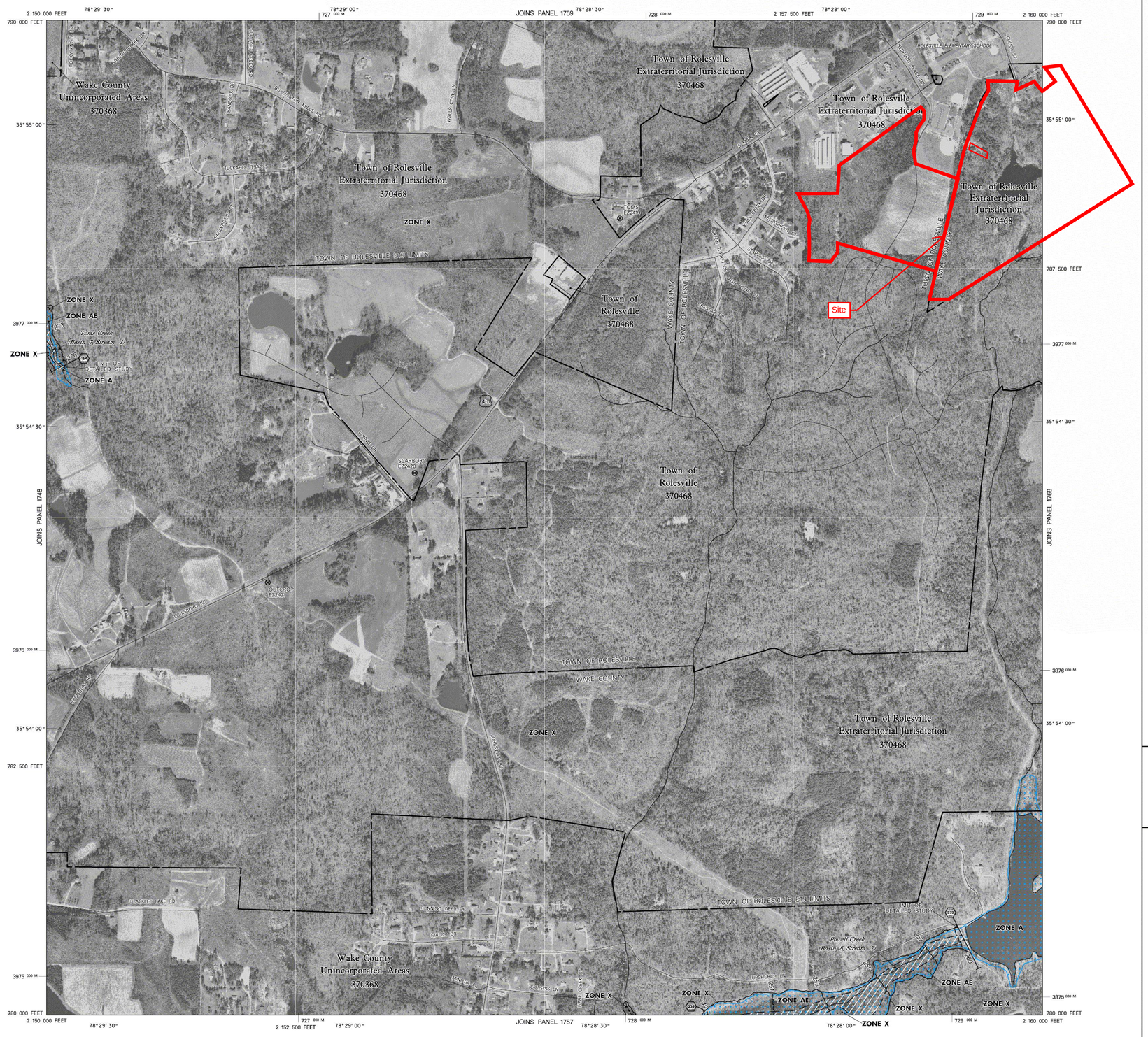
Example: NAVD 88 = NGVD 29 + (–0.88)

All streams listed in the **Flood Hazard Data Table** below were studied by detailed methods using field survey. Other flood hazard data shown on this map may have been derived using either a coastal analysis or limited detailed riverine analysis. More information on the flooding sources studied by these analyses is contained in the Flood Insurance Study report.

FLOOD HAZARD DATA TABLE

Cross Section	Stream Station	Flood Discharge (cfs)	1% Annual Chance (100-year) Water-Surface Elevation (feet NAVD 88)	Floodway Width (feet) Left/Right Distance From the Center of Stream to Encroachment Boundary (Looking Downstream) or Total Floodway Width
TOMS CREEK (BASIN 7, STREAM 1)				
164	16,350[1]	NA	275.5	50
POWELL CREEK (BASIN 8, STREAM 7)				
239	23,890[2]	NA	248.7	120
272	27,200[2]	NA	259.9	110

[1] Feet above confluence with Neuse River (Basin 15, Stream 1)
[2] Feet above confluence with Hodges Creek (Basin 8, Stream 1)



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 Area 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 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 future conditions 1% 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 and future conditions 1% 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 and future conditions 1% 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

- Cross section line
- Transect line
- 97°07' 30", 32°22' 30" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4278 000 M 1000-meter Universal Transverse Mercator grid ticks, zone 17
- 1 477 500 FEET 2500-foot grid values: North Carolina State Plane coordinate system (FIPSZONE 3200, State Plane NAD 83 feet)
- BM5510 North Carolina Geodetic Survey bench mark (see explanation in the Datum Information section of this FIRM panel).
- BM5510 National Geodetic Survey bench mark (see explanation in the Datum Information section of this FIRM panel).
- M1.5 River Mile

GRID NORTH

MAP SCALE 1" = 500' (1 : 6,000)
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1758J

FIRM
FLOOD INSURANCE RATE MAP
NORTH CAROLINA

PANEL 1758

(SEE LOCATOR DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	CID No.	PANEL	SUFFIX
ROLESVILLE, TOWN OF	370468	1758	J
WAKE COUNTY	370368	1758	J

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.

EFFECTIVE DATE
MAY 2, 2006

MAP NUMBER
3720175800J

State of North Carolina
Federal Emergency Management Agency

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, Floodway Data, Limited Detailed Flood Hazard 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 **regulatory floodways** shown on the FIRM for flooding sources studied by detailed methods 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 for flooding sources studied by detailed methods as well as **non-encroachment widths** for flooding sources studied by limited detailed methods are provided in the FIS report for this jurisdiction. The FIS report also provides instructions for determining a floodway using non-encroachment widths for flooding sources studied by limited detailed methods. Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 4.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

Base map information and geospatial data used to develop this FIRM were obtained from various organizations, including the participating local community(ies), state and federal agencies, and/or other sources. The primary base for this FIRM is aerial imagery acquired by Wake County. The time period of collection for the imagery is 1999. Information and geospatial data supplied by the local community(ies) that met FEMA base map specifications were considered the preferred source for development of the base map. See geospatial metadata for the associated digital FIRM for additional information about base map preparation.

Base map features shown on this map, such as **corporate limits**, are based on the most up-to-date data available at the time of publication. **Changes in the corporate limits may have occurred since this map was published**. Map users should consult the appropriate community official or website to verify current conditions of jurisdictional boundaries and base map features. This map may contain roads that were not considered in the hydraulic analysis of streams where no new hydraulic model was created during the production of this statewide format FIRM.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

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.

If you have **questions about this map**, or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at www.fema.gov.

An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the **North Carolina Floodplain Mapping Program** website at www.ncfloodmaps.com, or contact the **FEMA Map Service Center** at 1-800-358-9616 for information on all related products associated with this FIRM. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at www.msc.fema.gov.

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index or visit www.ncfloodmaps.com.

EFFECTIVE DATE OF FLOOD INSURANCE RATE MAP PANEL
MAY 2, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to statewide 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, the North Carolina Division of Emergency Management or the National Flood Insurance Program at the following phone numbers or websites:

NC Division of Emergency Management (919) 715-8000 www.nccrimecontrol.org/nfip
National Flood Insurance Program 1-800-638-6620 www.fema.gov/nfip

NORTH CAROLINA Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map floodplain areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

www.ncfloodmaps.com

ATTACHMENT 5: RAINFALL DATA

NOAA Atlas 14, Volume 2, Version 3
Location name: Rolesville, North Carolina, USA*
Latitude: 35.9195°, Longitude: -78.4618°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.84** (4.43-5.29)	**5.62** (5.15-6.14)	**6.41** (5.87-6.98)	**7.19** (6.58-7.85)	**7.98** (7.27-8.70)	**8.62** (7.81-9.38)	**9.17** (8.27-9.98)	**9.66** (8.66-10.5)	**10.2** (9.07-11.1)	**10.7** (9.43-11.7)
10-min	**3.86** (3.54-4.22)	**4.49** (4.12-4.91)	**5.13** (4.70-5.60)	**5.75** (5.26-6.27)	**6.36** (5.79-6.93)	**6.86** (6.22-7.47)	**7.28** (6.56-7.94)	**7.66** (6.86-8.36)	**8.08** (7.18-8.82)	**8.43** (7.43-9.22)
15-min	**3.22** (2.95-3.52)	**3.77** (3.45-4.12)	**4.32** (3.96-4.72)	**4.85** (4.44-5.29)	**5.38** (4.89-5.86)	**5.79** (5.25-6.31)	**6.14** (5.53-6.69)	**6.44** (5.77-7.03)	**6.78** (6.02-7.40)	**7.05** (6.22-7.72)
30-min	**2.21** (2.02-2.41)	**2.60** (2.38-2.84)	**3.07** (2.82-3.35)	**3.51** (3.21-3.83)	**3.98** (3.62-4.34)	**4.36** (3.95-4.75)	**4.70** (4.24-5.12)	**5.02** (4.49-5.47)	**5.39** (4.79-5.89)	**5.71** (5.03-6.25)
60-min	**1.38** (1.26-1.51)	**1.63** (1.50-1.78)	**1.97** (1.81-2.15)	**2.29** (2.09-2.50)	**2.65** (2.41-2.89)	**2.95** (2.68-3.22)	**3.24** (2.92-3.53)	**3.52** (3.15-3.84)	**3.87** (3.44-4.22)	**4.17** (3.67-4.56)
2-hr	**0.804** (0.732-0.888)	**0.957** (0.874-1.05)	**1.17** (1.06-1.28)	**1.37** (1.24-1.50)	**1.61** (1.45-1.77)	**1.83** (1.64-2.00)	**2.03** (1.81-2.22)	**2.24** (1.98-2.44)	**2.51** (2.20-2.74)	**2.75** (2.39-3.01)
3-hr	**0.568** (0.516-0.629)	**0.676** (0.617-0.746)	**0.828** (0.754-0.913)	**0.979** (0.888-1.08)	**1.16** (1.05-1.28)	**1.33** (1.19-1.46)	**1.49** (1.32-1.63)	**1.66** (1.46-1.82)	**1.89** (1.65-2.07)	**2.09** (1.81-2.30)
6-hr	**0.342** (0.312-0.378)	**0.407** (0.372-0.448)	**0.499** (0.455-0.548)	**0.591** (0.537-0.648)	**0.704** (0.637-0.771)	**0.807** (0.725-0.882)	**0.910** (0.810-0.994)	**1.02** (0.897-1.11)	**1.17** (1.01-1.27)	**1.30** (1.12-1.42)
12-hr	**0.200** (0.183-0.220)	**0.239** (0.219-0.262)	**0.294** (0.269-0.322)	**0.350** (0.319-0.383)	**0.420** (0.381-0.459)	**0.485** (0.436-0.527)	**0.550** (0.489-0.598)	**0.620** (0.546-0.673)	**0.717** (0.621-0.778)	**0.807** (0.688-0.876)
24-hr	**0.119** (0.111-0.128)	**0.144** (0.134-0.155)	**0.181** (0.168-0.195)	**0.210** (0.195-0.226)	**0.250** (0.231-0.269)	**0.282** (0.260-0.303)	**0.315** (0.289-0.339)	**0.349** (0.320-0.376)	**0.396** (0.361-0.427)	**0.433** (0.393-0.468)
2-day	**0.069**	**0.083**	**0.104**	**0.120**	**0.142**	**0.159**	**0.177**	**0.196**	**0.221**	**0.241**

	(0.064-0.074)	(0.078-0.090)	(0.097-0.112)	(0.111-0.129)	(0.131-0.153)	(0.147-0.172)	(0.163-0.191)	(0.180-0.211)	(0.202-0.239)	(0.219-0.261)
3-day	**0.049** (0.046-0.052)	**0.059** (0.055-0.063)	**0.073** (0.068-0.078)	**0.084** (0.078-0.090)	**0.099** (0.092-0.106)	**0.111** (0.103-0.119)	**0.124** (0.114-0.133)	**0.137** (0.125-0.147)	**0.154** (0.141-0.166)	**0.168** (0.153-0.182)
4-day	**0.039** (0.036-0.041)	**0.046** (0.043-0.050)	**0.057** (0.054-0.061)	**0.066** (0.062-0.071)	**0.078** (0.072-0.083)	**0.087** (0.081-0.093)	**0.097** (0.090-0.104)	**0.107** (0.098-0.115)	**0.121** (0.110-0.130)	**0.132** (0.120-0.142)
7-day	**0.026** (0.024-0.027)	**0.031** (0.029-0.033)	**0.037** (0.035-0.040)	**0.043** (0.040-0.046)	**0.050** (0.047-0.053)	**0.056** (0.052-0.060)	**0.062** (0.057-0.066)	**0.068** (0.063-0.073)	**0.077** (0.070-0.082)	**0.083** (0.076-0.089)
10-day	**0.020** (0.019-0.022)	**0.024** (0.023-0.026)	**0.029** (0.027-0.031)	**0.033** (0.031-0.035)	**0.038** (0.036-0.041)	**0.043** (0.040-0.045)	**0.047** (0.043-0.050)	**0.051** (0.047-0.055)	**0.057** (0.052-0.061)	**0.061** (0.056-0.066)
20-day	**0.014** (0.013-0.015)	**0.016** (0.015-0.017)	**0.019** (0.018-0.020)	**0.022** (0.020-0.023)	**0.025** (0.023-0.026)	**0.027** (0.025-0.029)	**0.030** (0.028-0.032)	**0.032** (0.030-0.035)	**0.036** (0.033-0.038)	**0.039** (0.036-0.041)
30-day	**0.011** (0.011-0.012)	**0.013** (0.013-0.014)	**0.016** (0.015-0.017)	**0.017** (0.016-0.018)	**0.020** (0.018-0.021)	**0.021** (0.020-0.023)	**0.023** (0.021-0.024)	**0.025** (0.023-0.026)	**0.027** (0.025-0.029)	**0.029** (0.027-0.031)
45-day	**0.010** (0.009-0.010)	**0.011** (0.011-0.012)	**0.013** (0.012-0.014)	**0.014** (0.013-0.015)	**0.016** (0.015-0.017)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)	**0.020** (0.018-0.021)	**0.021** (0.020-0.022)	**0.022** (0.021-0.024)
60-day	**0.009** (0.008-0.009)	**0.010** (0.010-0.011)	**0.011** (0.011-0.012)	**0.013** (0.012-0.013)	**0.014** (0.013-0.015)	**0.015** (0.014-0.016)	**0.016** (0.015-0.017)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)	**0.019** (0.018-0.020)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

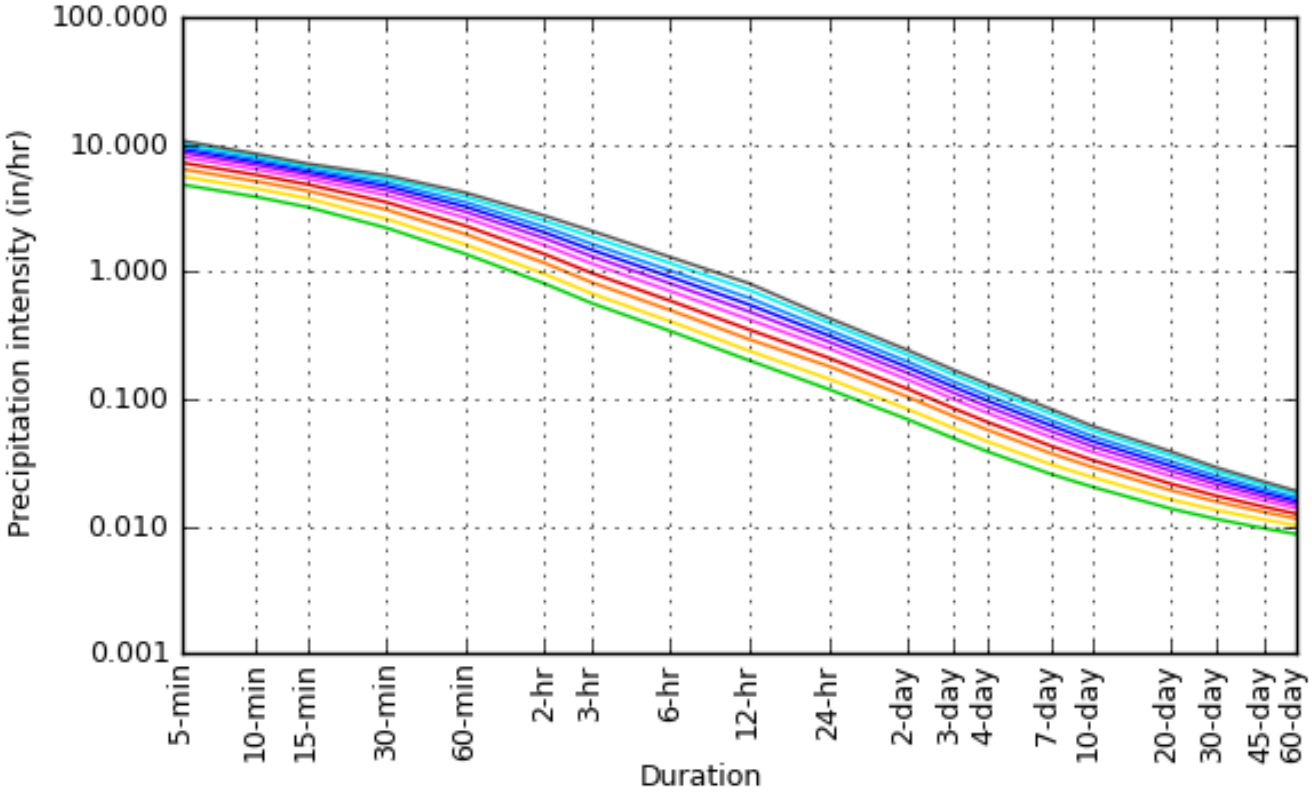
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

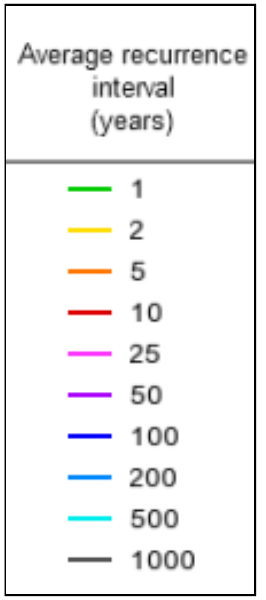
Please refer to NOAA Atlas 14 document for more information.

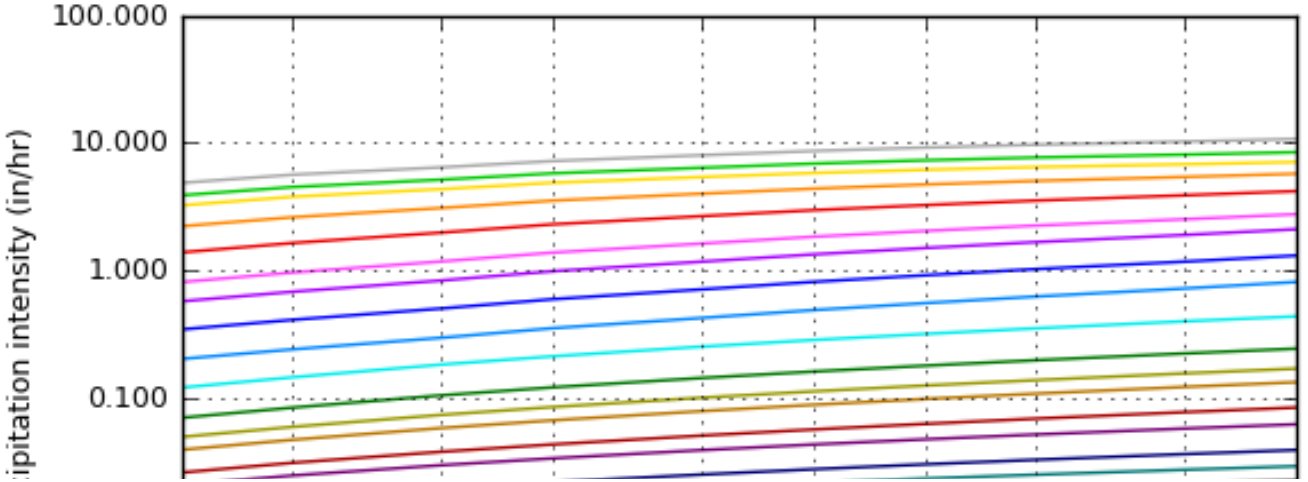
Back to Top

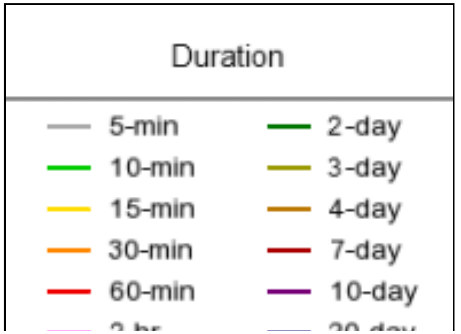
PF graphical

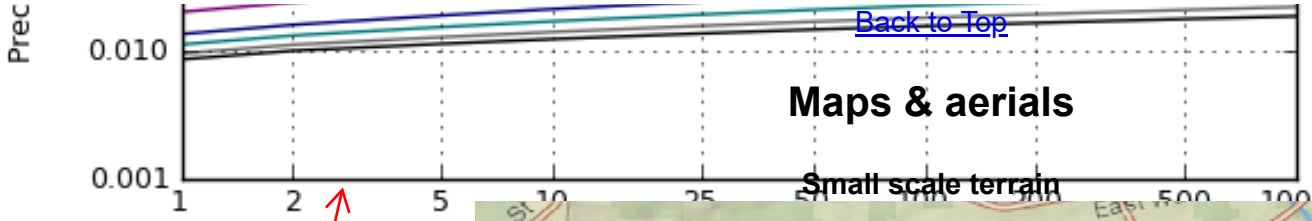
PDS-based intensity-duration-frequency (IDF) curves
Latitude: 35.9195°, Longitude: -78.4618°





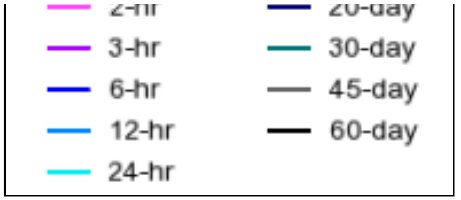






Back to Top

Maps & aerials



NOAA Atlas 14, Volume 2, Version 3

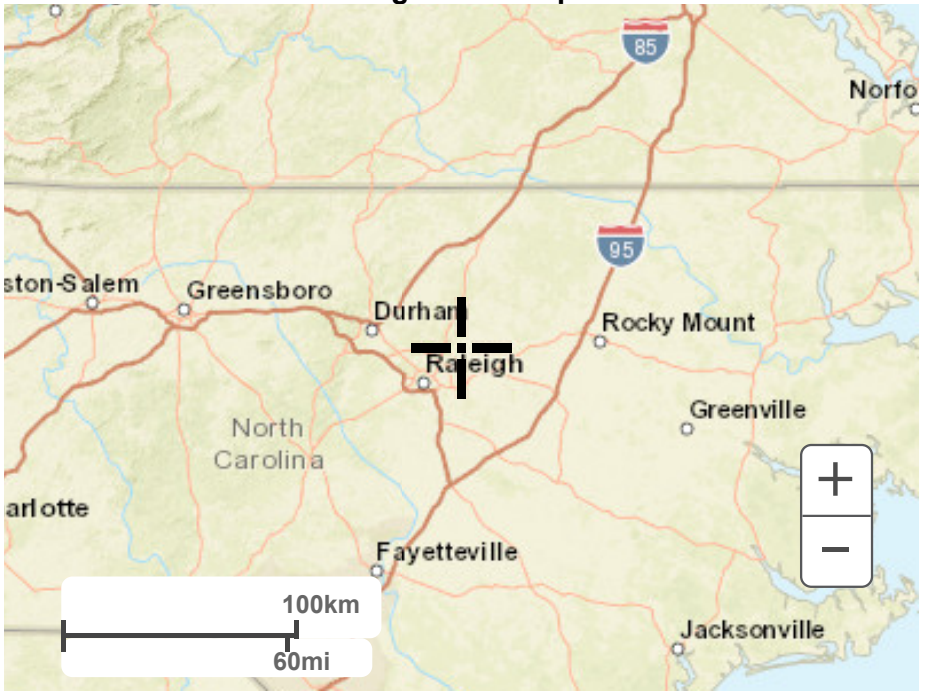
2023

#186- graph is split between two pages

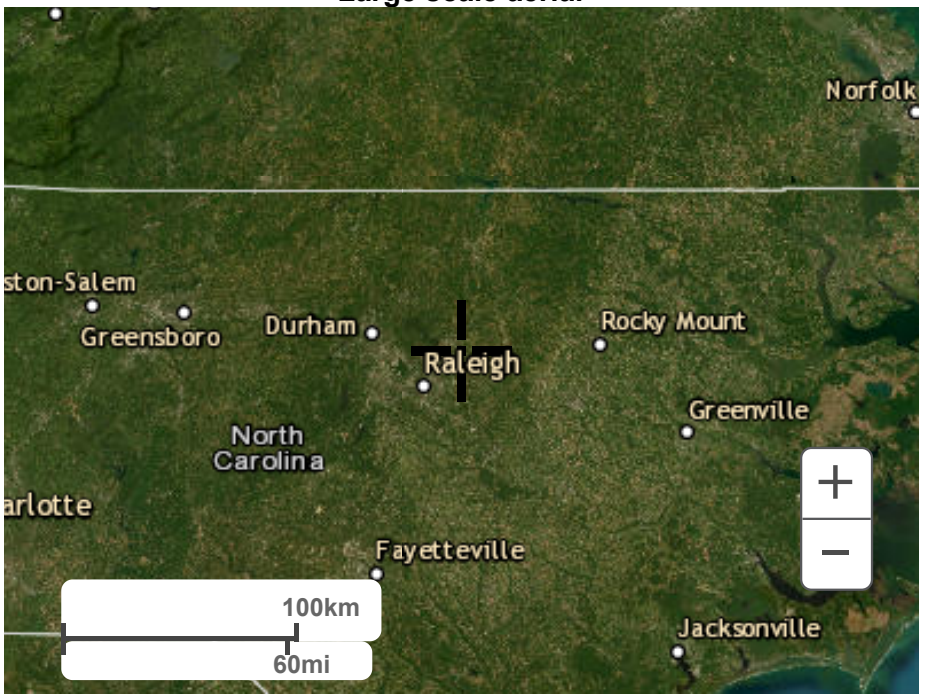
Small scale terrain

Large scale terrain

Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

ATTACHMENT 6: PRE- AND POST-DEVELOPMENT DRAINAGE AREA MAPS

NORTH

EDWARD W. SCARBORO, JR. ET AL.
WF 14-E-3861
DB 1112 PG 065
PIN# 1758998909

TOWN OF ROLESVILLE
DB 18568 PG 660
PIN# 1768098727

TOWN OF ROLESVILLE
DB 18568 PG 660
PIN# 1768094465

WAKE COUNTY BOARD OF EDUCATION
BM 2003 PG 557
PIN# 1758990785

THE TOWN OF ROLESVILLE
DB 5134 PG 618
BM 1991 PG 1333
PIN# 1758980948

REDFORD PLAZA, LLC
DB 16331 PG 976
BM 1993 PG 1381
PIN# 1758895219

REDFORD PLAZA, LLC
DB 16331 PG 976
BM 1995 PG 1400
PIN# 1758892038

REDFORD PLAZA, LLC
DB 16331 PG 976
BM 2006 PG 1022
PIN# 1758882842

REDFORD PLAZA, LLC
DB 16331 PG 976
BM 2001 PG 1114
PIN# 1758880834

THE TOWN OF ROLESVILLE
DB 5134 PG 618
BM 1991 PG 1333
PIN# 1758980948

PATSY V. YOUNG ET AL.
WF 20-E-2569
DB 9301 PG 1320
BM 1935 PG 60
PIN# 1768192148

STORAGE MAX VIII, LLC
DB 17556 PG 1235
BM 2013 PG 1030
PIN# 1758785571

STORAGE MAX II, LLC
DB 11710 PG 2072
BM 2005 PG 2354
PIN# 1758787576

DRAINAGE AREA #1
±19.90 AC
TOTAL

DRAINAGE AREA #2
±18.37 AC
TOTAL

DRAINAGE AREA #3
±43.94 AC
TOTAL

DRAINAGE AREA #4
±4.72 AC
TOTAL

CEDAR LAKES SUBDIVISION, PHASE I
BM 2008 PG 2457

WALL CREEK, PHASE I
BM 1993 PG 1086

THE VILLAGE AT ROLESVILLE
PHASE I, TRACT I
BM 2004 PG 199-201

THE VILLAGE AT ROLESVILLE, PHASE I, TRACT 2
BM 2004 PG 202-203

CEDAR LAKES HOMEOWNERS ASSOCIATION, INC.
DB 17611 PG 1888
BM 2019 PG 1539
PIN# 1768087015

CEDAR LAKES HOMEOWNERS ASSOCIATION, INC.
DB 16748 PG 219
BM 2015 PG 116-117
PIN# 1768076776

CEDAR LAKES HOMEOWNERS ASSOCIATION, INC.
DB 16748 PG 219
BM 2016 PG 1977
PIN# 1758916693

CEDAR RIDGE SUBDIVISION, PHASE 5A
BM 2016 PG 1977

CEDAR LAKES HOMEOWNERS ASSOCIATION, INC.
DB 17611 PG 1888
BM 2017 PG 678-680
PIN# 1758964943

CEDAR RIDGE SUBDIVISION
PHASE II C
BM 2015 PG 899

#187- This section is not draining towards POA #2

#187- What elevations are these contours at? Should this be a different drainage area?

POA #1

POA #2

POA #3

POA #4

ADJOINING PROPERTY OWNERS

(A) MARQUIS BRYANT
DB 17767 PG 964
BM 2015 PG 899
PIN# 1758972232

(G) GARY W. PARRISH & CHARLENE T. PARRISH
DB 10991 PG 755
BM 2004 PG 202-203
PIN# 1758878325

(M) THE VILLAGE AT ROLESVILLE HOMEOWNERS ASSOCIATION, INC.
DB 10381 PG 2701
BM 2003 PG 1124-1125
BM 2004 PG 202-203
PIN# 1758875606

(Q) DOROTHY JONES PENDER ET AL. (HEIRS OF DOROTHY D. JONES)
WF 16-E-4056
DB 1613 PG 481
PIN# 1758997386

BGE
5440 WADE PARK BLVD, SUITE 102
RALEIGH NC 27607
www.bgeinc.com
NC LICENSE #C-4397

PRE DEVELOPMENT DRAINAGE AREA

DATE: 2/6/2023

0 150' 300' 450'

SCALE: 1" = 150'

G:\NCA\Projects\Lennar\8430-03 - Lennar - School Street - Rolesville\04 - Calculations\Storm\PRE AND POST DRAINAGE AREA MAP recover.dwg

NORTH

#187- Any changes to pre-development drainage areas should be reflected in the post-development map.

#188- The drainage area routed through the ponds does not line up with the drainage areas shown on the drainage inlet map. Areas should be adjusted and updated to accurately reflect the proposed conditions.

DRAINAGE AREA #1 ±9.00 AC TOTAL

BYPASS #1 ±10.80 AC

BYPASS #1A ±0.22 AC

DRAINAGE AREA #3 ±14.11 AC TOTAL

SCM #3

BYPASS #3 ±16.68 AC

DRAINAGE AREA #4 ±11.66 AC TOTAL

SCM #4

BYPASS #4 ±0.66 AC

IRINA DRIVE

POA #4

SCM #1

DRAINAGE AREA #2 ± 19.99 AC TOTAL

BYPASS #1B ±0.08 AC

SCM #2

POA #1

POA #3

CONC

BYPASS #2 ±3.91 AC

POA #2

NOTE: BYPASS #1A & #1B WERE CALCULATED AND COMBINED WITH BYPASS #1

BGE
5440 WADE PARK BLVD, SUITE 102
RALEIGH NC 27607
www.bgeinc.com
NC LICENSE #C-4397

POST DEVELOPMENT DRAINAGE AREA

DATE: 3/29/2023

0 150' 300' 450'

SCALE: 1" = 150'

G:\NC\Projects\Lennar\8430-03 - Lennar - School Street - Rolesville\04 - Calculations\Storm\Post Drainge Area Map.dwg

ATTACHMENT 7: SCM CALCULATIONS

Project Name: Parker Ridge | Project #: 8430-03

City/State: Rolesville, NC | Date: 6/1/23

Table 1 Surface Area to Drainage Area Ratio for Permanent Pool Sizing

Piedmont and Mountain SA/DA Table (Adapted from Driscoll, 1986)

	Permanent Pool Depth (feet)					
% Impervious	3.0	4.0	5.0	6.0	7.0	8.0
10	0.51	0.43	0.37	0.30	0.27	0.25
20	0.84	0.69	0.61	0.51	0.44	0.40
30	1.17	0.94	0.84	0.72	0.61	0.56
40	1.51	1.24	1.09	0.91	0.78	0.71
50	1.79	1.51	1.31	1.13	0.95	0.87
60	2.09	1.77	1.49	1.31	1.12	1.03
70	2.51	2.09	1.80	1.56	1.34	1.17
80	2.92	2.41	2.07	1.82	1.62	1.40
90	3.25	2.64	2.31	2.04	1.84	1.59
100	3.55	2.79	2.52	2.34	2.04	1.75

Source: NCDEQ Stormwater Design Manual Minimum Design Criteria C-3 Wet Pond (4.18.2017)

Drainage Area Information

Total Drainage Area = 9.00 acres

Total Impervious Area = 5.13 acres

% Impervious Surface Area = **57.00 %**

Normal Pool Information

Minimum Required Permanent Pool Surface Area		Provided Permanent Pool Surface Area	
Avg Depth =	3.50 ft	Normal Pool Elevation =	384.5
SA/DA ratio =	1.85 *From Table 1*	Main Pool SA Provided =	**8489 sq. ft.**
			0.195 acres

$$\text{Minimum pond surface area } (SA) = \frac{DA \times SA \div DA\ ratio}{100}$$

SA = **7237 sq. ft.**

0.166 acres

Water Quality Information

1-Inch Runoff Volume Calculation (Water Quality Volume)		Provided Water Quality Volume	
Using "Simple Method" Runoff Volume Calculations		Water Quality Pool Elev =	386.00 ft
As described by Schueler (1987)		Overflow Elev =	389.00 ft
$Rv = 0.05 + 0.9 \times I$	Where: Rv = Runoff coefficient (in./in.) I = Percent impervious	Storage Volume Provided =	85656 cu. ft.
			1.966 acre-ft
Rv =	**0.56 in/in**		

Total runoff volume from 1-inch precipitation:

$$\text{Runoff Volume } (S) = \text{Design Rainfall} \times Rv \times \text{Drainage Area}$$

S = **18393 cu. ft.**

0.422 acre-ft

Using the runoff volume calculations in the "Simple Method" as described by Schueler (1987)

$$Rv = 0.05 + 0.9 \times I$$

Where: Rv= Runoff coefficient (in./in.)

I= Percent impervious

Rv = 0.05 in./in.

Total runoff volume from 1-inch precipitation:

$$\text{Runoff Volume } (S) = \text{Design Rainfall} \times Rv \times \text{Drainage Area}$$

S =	**0.422**	**acre-ft**
	18393	cu. ft.

Water quality pool elevation=	386.00	feet
Overflow elevation=	395.00	feet
Storage volume provided =	**1.567**	**acre-ft**
	68270	cu. ft.

#189- verify elevation, it appears to be too high

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

AVERAGE DEPTH

Per NCDEQ "Stormwater Design Manual" Minimum Design Criteria:

The average depth of a wet pond is to be calculated by one of these two options:

	Below Normal Pool Contours (feet)	Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	
A_{bot_pond} →	379.00	4017			
	380.00	4627	4318	4318	←Sediment Storage Volume
	381.00	5266	4943	9261	
A_{bot_shelf} →	384.00	7367	18862	28123	
A_{perm_pool} →	384.50	10590	4465	32588	←Total Pond Volume

V_{perm_pool} = Total Volume - Sediment Storage Volume = 28,269 cf

#190- The forebay area should not be included in this value. This applies to all pond calculations.

OPTION 1: Use the following equation:

$$D_{avg} = \frac{V_{perm\_pool}}{A_{perm\_pool}}$$

Where:
- D_{avg} = Average Depth (ft)
- V_{perm_pool} = Volume of Permanent Pool (ft^3)
- A_{perm_pool} = Area of Permanent Pool (ft^2)

D_{avg} = 1.54 ft

#190- Is this number correct?

OPTION 2: Use the following equation:

$$D_{avg} = 0.25 \text{ x } \left(1 + \frac{A_{bot\_shelf}}{A_{perm\_pool}}\right) + \frac{A_{bot\_shelf} + A_{bot\_pond}}{2} \text{ x } \frac{Depth}{A_{bot\_shelf}}$$

Where:
- D_{avg} = Average Depth (ft)
- A_{bot_shelf} = Area of Wet Pond at the Bottom of the Shelf (ft^2)
- A_{bot_pond} = Area of Wet Pond Bottom above Sediment Storage (ft2)
- A_{perm_pool} = Area of Permanent Pool (ft^2)
- Depth = Depth of Wet Pond from Bottom of Shelf to Sediment Storage (ft)

D_{avg} = 3.68 ft

Use Average Depth = 3.50 ft

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

FOREBAY DESIGN

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The forebay volume shall be 15-20% of the main pool.

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

70 Runoff Storage Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume	Accumulated Contour Volume	
Storage Volume	390.00	20,196	36,910	85,656	←Top of Dam
	388.00	16,767	15,946	48,746	
	387.00	15,138	14,344	32,800	
	386.00	13,565	12,800	18,456	
	385.00	12,050	5,656	5,656	
Normal Pool	384.50	10,590	0	0	←Normal Pool

70 Pond Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume (cf)	Accumulated Contour Volume (cf)	
Main Pool	384.50	8,489	3,961	32,109	←Normal Pool
	384.00	7,367	7,001	28,148	←Bottom of Litoral Shelf
	383.00	6,641	6,287	21,147	
	382.00	5,939	5,599	14,861	
	381.00	5,266	4,943	9,261	
	380.00	4,627	4,318	4,318	←Sediment Storage Volume
	379.00	4,017	0	0	←Pond Bottom
Forebay	384.50	2,101	927	5,775	←Normal Pool
	384.00	1,617	1,470	4,848	←Bottom of Litoral Shelf
	383.00	1,328	1,194	3,378	
	382.00	1,064	942	2,184	
	381.00	826	718	1,242	
	380.00	616	523	523	←Sediment Storage Volume
	379.00	436	0	0	←Forebay Bottom
Total	384.50	10,590	4,888	37,887	
	384.00	8,984	8,471	32,999	
	383.00	7,969	7,481	24,528	
	382.00	7,003	6,542	17,047	
	381.00	6,092	5,662	10,505	
	380.00	5,243	4,843	4,843	
	379.00	4,453	0	0	

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

ORIFICE CALCULATOR

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The design volume shall draw down to the permenant pool level in 2-5 days.

$$Q = C_d A\sqrt{2gh}$$

1" WATER QUALITY STORM VOLUME

Variables				**Constants**	
WQ Volume:	0.422 Acre-ft	18393 cf		g =	32.2 ft/s2
Head / Driving Head:	386.00 ft	128.67 ft		Cd=	0.6
Draw down time:	48 hrs	172800 s			
Orifice Area =	0.002 sq. ft	0.281 sq. in			
Orifice Diameter =	0.598 in				

USE 1 INCH DIAMETER ORIFICE

LEVEL SPREADER FILTER STRIP CALCULATIONS

Drawdown Rate:	0.11 cfs	
LS Length:	10 feet	(min)

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

OS-A Anti-Floatation Sizing Calulations

Outlet Structure Dimension

Inside Riser Width:	4	**ft**	**Outside Riser Width:**	5	**ft**
Wall Thickness:	6	**in**			
Top Elevation:	295	**ft**			
Invert Elevation:	386	**ft**			
Bottom Elevation:	386	**ft**			
Extended Base:	12	**in**	**Extended Base Width**	7	**ft**

Displaced Volume:	-2275	**cu ft**
Displaced Weight:	-141960	**lbs**

Volume of Actual Structure:	-819	**cu ft**
/eight of Concrete Structure:	-122850	**lbs**
›f Earth with Extended Base:	-120120	**lbs**
Weight of Extra Depth:	0	**lbs**
Total Weight of Structure:	-242970	**lbs**

#191- why are these values negative?

Factor of Safety: 1.7 OK

Project Name: Parker Ridge | Project #: 8430-03

City/State: Rolesville, NC | Date: 6/1/23

Table 1 Surface Area to Drainage Area Ratio for Permanent Pool Sizing

Piedmont and Mountain SA/DA Table (Adapted from Driscoll, 1986)

	Permanent Pool Depth (feet)					
% Impervious	3.0	4.0	5.0	6.0	7.0	8.0
10	0.51	0.43	0.37	0.30	0.27	0.25
20	0.84	0.69	0.61	0.51	0.44	0.40
30	1.17	0.94	0.84	0.72	0.61	0.56
40	1.51	1.24	1.09	0.91	0.78	0.71
50	1.79	1.51	1.31	1.13	0.95	0.87
60	2.09	1.77	1.49	1.31	1.12	1.03
70	2.51	2.09	1.80	1.56	1.34	1.17
80	2.92	2.41	2.07	1.82	1.62	1.40
90	3.25	2.64	2.31	2.04	1.84	1.59
100	3.55	2.79	2.52	2.34	2.04	1.75

Source: NCDEQ Stormwater Design Manual Minimum Design Criteria C-3 Wet Pond (4.18.2017)

Drainage Area Information

Total Drainage Area = 19.99 acres

Total Impervious Area = 10.03 acres

% Impervious Surface Area = **50.18 %**

Normal Pool Information

Minimum Required Permanent Pool Surface Area	Provided Permanent Pool Surface Area
Avg Depth = 3.50 ft	Normal Pool Elevation = 351.5
SA/DA ratio = 2.10 *From Table 1*	Main Pool SA Provided = **20453 sq. ft.**
Minimum pond surface area $(SA) = \frac{DA \times SA \div DA\ ratio}{100}$	0.470 acres
SA = 18309 sq. ft.	23801.598
0.420 acres	

Water Quality Information

1-Inch Runoff Volume Calculation (Water Quality Volume)	Provided Water Quality Volume
Using "Simple Method" Runoff Volume Calculations	Water Quality Pool Elev = 352.82 ft
As described by Schueler (1987)	Overflow Elev = 356.00 ft
$Rv = 0.05 + 0.9 \times I$ Where: Rv = Runoff coefficient (in./in.) I = Percent impervious	Storage Volume Provided = 174878 cu. ft.
Rv = 0.50 in/in	4.015 acre-ft
Total runoff volume from 1-inch precipitation:	
Runoff Volume (S) = Design Rainfall × Rv × Drainage Area	
S = 36396 cu. ft.	
0.836 acre-ft	

Using the runoff volume calculations in the "Simple Method" as described by Schueler (1987)

$Rv = 0.05 + 0.9 \times I$ Where: Rv= Runoff coefficient (in./in.)

I= Percent impervious

Rv = 0.05 in./in.

Total runoff volume from 1-inch precipitation:

Runoff Volume (S) = Design Rainfall × Rv × Drainage Area

S =	**0.836**	**acre-ft**
	36396	cu. ft.

Water quality pool elevation=	353.00	feet
Overflow elevation=	356.00	feet
Storage volume provided =	**3.000**	**acre-ft**
	130671	cu. ft.

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

AVERAGE DEPTH

Per NCDEQ "Stormwater Design Manual" Minimum Design Criteria:

The average depth of a wet pond is to be calculated by one of these two options:

	Below Normal Pool Contours (feet)	Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	
A_{bot_pond} →	346.00	12067			
	347.00	13278	12668	12668	←**Sediment Storage Volume**
	348.00	14515	13892	26560	
$A_{bot\ shelf}$ →	351.00	18375	49221	75781	
A_{perm_pool} →	351.50	25295	10872	86652	←**Total Pond Volume**

V_{perm_pool} = Total Volume - Sediment Storage Volume = 73,985 cf

OPTION 1: Use the following equation:

$$D_{avg} = \frac{V_{perm\_pool}}{A_{perm\_pool}}$$

Where: D_{avg} = Average Depth (ft)

V_{perm_pool} = Volume of Permanent Pool (ft^3)

A_{perm_pool} = Area of Permanent Pool (ft^2)

D_{avg} = 2.03 ft

OPTION 2: Use the following equation:

$$D_{avg} = 0.25 \text{ x } \left(1 + \frac{A_{bot\_shelf}}{A_{perm\_pool}}\right) + \frac{A_{bot\_shelf} + A_{bot\_pond}}{2} \text{ x } \frac{Depth}{A_{bot\_shelf}}$$

Where: D_{avg} = Average Depth (ft)

A_{bot_shelf} = Area of Wet Pond at the Bottom of the Shelf (ft^2)

A_{bot_pond} = Area of Wet Pond Bottom above Sediment Storage (ft2)

A_{perm_pool} = Area of Permanent Pool (ft^2)

Depth = Depth of Wet Pond from Bottom of Shelf to Sediment Storage (ft)

D_{avg} = 3.88 ft

Use Average Depth = 3.50 ft

Pond Volume

Project Name: **Parker Ridge** Project #: 8430-03
City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

FOREBAY DESIGN

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The forebay volume shall be 15-20% of the main pool.

Project Name: **Parker Ridge** Project #: 8430-03
City/State: Rolesville, NC Date: 6/1/23

70 Runoff Storage Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume	Accumulated Contour Volume	
Storage Volume	357.00	37,716	71,021	174,878	←Top of Dam
	355.00	33,350	32,295	103,857	
	354.00	31,251	30,224	71,562	
	353.00	29,209	28,211	41,337	
	352.00	27,224	13,127	13,127	
Normal Pool	351.50	25,295	0	0	←Normal Pool

70 Pond Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume (cf)	Accumulated Contour Volume (cf)	
Main Pool	351.50	20,429	9,696	85,528	←Normal Pool
	351.00	18,375	17,715	75,832	←Bottom of Litoral Shelf
	350.00	17,063	16,416	58,117	
	349.00	15,777	15,142	41,701	
	348.00	14,515	13,892	26,560	
	347.00	13,278	12,668	12,668	←Sediment Storage Volume
	346.00	12,067	0	0	←Pond Bottom
Forebay	351.50	4,866	2,162	12,752	←Normal Pool
	351.00	3,805	3,432	10,590	←Bottom of Litoral Shelf
	350.00	3,073	2,724	7,157	
	349.00	2,390	2,067	4,433	
	348.00	1,760	1,461	2,366	
	347.00	1,181	905	905	←Sediment Storage Volume
	346.00	655	0	0	←Forebay Bottom
Total	351.50	25,295	11,860	98,305	
	351.00	22,180	21,150	86,444	
	350.00	20,136	19,143	65,295	
	349.00	18,167	17,212	46,152	
	348.00	16,275	15,358	28,939	
	347.00	14,459	13,581	13,581	
	346.00	12,722	0	0	

#192- Forebay volume should be 15-20% of the volume in the main pool

Orifice Calculator-LS Calc

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

ORIFICE CALCULATOR

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The design volume shall draw down to the permenant pool level in 2-5 days.

$$Q = C_d A\sqrt{2gh}$$

1" WATER QUALITY STORM VOLUME

Variables				**Constants**	
WQ Volume:	0.836 Acre-ft	36396 cf		g =	32.2 ft/s2
Head / Driving Head:	353.00 ft	117.67 ft		Cd=	0.6
Draw down time:	48 hrs	172800 s			
Orifice Area =	0.004 sq. ft	0.581 sq. in			
Orifice Diameter =	0.860 in				

USE 1 INCH DIAMETER ORIFICE

LEVEL SPREADER FILTER STRIP CALCULATIONS

Drawdown Rate:	0.21 cfs	
LS Length:	10 feet	(min)

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

OS-A Anti-Floatation Sizing Calulations

Outlet Structure Dimension

Inside Riser Width:	4	**ft**	**Outside Riser Width:**	5	**ft**
Wall Thickness:	6	**in**			
Top Elevation:	356	**ft**			
Invert Elevation:	347	**ft**			
Bottom Elevation:	347	**ft**			
Extended Base:	12	**in**	**Extended Base Width**	7	**ft**

Displaced Volume:	225	**cu ft**
Displaced Weight:	14040	**lbs**

Volume of Actual Structure:	81	**cu ft**
/eight of Concrete Structure:	12150	**lbs**
›f Earth with Extended Base:	11880	**lbs**
Weight of Extra Depth:	0	**lbs**
Total Weight of Structure:	24030	**lbs**

Factor of Safety:	1.7	OK

Project Name: Parker Ridge
City/State: Rolesville, NC

Project #: 8430-03
Date: 6/1/23

Table 1 Surface Area to Drainage Area Ratio for Permanent Pool Sizing
Piedmont and Mountain SA/DA Table (Adapted from Driscoll, 1986)

	Permanent Pool Depth (feet)					
% Impervious	3.0	4.0	5.0	6.0	7.0	8.0
10	0.51	0.43	0.37	0.30	0.27	0.25
20	0.84	0.69	0.61	0.51	0.44	0.40
30	1.17	0.94	0.84	0.72	0.61	0.56
40	1.51	1.24	1.09	0.91	0.78	0.71
50	1.79	1.51	1.31	1.13	0.95	0.87
60	2.09	1.77	1.49	1.31	1.12	1.03
70	2.51	2.09	1.80	1.56	1.34	1.17
80	2.92	2.41	2.07	1.82	1.62	1.40
90	3.25	2.64	2.31	2.04	1.84	1.59
100	3.55	2.79	2.52	2.34	2.04	1.75

Source: NCDEQ Stormwater Design Manual Minimum Design Criteria C-3 Wet Pond (4.18.2017)

Drainage Area Information

Total Drainage Area =	14.11 acres
Total Impervious Area =	4.65 acres
% Impervious Surface Area =	**32.96 %**

Input
Output

Normal Pool Information

Minimum Required Permanent Pool Surface Area

Avg Depth = 3.50 ft

SA/DA ratio = 1.15 *From Table 1*

$$\text{Minimum pond surface area } (SA) = \frac{DA \times SA \div DA\ ratio}{100}$$

SA = 7066 sq. ft.
0.162 acres

Provided Permanent Pool Surface Area

Normal Pool Elevation = 384.5
Main Pool SA Provided = **7226 sq. ft.**
0.166 acres

Water Quality Information

1-Inch Runoff Volume Calculation (Water Quality Volume)

Using "Simple Method" Runoff Volume Calculations

As described by Schueler (1987)

$$Rv = 0.05 + 0.9 \times I$$

Where: Rv = Runoff coefficient (in./in.)
I = Percent impervious

Rv = 0.35 in/in

Total runoff volume from 1-inch precipitation:

$$\text{Runoff Volume } (S) = \text{Design Rainfall} \times Rv \times \text{Drainage Area}$$

S = 17753 cu. ft.
0.408 acre-ft

Provided Water Quality Volume

Water Quality Pool Elev = 386.15 ft
Overflow Elev = 389.00 ft
Storage Volume Provided = 72444 cu. ft.
1.663 acre-ft

Using the runoff volume calculations in the "Simple Method" as described by Schueler (1987)

$$Rv = 0.05 + 0.9 \times I$$

Where: Rv= Runoff coefficient (in./in.)
I= Percent impervious

Rv = 0.05 in./in.

Total runoff volume from 1-inch precipitation:

$$\text{Runoff Volume } (S) = \text{Design Rainfall} \times Rv \times \text{Drainage Area}$$

S = 0.408 acre-ft
17753 cu. ft.

Water quality pool elevation= 386.15 feet
Overflow elevation= 389.00 feet
Storage volume provided = **1.543 acre-ft**
67231 cu. ft.

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

AVERAGE DEPTH

Per NCDEQ "Stormwater Design Manual" Minimum Design Criteria:

The average depth of a wet pond is to be calculated by one of these two options:

	Below Normal Pool Contours (feet)	Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	
A_{bot_pond} →	379.00	3496			
	380.00	4003	3747	3747	←**Sediment Storage Volume**
	381.00	4531	4264	8011	
A_{bot_shelf} →	384.00	6265	16124	24135	
A_{perm_pool} →	384.50	9342	3876	28011	←**Total Pond Volume**

V_{perm_pool} = Total Volume - Sediment Storage Volume = 24,264 cf

OPTION 1: Use the following equation:

$$D_{avg} = \frac{V_{perm\_pool}}{A_{perm\_pool}}$$

Where:
- D_{avg} = Average Depth (ft)
- V_{perm_pool} = Volume of Permanent Pool (ft^3)
- A_{perm_pool} = Area of Permanent Pool (ft^2)

D_{avg} = 1.37 ft ← #190- is this correct?

OPTION 2: Use the following equation:

$$D_{avg} = 0.25 \text{ x } \left(1 + \frac{A_{bot\_shelf}}{A_{perm\_pool}}\right) + \frac{A_{bot\_shelf} + A_{bot\_pond}}{2} \text{ x } \frac{Depth}{A_{bot\_shelf}}$$

Where:
- D_{avg} = Average Depth (ft)
- A_{bot_shelf} = Area of Wet Pond at the Bottom of the Shelf (ft^2)
- A_{bot_pond} = Area of Wet Pond Bottom above Sediment Storage (ft2)
- A_{perm_pool} = Area of Permanent Pool (ft^2)
- Depth = Depth of Wet Pond from Bottom of Shelf to Sediment Storage (ft)

D_{avg} = 3.70 ft

Use Average Depth = 3.50 ft

Project Name: **Parker Ridge** Project #: 8430-03
City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area = 14.11

FOREBAY DESIGN

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The forebay volume shall be 15-20% of the main pool.

Project Name: **Parker Ridge Subdivision** Project #: 8430-03
City/State: Rolesville, NC Date: 6/1/23

70 Runoff Storage Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume	Accumulated Contour Volume	
Storage Volume	390.00	16,783	30,829	72,444	←Top of Dam
	388.00	14,086	13,446	41,614	
	387.00	12,816	12,204	28,168	
	386.00	11,603	11,019	15,964	
	385.00	10,446	4,944	4,944	
Normal Pool	384.50	9,342	0	0	←Normal Pool

70 Pond Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume	Accumulated Contour Volume	
Main Pool	384.50	7,226	3,370	27,517	←Normal Pool
	384.00	6,265	5,961	24,147	←Bottom of Litoral Shelf
	383.00	5,662	5,370	18,186	
	382.00	5,084	4,805	12,816	
	381.00	4,531	4,264	8,011	
	380.00	4,003	3,747	3,747	←Sediment Storage Volume
	379.00	3,496	0	0	←Pond Bottom
Forebay	384.50	2,116	927	5,417	←Normal Pool
	384.00	1,604	1,445	4,490	←Bottom of Litoral Shelf
	383.00	1,292	1,143	3,045	
	382.00	1,000	866	1,902	
	381.00	738	622	1,037	
	380.00	512	415	415	←Sediment Storage Volume
	379.00	325	0	0	←Forebay Bottom
Total	384.50	9,342	4,297	32,940	
	384.00	7,869	7,407	28,643	
	383.00	6,954	6,514	21,236	
	382.00	6,084	5,672	14,722	
	381.00	5,269	4,887	9,050	
	380.00	4,515	4,163	4,163	
	379.00	3,821	0	0	

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

ORIFICE CALCULATOR

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The design volume shall draw down to the permenant pool level in 2-5 days.

$$Q = C_d A\sqrt{2gh}$$

1" WATER QUALITY STORM VOLUME

Variables					**Constants**		
WQ Volume:	0.408	Acre-ft	17753	cf	g =	32.2	ft/s2
Head / Driving Head:	386.15	ft	128.72	ft	Cd=	0.6	
Draw down time:	48	hrs	172800	s			
Orifice Area =	0.002	sq. ft	0.271	sq. in			
Orifice Diameter =	0.587	in					

USE 1 INCH DIAMETER ORIFICE

LEVEL SPREADER FILTER STRIP CALCULATIONS

Drawdown Rate:	0.10	cfs	
LS Length:	10	feet	(min)

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

OS-A Anti-Floatation Sizing Calulations

Outlet Structure Dimension

Inside Riser Width:	4	**ft**	**Outside Riser Width:**	5	**ft**
Wall Thickness:	6	**in**			
Top Elevation:	389	**ft**			
Invert Elevation:	380	**ft**			
Bottom Elevation:	380	**ft**			
Extended Base:	12	**in**	**Extended Base Width**	7	**ft**

Displaced Volume:	225	**cu ft**
Displaced Weight:	14040	**lbs**
Volume of Actual Structure:	81	**cu ft**
/eight of Concrete Structure:	12150	**lbs**
›f Earth with Extended Base:	11880	**lbs**
Weight of Extra Depth:	0	**lbs**
Total Weight of Structure:	24030	**lbs**
Factor of Safety:	1.7	OK

Project Name: Parker Ridge
City/State: Rolesville, NC

Project #: 8430-03
Date: 6/1/23

Table 1 Surface Area to Drainage Area Ratio for Permanent Pool Sizing
Piedmont and Mountain SA/DA Table (Adapted from Driscoll, 1986)

	Permanent Pool Depth (feet)					
% Impervious	3.0	4.0	5.0	6.0	7.0	8.0
10	0.51	0.43	0.37	0.30	0.27	0.25
20	0.84	0.69	0.61	0.51	0.44	0.40
30	1.17	0.94	0.84	0.72	0.61	0.56
40	1.51	1.24	1.09	0.91	0.78	0.71
50	1.79	1.51	1.31	1.13	0.95	0.87
60	2.09	1.77	1.49	1.31	1.12	1.03
70	2.51	2.09	1.80	1.56	1.34	1.17
80	2.92	2.41	2.07	1.82	1.62	1.40
90	3.25	2.64	2.31	2.04	1.84	1.59
100	3.55	2.79	2.52	2.34	2.04	1.75

Source: NCDEQ Stormwater Design Manual Minimum Design Criteria C-3 Wet Pond (4.18.2017)

Drainage Area Information

Total Drainage Area = 11.66 acres
Total Impervious Area = 5.02 acres
% Impervious Surface Area = **43.05 %**

Input
Output

Normal Pool Information

Minimum Required Permanent Pool Surface Area		Provided Permanent Pool Surface Area	
Avg Depth =	3.50 ft	Normal Pool Elevation =	380.5
SA/DA ratio =	2.00 *From Table 1*	Main Pool SA Provided =	**12694 sq. ft.**
			0.291 acres

$$\text{Minimum pond surface area } (SA) = \frac{DA \times SA \div DA\ ratio}{100}$$

SA = **10172 sq. ft.**
0.234 acres

Water Quality Information

1-Inch Runoff Volume Calculation (Water Quality Volume)		Provided Water Quality Volume	
Using "Simple Method" Runoff Volume Calculations		Water Quality Pool Elev =	381.63 ft
As described by Schueler (1987)		Overflow Elev =	385.00 ft
$Rv = 0.05 + 0.9 \times I$	Where: Rv = Runoff coefficient (in./in.)	Storage Volume Provided =	110199 cu. ft.
	I = Percent impervious		2.530 acre-ft
Rv = **0.44 in/in**			

Total runoff volume from 1-inch precipitation:

$$\text{Runoff Volume } (S) = \text{Design Rainfall} \times Rv \times \text{Drainage Area}$$

S = **18517 cu. ft.**
0.425 acre-ft

Using the runoff volume calculations in the "Simple Method" as described by Schueler (1987)

$$Rv = 0.05 + 0.9 \times I$$

Where: Rv= Runoff coefficient (in./in.)
I= Percent impervious

Rv = 0.05 in./in.

Total runoff volume from 1-inch precipitation:

$$\text{Runoff Volume } (S) = \text{Design Rainfall} \times Rv \times \text{Drainage Area}$$

S = **0.425** **acre-ft**
18517 cu. ft.

Water quality pool elevation= 381.66 feet
Overflow elevation= 386.00 feet
Storage volume provided = **2.522** **acre-ft**
109845 cu. ft.

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

AVERAGE DEPTH

Per NCDEQ "Stormwater Design Manual" Minimum Design Criteria:

The average depth of a wet pond is to be calculated by one of these two options:

	Below Normal Pool Contours (feet)	Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	
A_{bot_pond} →	375.00	5005			
	376.00	5657	5328	5328	←**Sediment Storage Volume**
	377.00	6334	5992	11320	
A_{bot_shelf} →	380.00	8517	22196	33516	
A_{perm_pool} →	380.50	14636	5720	39235	←**Total Pond Volume**

V_{perm_pool} = Total Volume - Sediment Storage Volume = 33,908 cf

OPTION 1: Use the following equation:

$$D_{avg} = \frac{V_{perm\_pool}}{A_{perm\_pool}}$$

Where:
D_{avg} = Average Depth (ft)
V_{perm_pool} = Volume of Permanent Pool (ft^3)
A_{perm_pool} = Area of Permanent Pool (ft^2)

D_{avg} = 1.83 ft

OPTION 2: Use the following equation:

$$D_{avg} = 0.25 \text{ x } \left(1 + \frac{A_{bot\_shelf}}{A_{perm\_pool}}\right) + \frac{A_{bot\_shelf} + A_{bot\_pond}}{2} \text{ x } \frac{Depth}{A_{bot\_shelf}}$$

Where:
D_{avg} = Average Depth (ft)
A_{bot_shelf} = Area of Wet Pond at the Bottom of the Shelf (ft^2)
A_{bot_pond} = Area of Wet Pond Bottom above Sediment Storage (ft2)
A_{perm_pool} = Area of Permanent Pool (ft^2)
Depth = Depth of Wet Pond from Bottom of Shelf to Sediment Storage (ft)

D_{avg} = 3.72 ft

Use Average Depth = 3.50 ft

Project Name: **Parker Ridge** Project #: 8430-03
City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area = 11.66

FOREBAY DESIGN

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The forebay volume shall be 15-20% of the main pool

Project Name: **Parker Ridge** Project #: 8430-03
City/State: Rolesville, NC Date: 6/1/23

70 Runoff Storage Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume	Accumulated Contour Volume	
Storage Volume	386.00	24,300	45,794	110,199	←Top of Dam
	384.00	21,522	20,622	64,405	
	383.00	19,735	18,863	43,783	
	382.00	18,005	17,175	24,919	
	381.00	16,358	7,745	7,745	
Normal Pool	380.50	14,636	0	0	←Normal Pool

70 Pond Volume Information

Pond Area	Countour Elevation (ft)	Contour Area (sf)	Incremental Contour Volume	Accumulated Contour Volume	
Main Pool	380.50	10,441	4,731	38,269	←Normal Pool
	380.00	8,517	8,138	33,538	←Bottom of Litoral Shelf
	379.00	7,764	7,398	25,400	
	378.00	7,037	6,682	18,002	
	377.00	6,334	5,992	11,320	
	376.00	5,657	5,328	5,328	←Sediment Storage Volume
	375.00	5,005	0	0	←Pond Bottom
Forebay	380.50	4,195	1,510	7,831	←Normal Pool
	380.00	1,981	1,821	6,321	←Bottom of Litoral Shelf
	379.00	1,665	1,517	4,500	
	378.00	1,374	1,239	2,983	
	377.00	1,109	986	1,744	
	376.00	868	758	758	←Sediment
	375.00	653	0	0	←Forebay B
Total	380.50	14,636	6,255	46,116	
	380.00	10,498	9,959	39,861	
	379.00	9,429	8,915	29,903	
	378.00	8,411	7,922	20,987	
	377.00	7,443	6,979	13,065	
	376.00	6,525	6,086	6,086	
	375.00	5,658	0	0	

#193- verify both forebays are being included in these values and that the main pool value is correct.

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

ORIFICE CALCULATOR

Per NCDEQ "*Stormwater Design Manual* " Minimum Design Criteria:

The design volume shall draw down to the permenant pool level in 2-5 days.

$$Q = C_d A\sqrt{2gh}$$

1" WATER QUALITY STORM VOLUME

Variables					**Constants**		
WQ Volume:	0.425	Acre-ft	18517	cf	g =	32.2	ft/s2
Head / Driving Head:	381.66	ft	127.22	ft	Cd=	0.6	
Draw down time:	48	hrs	172800	s			
Orifice Area =	0.002	sq. ft	0.284	sq. in			
Orifice Diameter =	0.601	in					

USE 1 INCH DIAMETER ORIFICE

LEVEL SPREADER FILTER STRIP CALCULATIONS

Drawdown Rate:	0.11	cfs	
LS Length:	10	feet	(min)

Project Name: **Parker Ridge** Project #: 8430-03

City/State: Rolesville, NC Date: 6/1/23

Total Drainage Area =

OS-A Anti-Floatation Sizing Calulations

Outlet Structure Dimension

Inside Riser Width:	4	**ft**	**Outside Riser Width:**	5 **ft**
Wall Thickness:	6	**in**		
Top Elevation:	386	**ft**		
Invert Elevation:	377	**ft**		
Bottom Elevation:	377	**ft**		
Extended Base:	12	**in**	**Extended Base Width**	7 **ft**

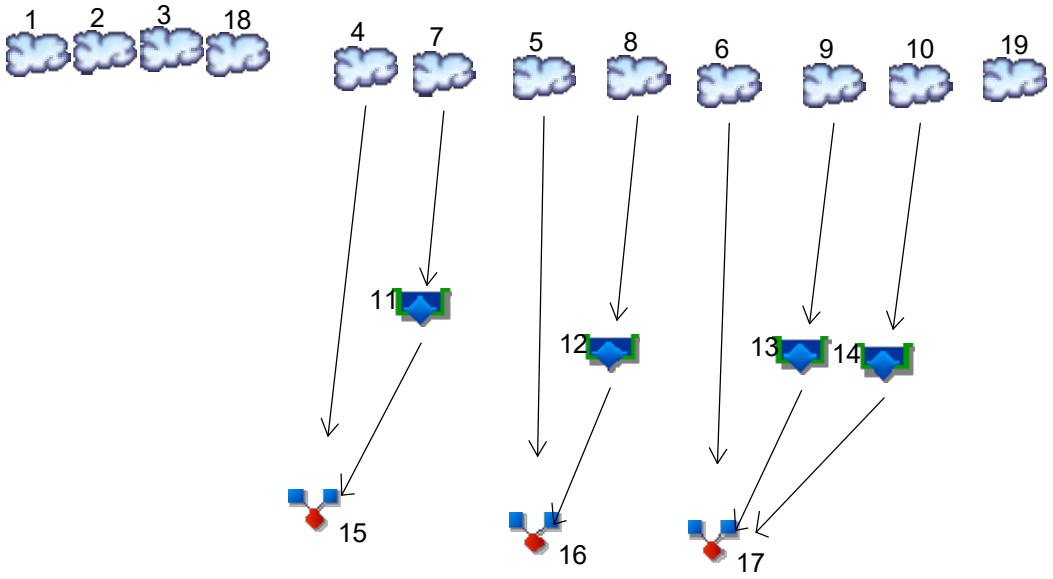
Displaced Volume:	225	**cu ft**
Displaced Weight:	14040	**lbs**
Volume of Actual Structure:	81	**cu ft**
/eight of Concrete Structure:	12150	**lbs**
›f Earth with Extended Base:	11880	**lbs**
Weight of Extra Depth:	0	**lbs**
Total Weight of Structure:	24030	**lbs**
Factor of Safety:	1.7	OK

Hydraflow Table of Contents

SCMs.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Thursday, 06 / 1 / 2023

Watershed Model Schematic

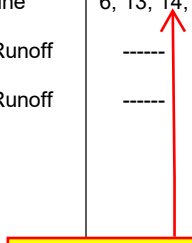


Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre POA #3
2	SCS Runoff	Pre POA #2
3	SCS Runoff	Pre POA #1
4	SCS Runoff	Bypass #1
5	SCS Runoff	Bypass #2
6	SCS Runoff	Bypass #3
7	SCS Runoff	Post DA #1
8	SCS Runoff	Post DA #2
9	SCS Runoff	Post DA #3
10	SCS Runoff	Post DA #4
11	Reservoir	SCM 1 ROUTE
12	Reservoir	SCM 2 ROUTE
13	Reservoir	SCM 3 ROUTE
14	Reservoir	SCM 4 ROUTE
15	Combine	Post POA 1
16	Combine	Post POA #2
17	Combine	Post POA #3
18	SCS Runoff	Pre POA #4
19	SCS Runoff	Bypass #4 - POST POA #4

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	SCS Runoff	------	81.28	113.63	-------	-------	208.92	268.97	-------	367.67	Pre POA #3
2	SCS Runoff	------	41.38	56.14	-------	-------	97.64	123.08	-------	164.45	Pre POA #2
3	SCS Runoff	------	34.25	48.19	-------	-------	89.35	115.26	-------	157.92	Pre POA #1
4	SCS Runoff	------	17.16	24.31	-------	-------	45.43	58.71	-------	80.61	Bypass #1
5	SCS Runoff	------	7.509	10.26	-------	-------	17.99	22.75	-------	30.50	Bypass #2
6	SCS Runoff	------	25.79	36.53	-------	-------	68.27	88.23	-------	121.13	Bypass #3
7	SCS Runoff	------	21.01	27.63	-------	-------	45.78	56.75	-------	74.50	Post DA #1
8	SCS Runoff	------	46.66	61.38	-------	-------	101.68	126.05	-------	165.46	Post DA #2
9	SCS Runoff	------	31.44	41.74	-------	-------	70.10	87.32	-------	115.21	Post DA #3
10	SCS Runoff	------	25.98	34.49	-------	-------	57.93	72.16	-------	95.20	Post DA #4
11	Reservoir	7	2.197	4.714	-------	-------	23.27	41.57	-------	57.41	SCM 1 ROUTE
12	Reservoir	8	3.529	6.867	-------	-------	45.89	68.54	-------	117.84	SCM 2 ROUTE
13	Reservoir	9	6.102	20.62	-------	-------	56.26	75.29	-------	105.11	SCM 3 ROUTE
14	Reservoir	10	2.880	5.717	-------	-------	23.34	45.90	-------	69.40	SCM 4 ROUTE
15	Combine	4, 11,	17.23	25.82	-------	-------	54.36	91.11	-------	134.51	Post POA 1
16	Combine	5, 12,	7.821	12.53	-------	-------	54.59	82.69	-------	140.19	Post POA #2
17	Combine	6, 13, 14,	28.10	47.73	-------	-------	131.98	192.53	-------	286.72	Post POA #3
18	SCS Runoff	------	10.04	14.02	-------	-------	25.45	32.66	-------	44.48	Pre POA #4
19	SCS Runoff	------	1.021	1.446	-------	-------	2.701	3.491	-------	4.793	Bypass #4 - POST POA #4



#194- why is 14 included in this?

#195- Where is the combined Post POA #4?

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

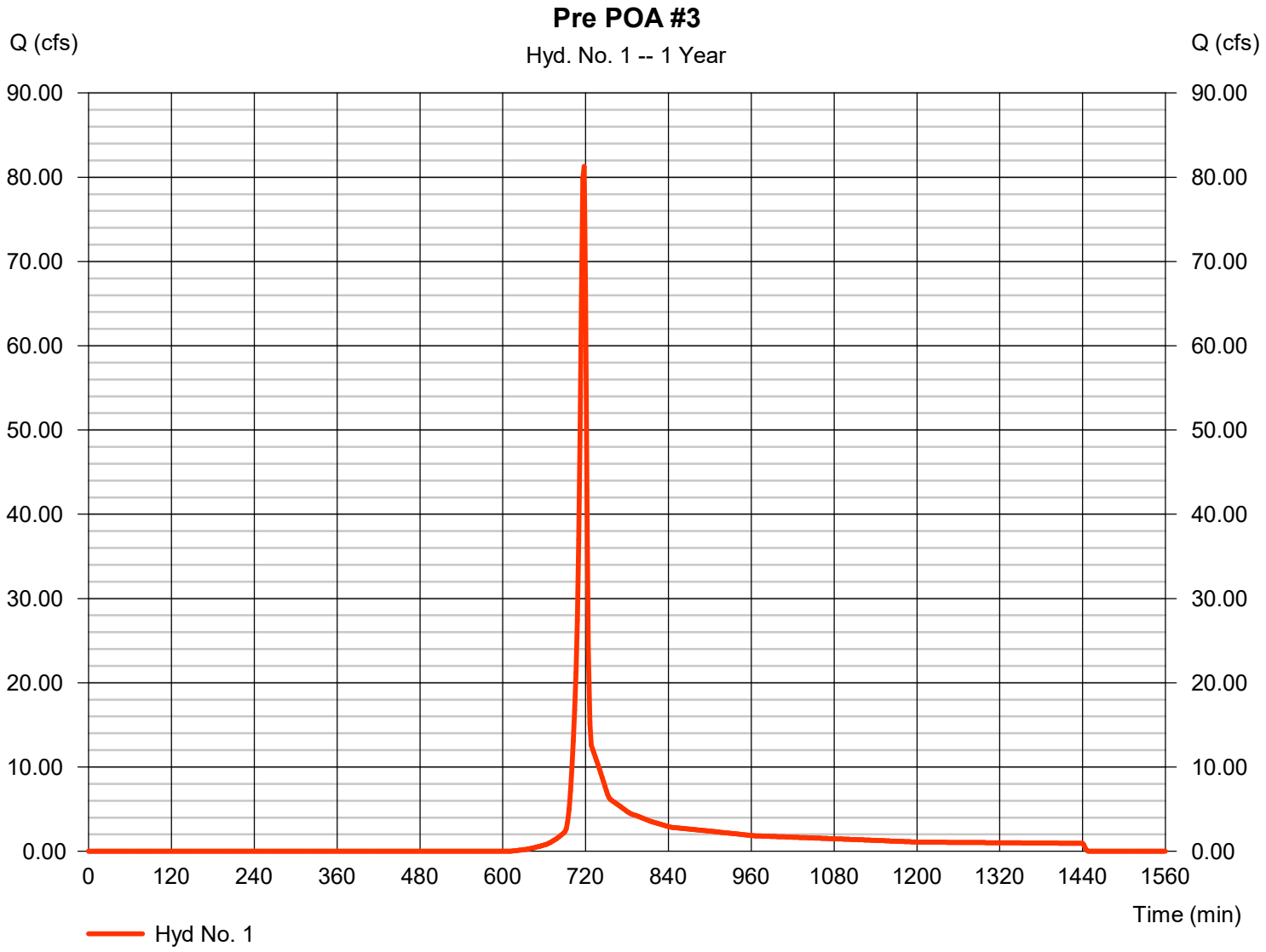
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	81.28	2	718	162,567	------	------	------	Pre POA #3
2	SCS Runoff	41.38	2	718	83,440	------	------	------	Pre POA #2
3	SCS Runoff	34.25	2	720	78,533	------	------	------	Pre POA #1
4	SCS Runoff	17.16	2	722	45,174	------	------	------	Bypass #1
5	SCS Runoff	7.509	2	720	19,536	------	------	------	Bypass #2
6	SCS Runoff	25.79	2	722	67,883	------	------	------	Bypass #3
7	SCS Runoff	21.01	2	720	54,494	------	------	------	Post DA #1
8	SCS Runoff	46.66	2	720	121,037	------	------	------	Post DA #2
9	SCS Runoff	31.44	2	720	81,511	------	------	------	Post DA #3
10	SCS Runoff	25.98	2	720	67,358	------	------	------	Post DA #4
11	Reservoir	2.197	2	754	36,026	7	386.76	29,313	SCM 1 ROUTE
12	Reservoir	3.529	2	774	89,949	8	353.88	67,960	SCM 2 ROUTE
13	Reservoir	6.102	2	736	61,876	9	387.80	38,885	SCM 3 ROUTE
14	Reservoir	2.880	2	754	49,283	10	382.54	35,048	SCM 4 ROUTE
15	Combine	17.23	2	722	81,200	4, 11,	------	------	Post POA 1
16	Combine	7.821	2	722	109,485	5, 12,	------	------	Post POA #2
17	Combine	28.10	2	722	179,042	6, 13, 14,	------	------	Post POA #3
18	SCS Runoff	10.04	1	716	17,463	------	------	------	Pre POA #4
19	SCS Runoff	1.021	2	722	2,686	------	------	------	Bypass #4 - POST POA #4

Hydrograph Report

Hyd. No. 1

Pre POA #3

Hydrograph type	=	SCS Runoff	Peak discharge	=	81.28 cfs
Storm frequency	=	1 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	162,567 cuft
Drainage area	=	43.940 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	3.10 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No. 1

Pre POA #3

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.20		0.00		0.00		
Land slope (%)	= 7.06		0.00		0.00		
Travel Time (min)	**= 2.12**	**+**	**0.00**	**+**	**0.00**	**=**	**2.12**
Shallow Concentrated Flow							
Flow length (ft)	= 193.00		0.00		0.00		
Watercourse slope (%)	= 4.30		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=4.22		0.00		0.00		
Travel Time (min)	**= 0.76**	**+**	**0.00**	**+**	**0.00**	**=**	**0.76**
Channel Flow							
X sectional flow area (sqft)	= 30.00		0.00		0.00		
Wetted perimeter (ft)	= 16.00		0.00		0.00		
Channel slope (%)	= 5.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=33.84						
			0.00				
					0.00		
Flow length (ft)	({0})500.0		0.0		0.0		
Travel Time (min)	**= 0.25**	**+**	**0.00**	**+**	**0.00**	**=**	**0.25**

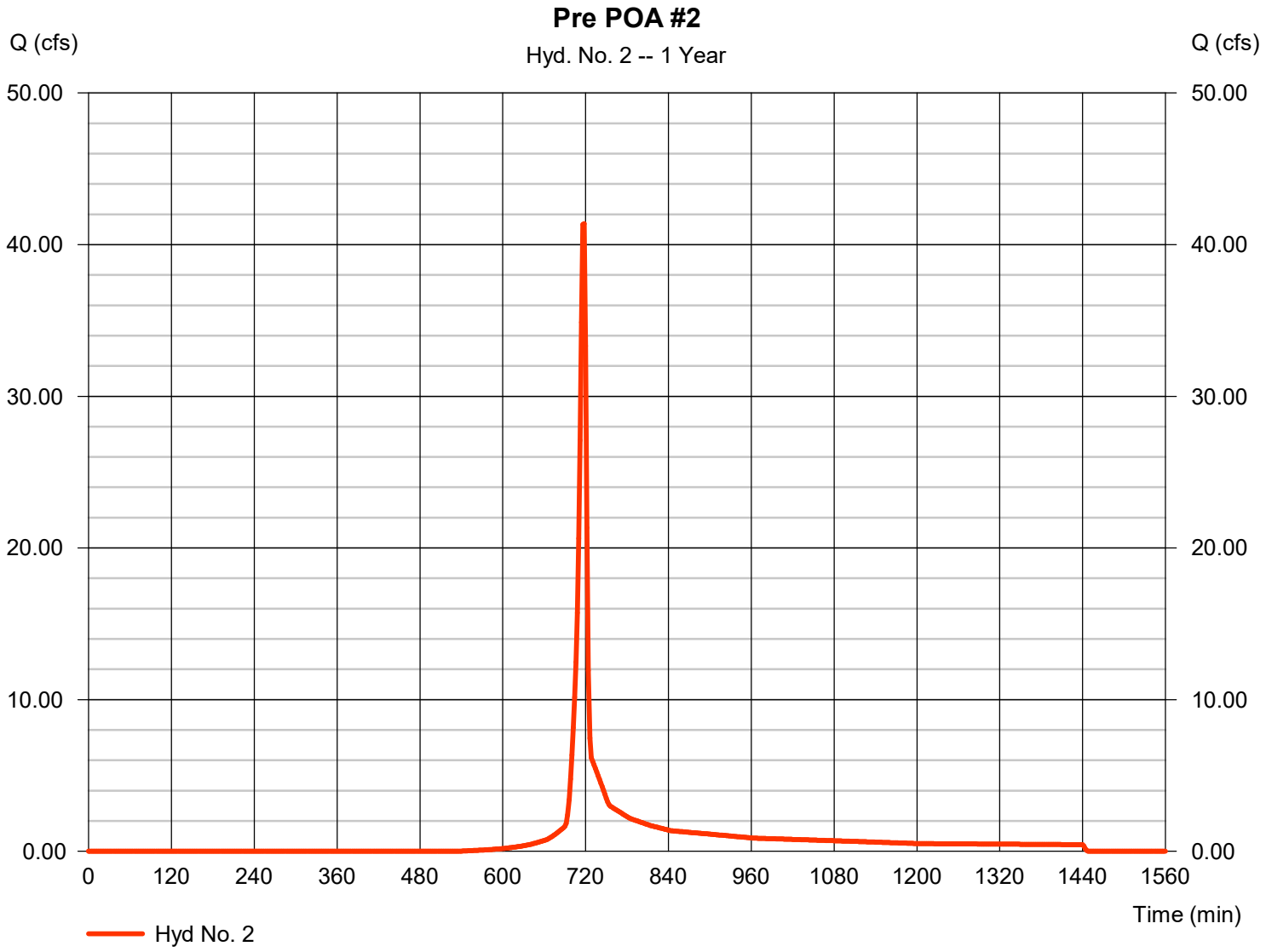
Total Travel Time, Tc ..... 3.10 min

Hydrograph Report

Hyd. No. 2

Pre POA #2

Hydrograph type	= SCS Runoff	Peak discharge	= 41.38 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 83,440 cuft
Drainage area	= 18.370 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.60 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 2

Pre POA #2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.20		0.00		0.00		
Land slope (%)	= 3.80		0.00		0.00		
Travel Time (min)	**= 2.72**	**+**	**0.00**	**+**	**0.00**	**=**	**2.72**
Shallow Concentrated Flow							
Flow length (ft)	= 850.00		0.00		0.00		
Watercourse slope (%)	= 6.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=4.98		0.00		0.00		
Travel Time (min)	**= 2.85**	**+**	**0.00**	**+**	**0.00**	**=**	**2.85**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

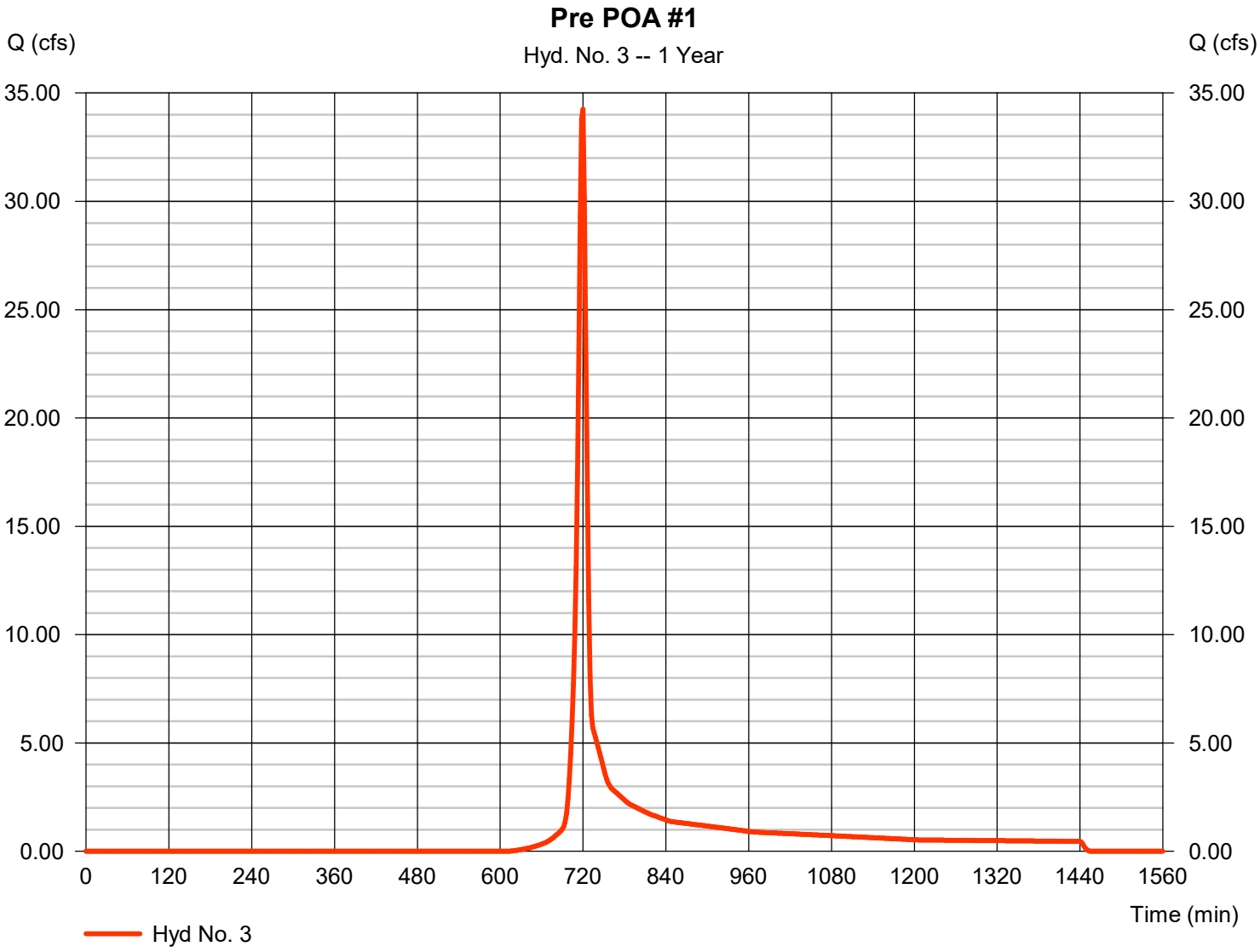
Total Travel Time, Tc ..... 5.60 min

Hydrograph Report

Hyd. No. 3

Pre POA #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	34.25 cfs
Storm frequency	=	1 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	78,533 cuft
Drainage area	=	19.900 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	9.70 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 3

Pre POA #1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.20		0.00		0.00		
Land slope (%)	= 4.60		0.00		0.00		
Travel Time (min)	**= 2.52**	**+**	**0.00**	**+**	**0.00**	**=**	**2.52**
Shallow Concentrated Flow							
Flow length (ft)	= 150.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 0.83**	**+**	**0.00**	**+**	**0.00**	**=**	**0.83**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 20.00		0.00		0.00		
Channel slope (%)	= 1.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=8.55						
			0.00				
					0.00		
Flow length (ft)	({0})3240.0		0.0		0.0		
Travel Time (min)	**= 6.31**	**+**	**0.00**	**+**	**0.00**	**=**	**6.31**

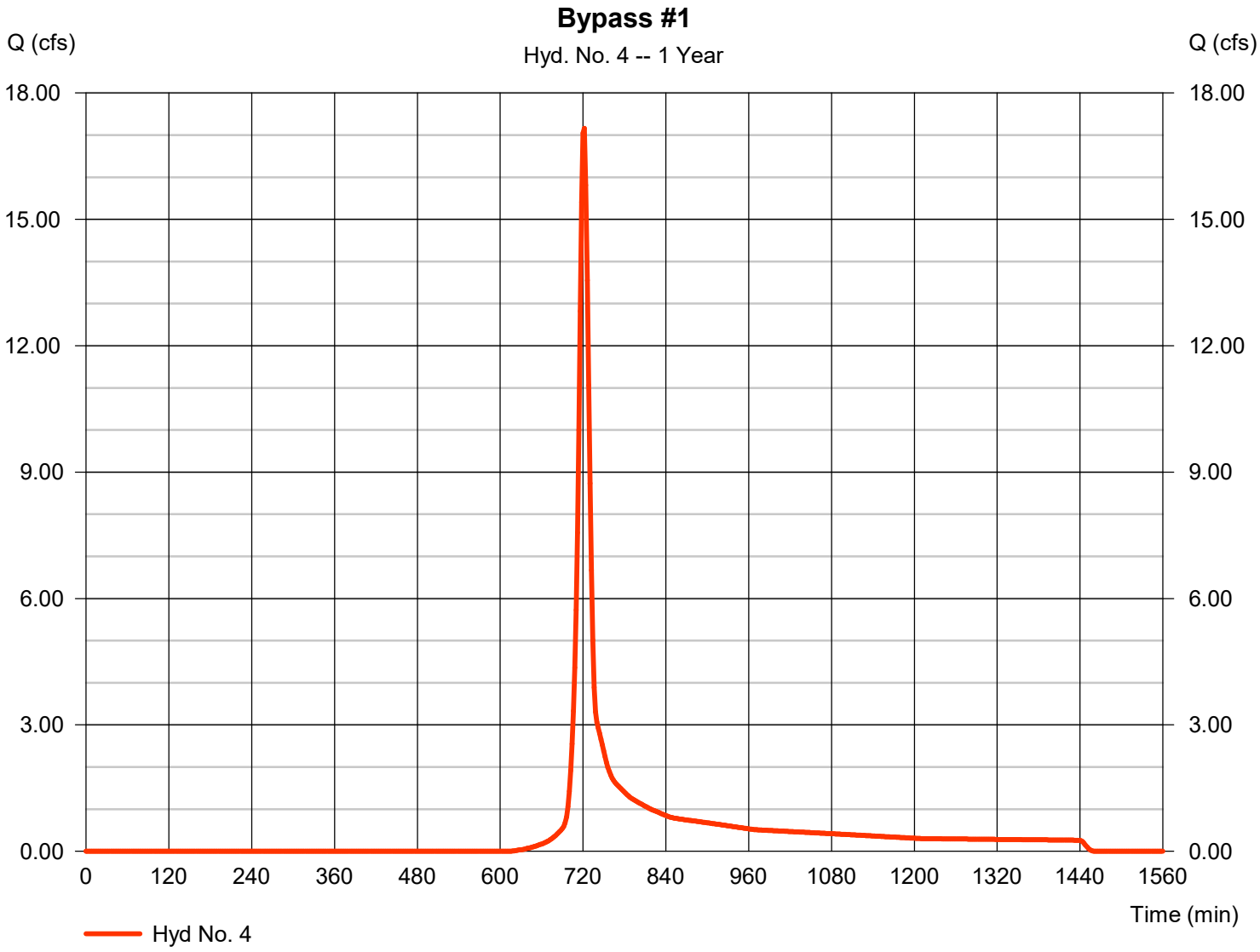
Total Travel Time, Tc ..... 9.70 min

Hydrograph Report

Hyd. No. 4

Bypass #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.16 cfs
Storm frequency	=	1 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	45,174 cuft
Drainage area	=	11.100 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

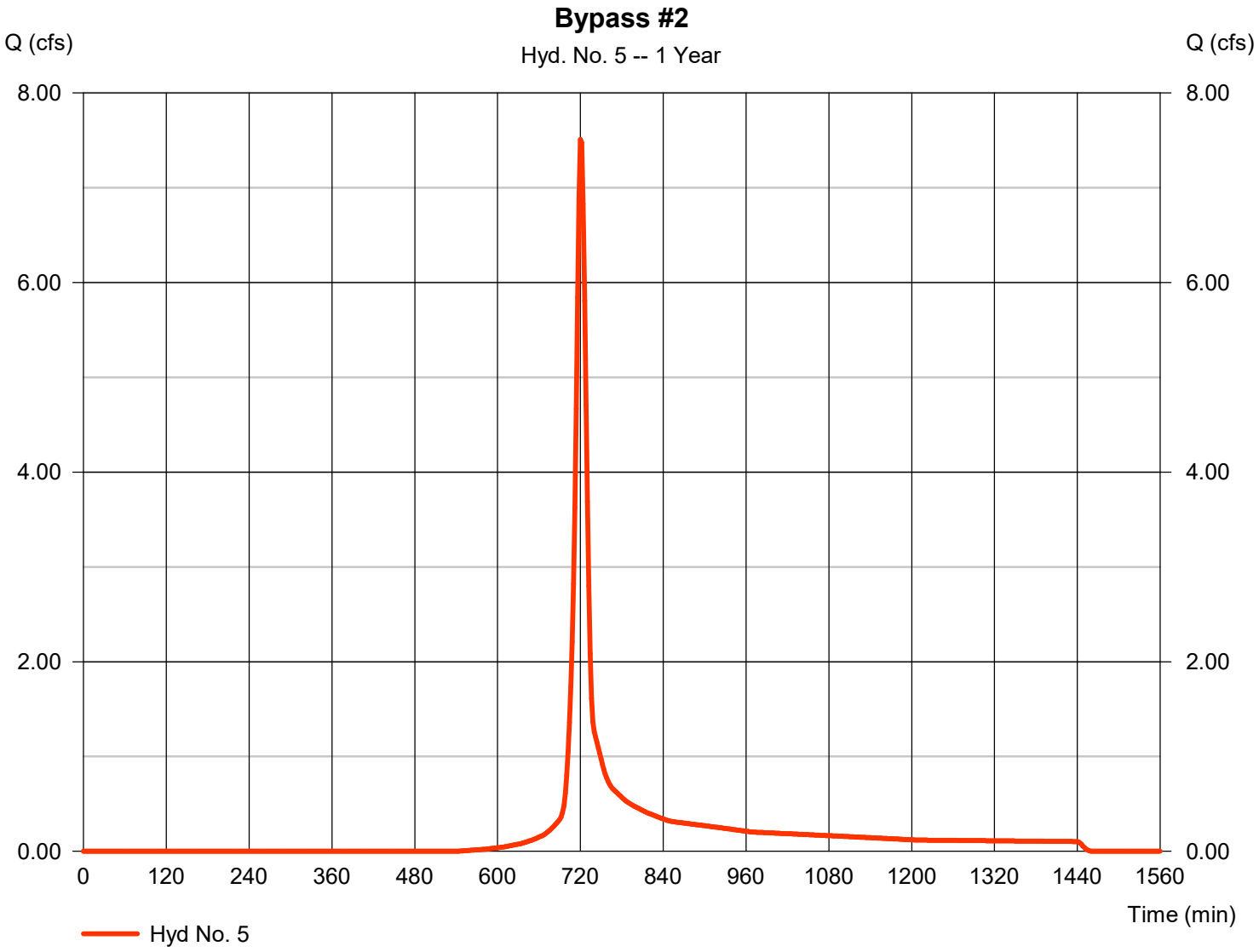


Hydrograph Report

Hyd. No. 5

Bypass #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.509 cfs
Storm frequency	=	1 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	19,536 cuft
Drainage area	=	3.910 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

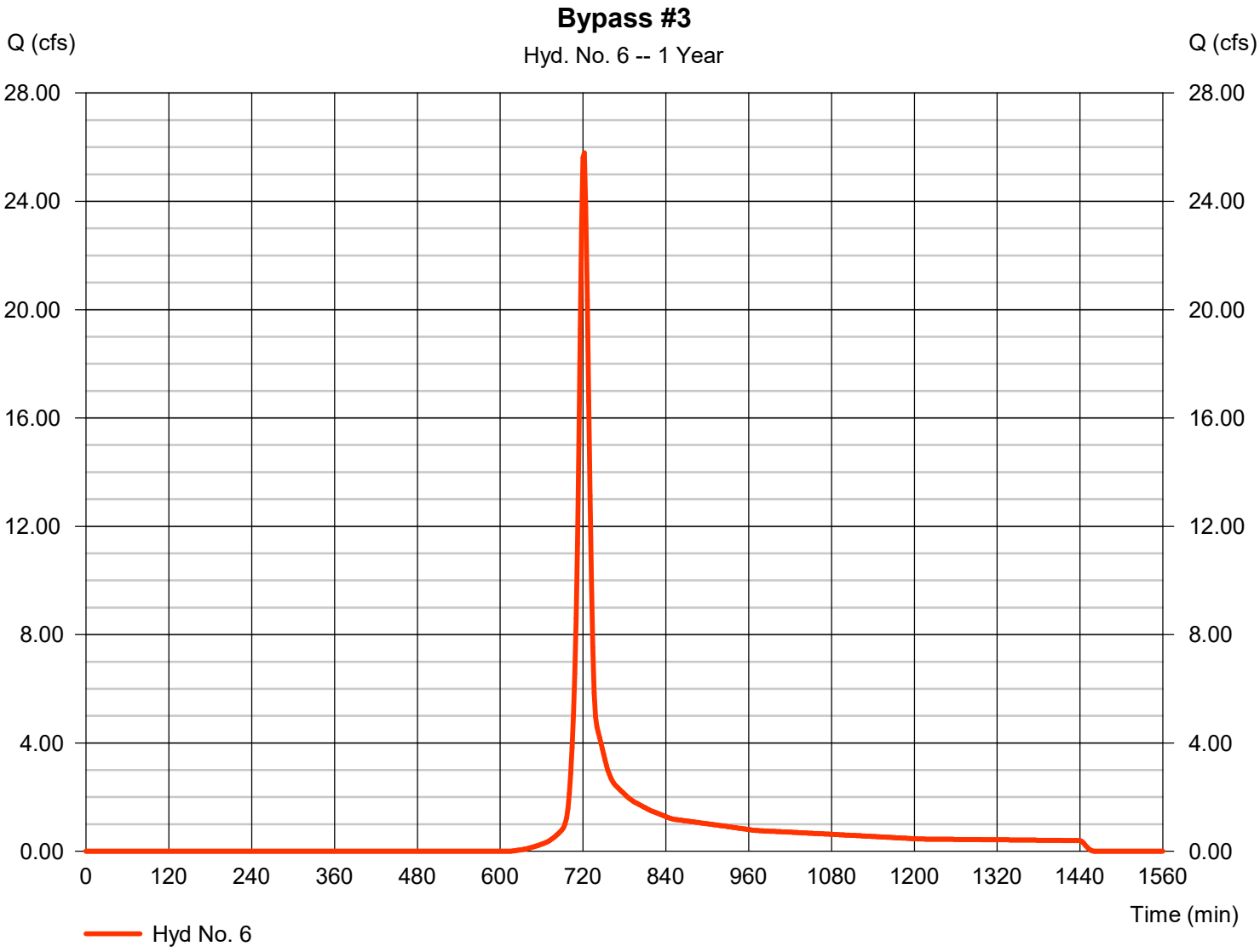


Hydrograph Report

Hyd. No. 6

Bypass #3

Hydrograph type	=	SCS Runoff	Peak discharge	=	25.79 cfs
Storm frequency	=	1 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	67,883 cuft
Drainage area	=	16.680 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

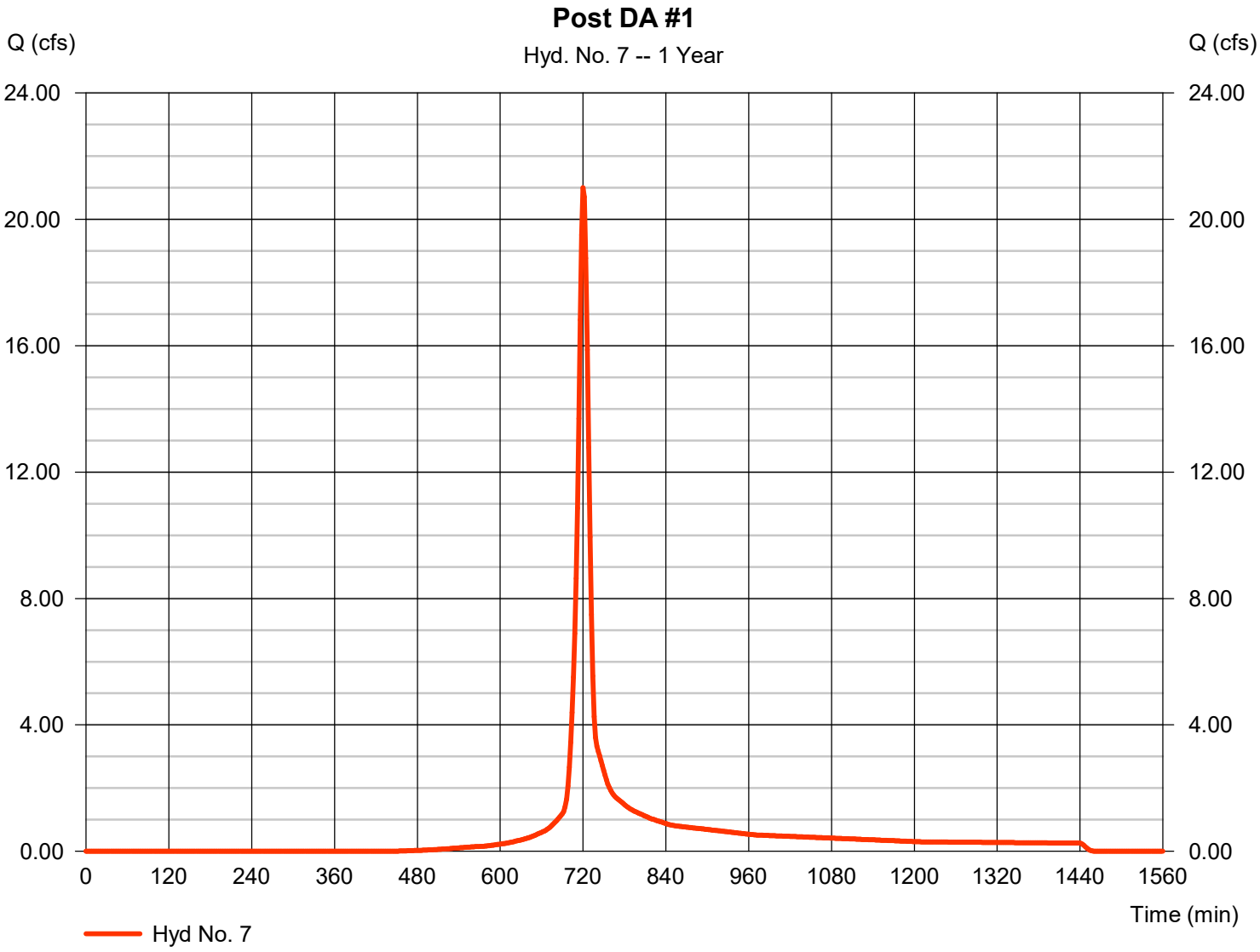


Hydrograph Report

Hyd. No. 7

Post DA #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.01 cfs
Storm frequency	=	1 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	54,494 cuft
Drainage area	=	9.000 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

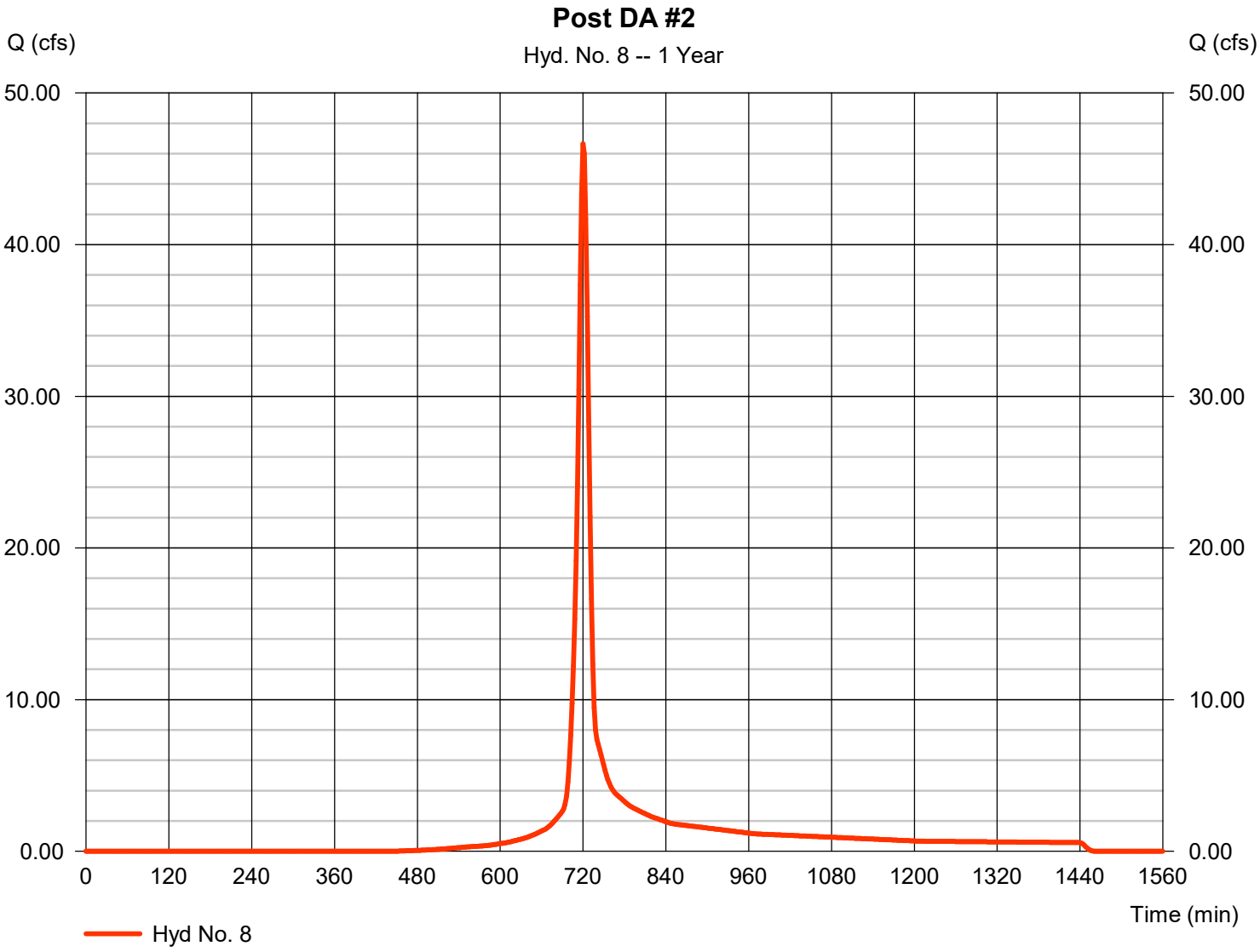


Hydrograph Report

Hyd. No. 8

Post DA #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	46.66 cfs
Storm frequency	=	1 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	121,037 cuft
Drainage area	=	19.990 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

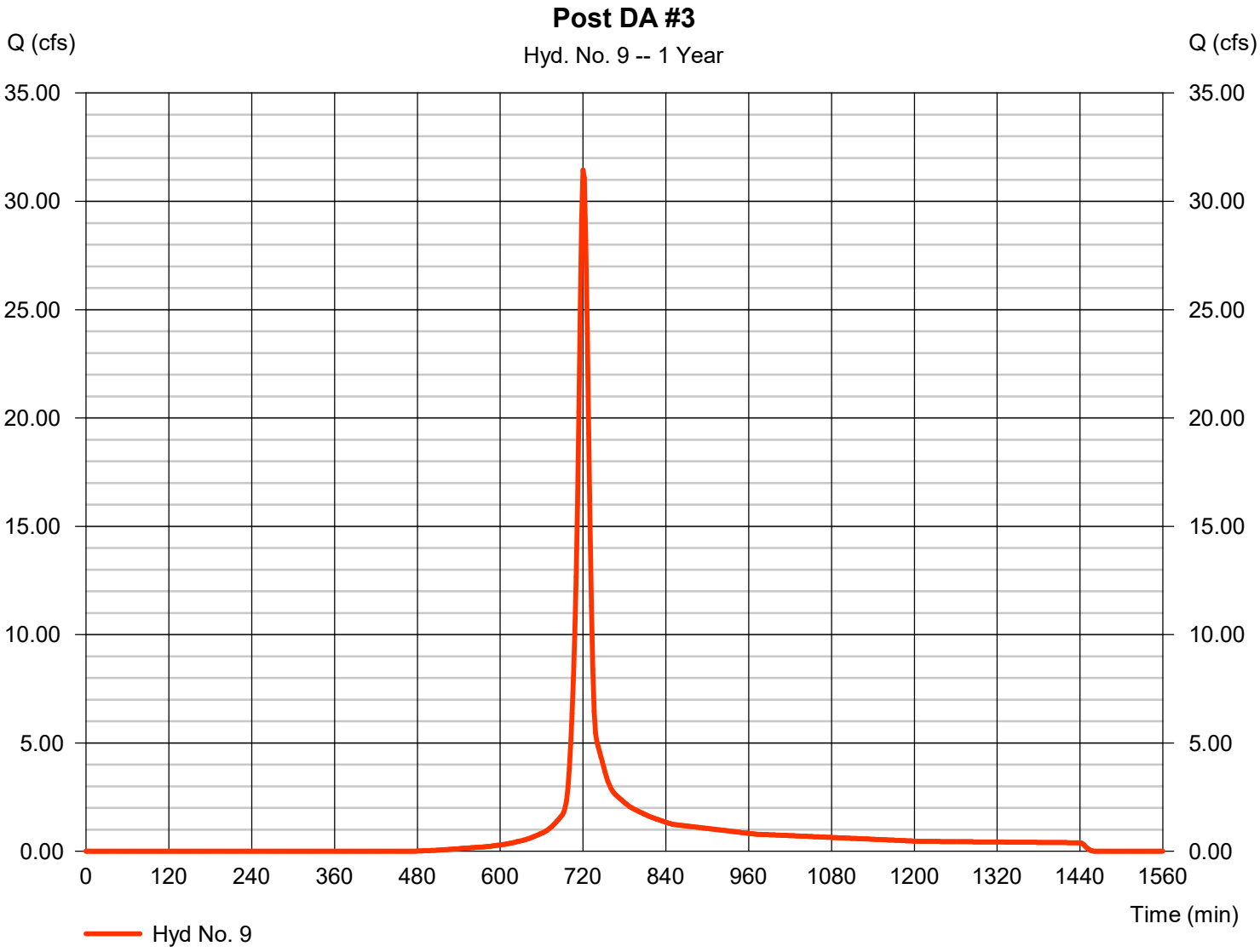


Hydrograph Report

Hyd. No. 9

Post DA #3

Hydrograph type	=	SCS Runoff	Peak discharge	=	31.44 cfs
Storm frequency	=	1 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	81,511 cuft
Drainage area	=	14.110 ac	Curve number	=	86
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

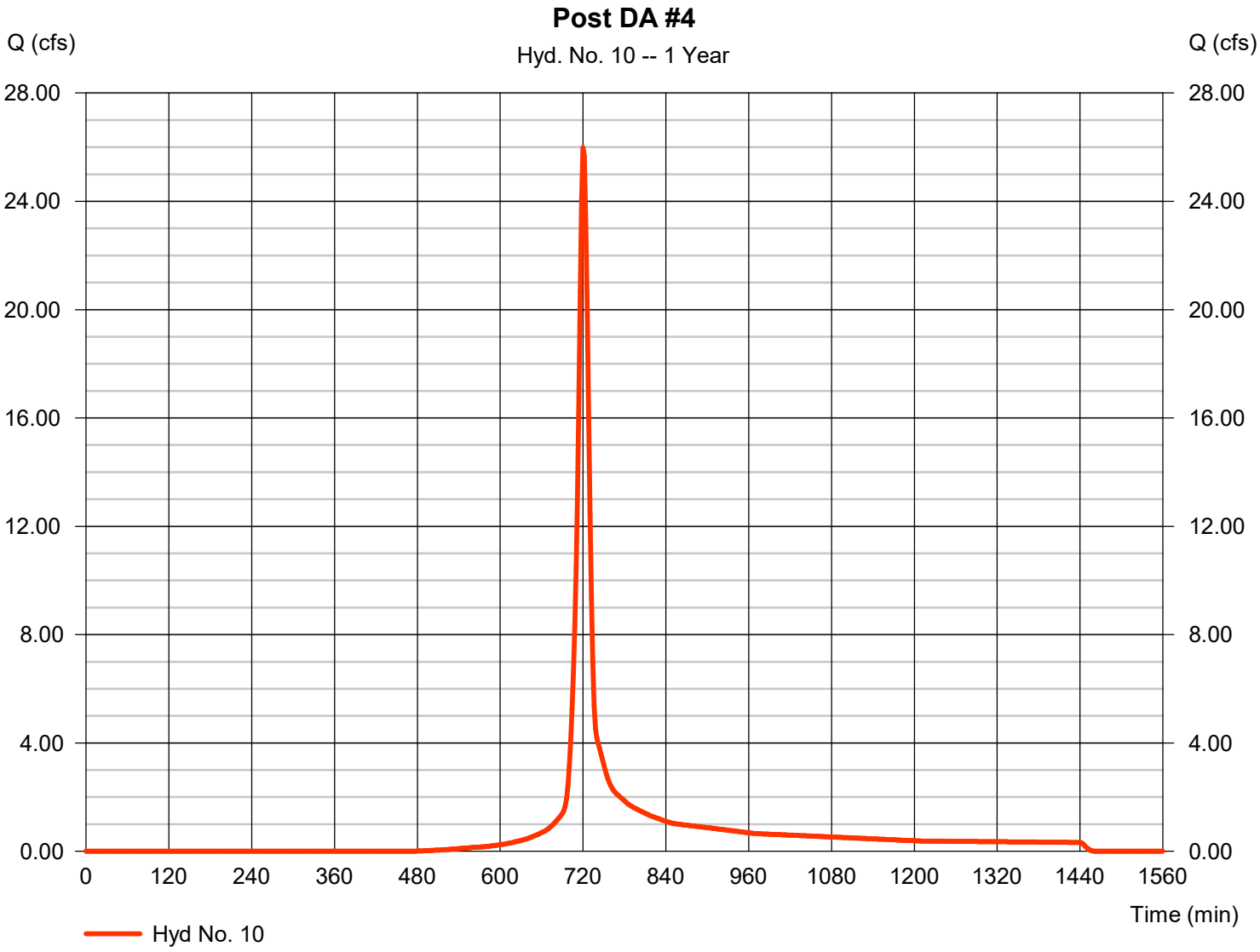


Hydrograph Report

Hyd. No. 10

Post DA #4

Hydrograph type	= SCS Runoff	Peak discharge	= 25.98 cfs
Storm frequency	= 1 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 67,358 cuft
Drainage area	= 11.660 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



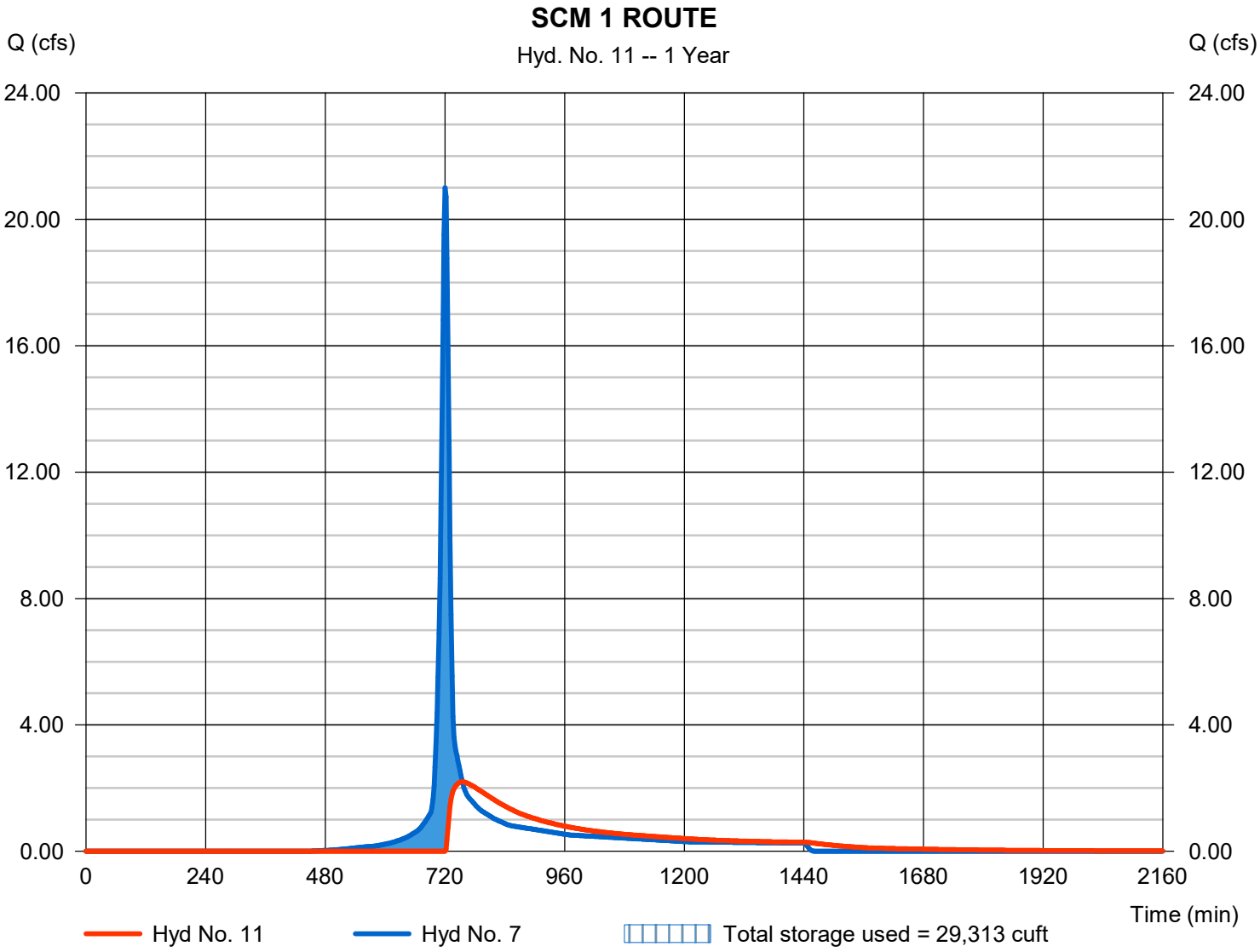
Hydrograph Report

Hyd. No. 11

SCM 1 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	2.197 cfs
Storm frequency	=	1 yrs	Time to peak	=	754 min
Time interval	=	2 min	Hyd. volume	=	36,026 cuft
Inflow hyd. No.	=	7 - Post DA #1	Max. Elevation	=	386.76 ft
Reservoir name	=	SCM 1	Max. Storage	=	29,313 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - SCM 1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 384.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	384.50	10,590	0	0
0.50	385.00	12,050	5,656	5,656
1.50	386.00	13,565	12,799	18,454
2.50	387.00	15,138	14,343	32,797
3.50	388.00	16,767	15,944	48,741
4.50	389.00	18,453	17,602	66,343
5.50	390.00	20,196	19,316	85,659

#196- verify this matches what is shown on the detail sheet

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	1.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 379.00	384.50	0.00	0.00
Length (ft)	= 165.00	1.00	0.00	0.00
Slope (%)	= 0.61	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

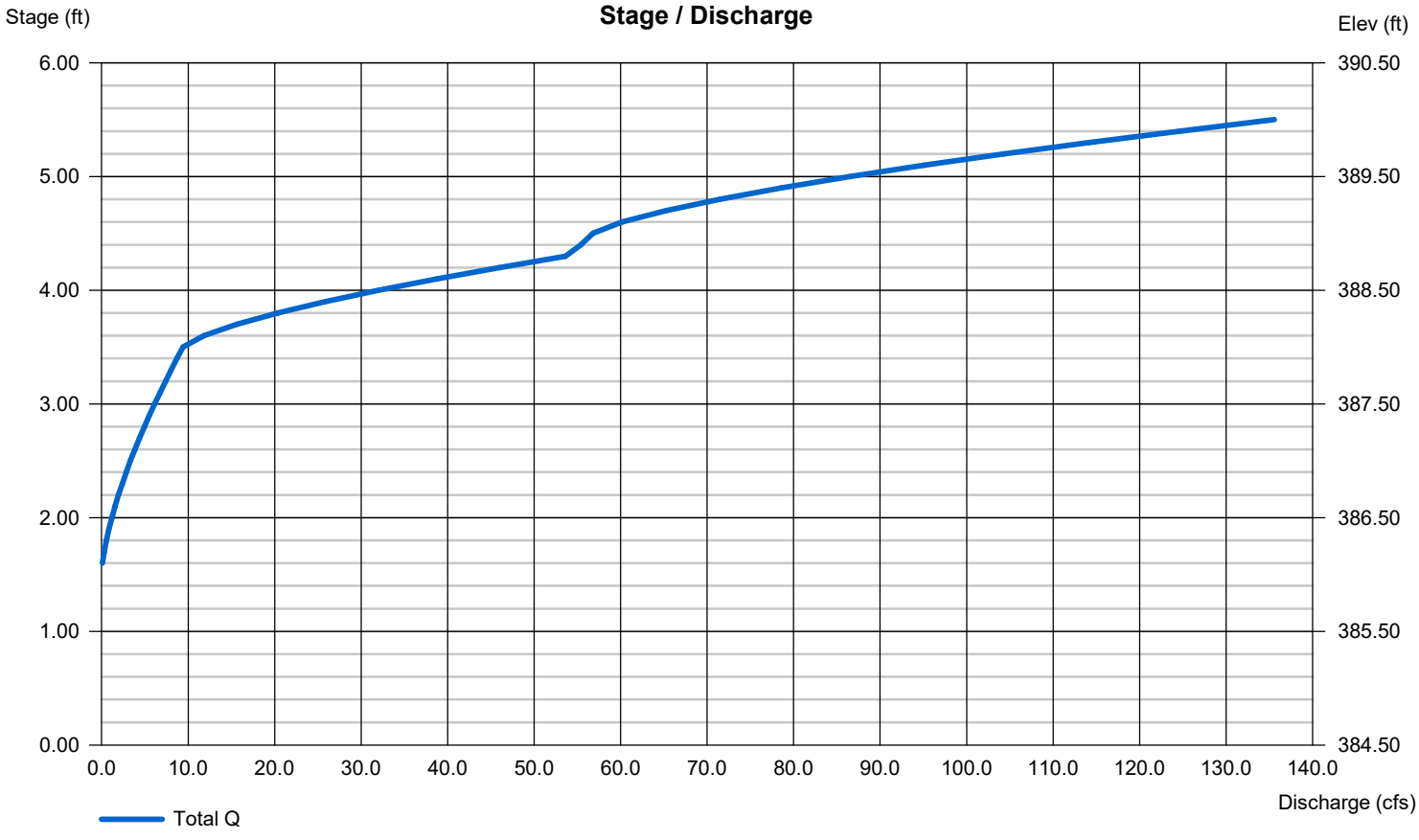
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	1.00	20.00	Inactive
Crest El. (ft)	= 388.00	386.00	389.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	Rect	---
Multi-Stage	= Yes	No	No	No

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

TW Elev. (ft) = 0.00

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



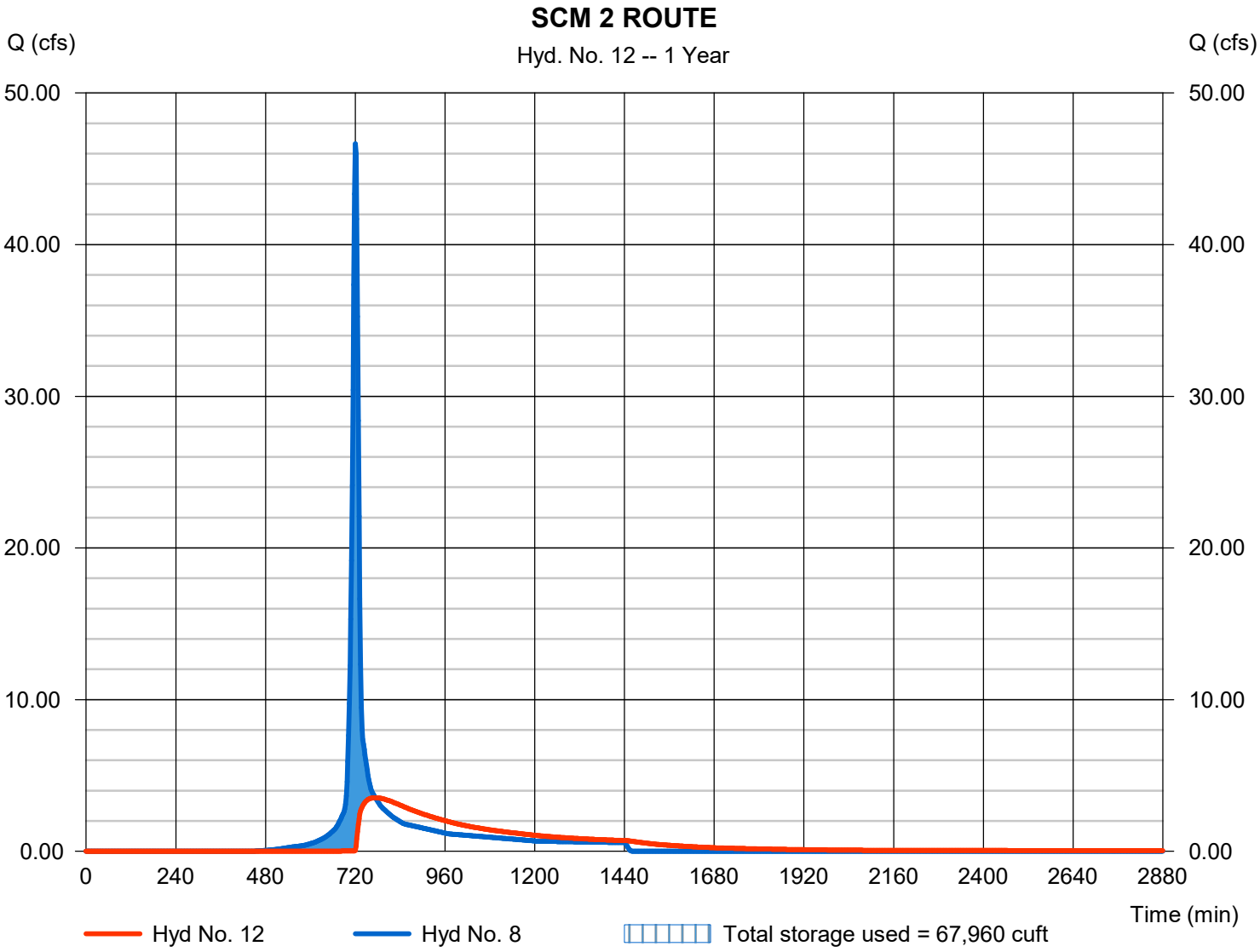
Hydrograph Report

Hyd. No. 12

SCM 2 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	3.529 cfs
Storm frequency	=	1 yrs	Time to peak	=	774 min
Time interval	=	2 min	Hyd. volume	=	89,949 cuft
Inflow hyd. No.	=	8 - Post DA #2	Max. Elevation	=	353.88 ft
Reservoir name	=	SCM 2	Max. Storage	=	67,960 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - SCM 2

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 351.50 ft

#196- verify this matches what is shown on the detail sheet

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	351.50	25,295	0	0
0.50	352.00	27,224	13,125	13,125
1.50	353.00	29,209	28,208	41,333
2.50	354.00	31,251	30,221	71,555
3.50	355.00	33,350	32,292	103,846
4.50	356.00	35,504	34,418	138,264
5.50	357.00	37,716	36,601	174,865

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	1.00	0.00	0.00
Span (in)	= 24.00	1.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 347.00	351.50	0.00	0.00
Length (ft)	= 87.00	1.00	0.00	0.00
Slope (%)	= 1.15	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

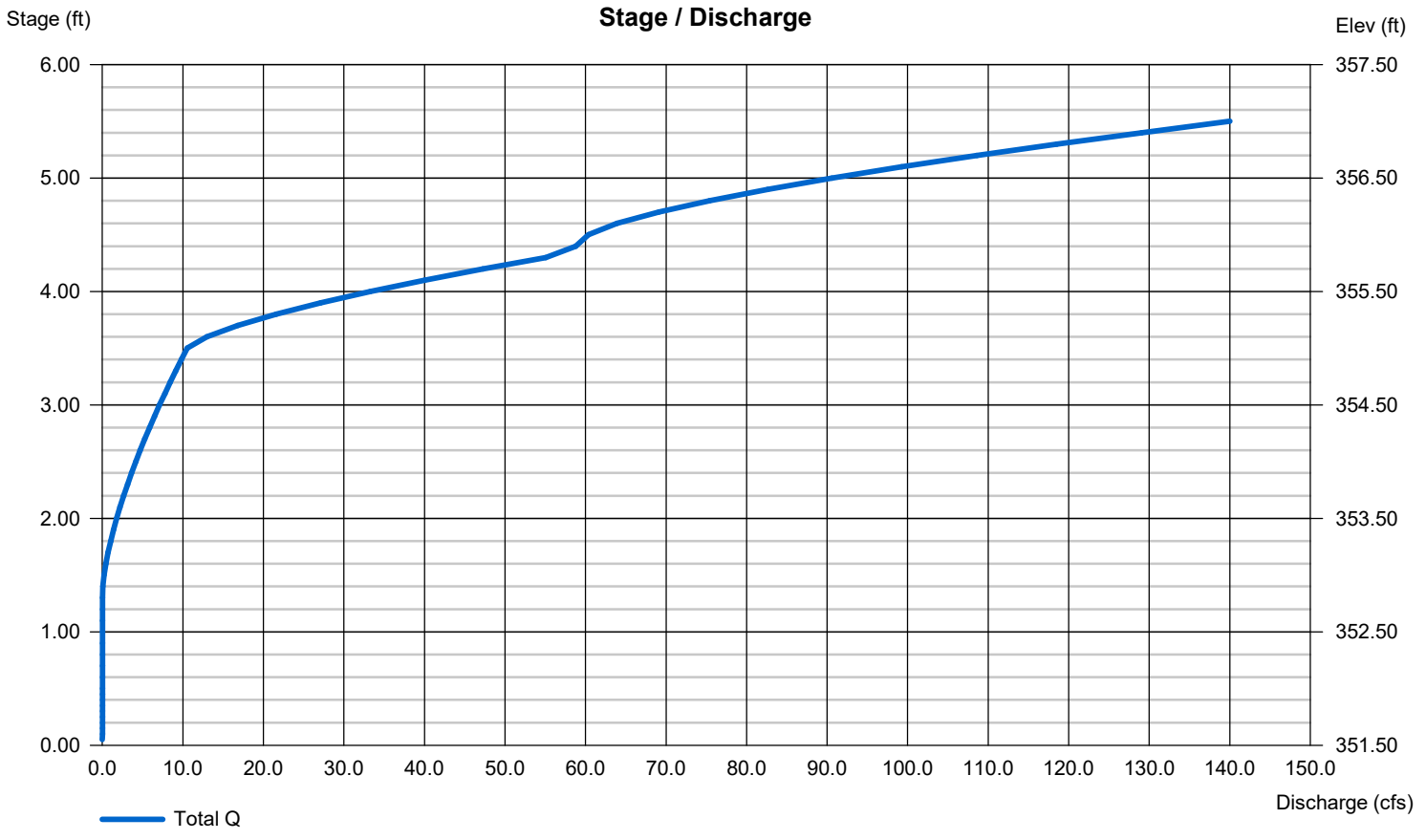
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	1.00	20.00	Inactive
Crest El. (ft)	= 355.00	352.85	356.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	Rect	---
Multi-Stage	= Yes	No	No	No

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

TW Elev. (ft) = 0.00

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



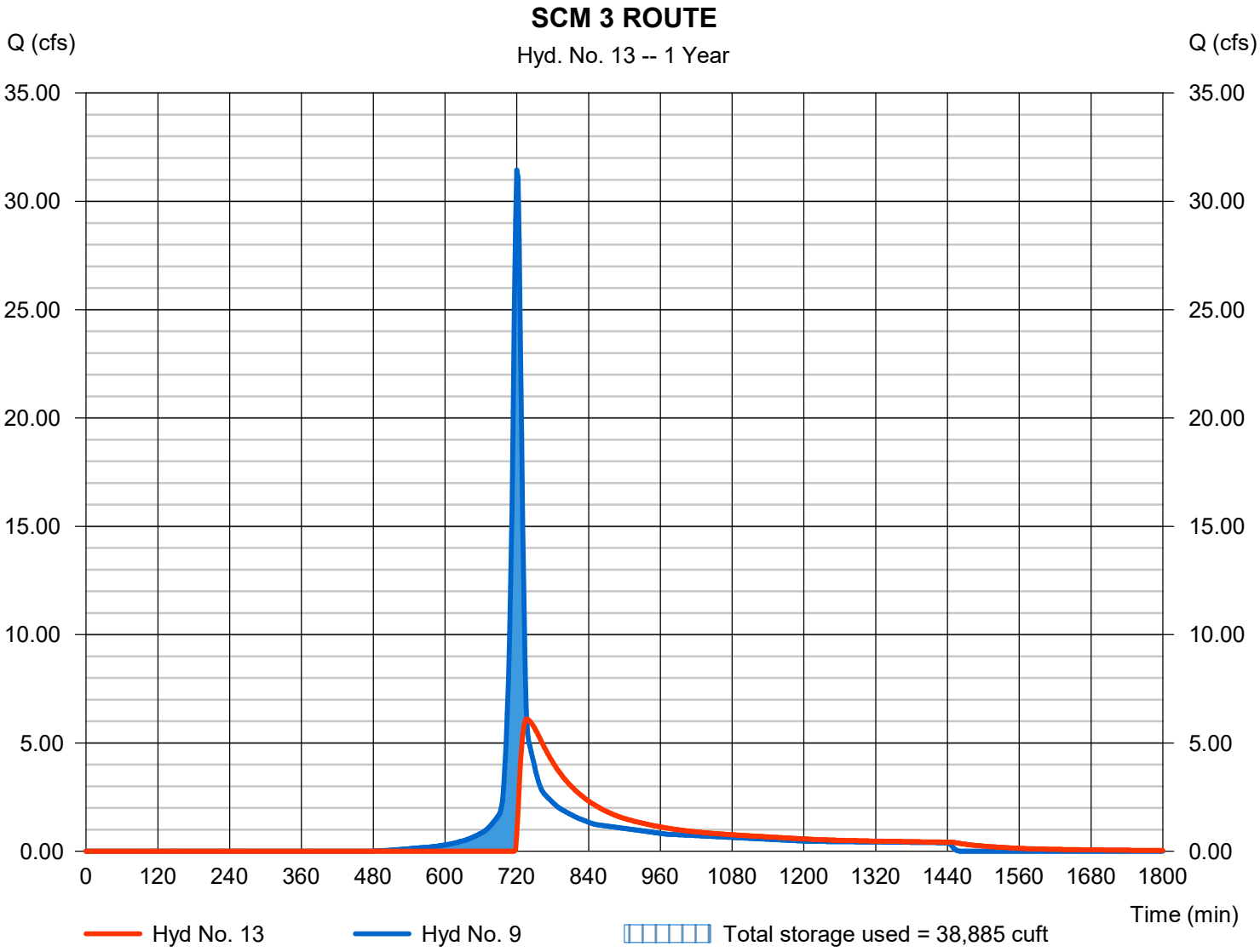
Hydrograph Report

Hyd. No. 13

SCM 3 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	6.102 cfs
Storm frequency	=	1 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	61,876 cuft
Inflow hyd. No.	=	9 - Post DA #3	Max. Elevation	=	387.80 ft
Reservoir name	=	SCM 3	Max. Storage	=	38,885 cuft

Storage Indication method used.



Pond Report

Pond No. 3 - SCM 3

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 384.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cu
0.00	384.50	9,342	0	0
0.50	385.00	10,446	4,944	4,944
1.50	386.00	11,603	11,018	15,962
2.50	387.00	12,816	12,203	28,166
3.50	388.00	14,086	13,445	41,610
4.50	389.00	15,412	14,743	56,353
5.50	390.00	16,783	16,091	72,444

#196- verify this matches what is shown on the detail sheet

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	1.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 380.00	384.50	0.00	0.00
Length (ft)	= 118.00	1.00	0.00	0.00
Slope (%)	= 0.85	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

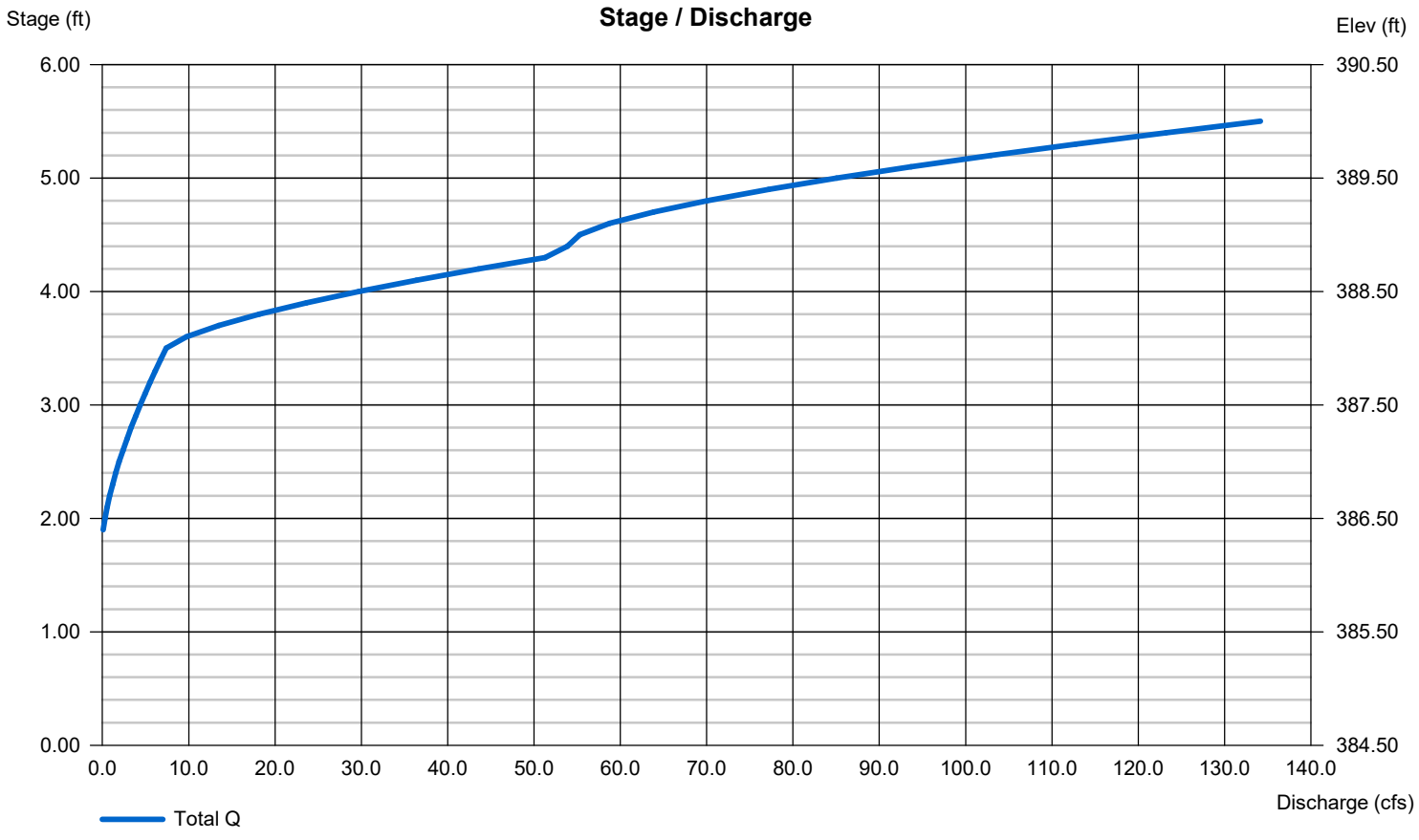
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	1.00	20.00	Inactive
Crest El. (ft)	= 388.00	386.30	389.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	Rect	---
Multi-Stage	= Yes	No	No	No

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

TW Elev. (ft) = 0.00

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



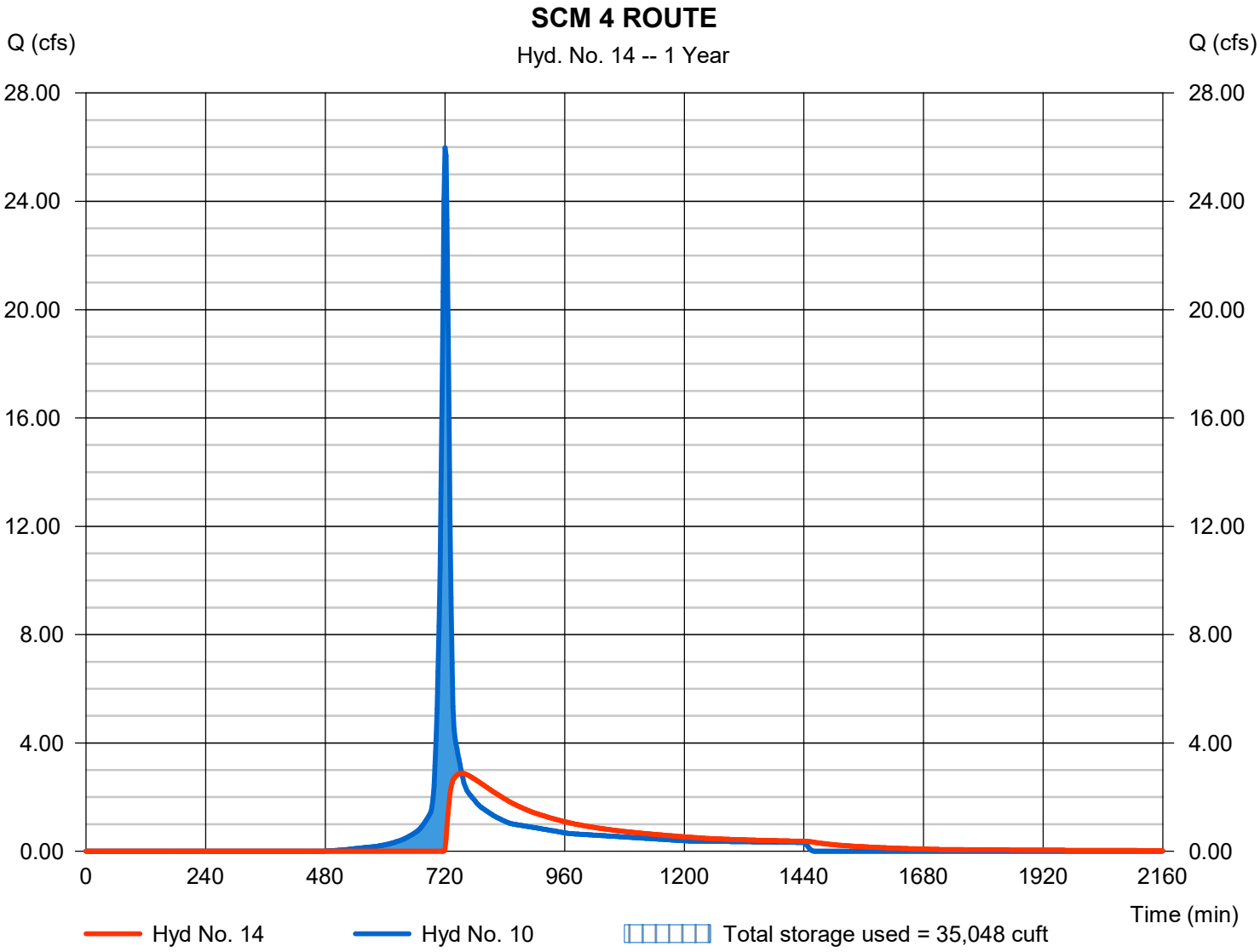
Hydrograph Report

Hyd. No. 14

SCM 4 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	2.880 cfs
Storm frequency	=	1 yrs	Time to peak	=	754 min
Time interval	=	2 min	Hyd. volume	=	49,283 cuft
Inflow hyd. No.	=	10 - Post DA #4	Max. Elevation	=	382.54 ft
Reservoir name	=	SCM 4	Max. Storage	=	35,048 cuft

Storage Indication method used.



Pond Report

Pond No. 4 - SCM 4

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 380.50 ft

#196- verify this matches what is shown on the detail sheet

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	380.50	14,636	0	0
0.50	381.00	16,358	7,744	7,744
1.50	382.00	18,005	17,173	24,917
2.50	383.00	19,735	18,862	43,778
3.50	384.00	21,522	20,620	64,398
4.50	385.00	22,548	22,031	86,429
5.50	386.00	24,300	23,416	109,845

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	1.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 375.00	380.50	0.00	0.00
Length (ft)	= 63.00	1.00	0.00	0.00
Slope (%)	= 1.60	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

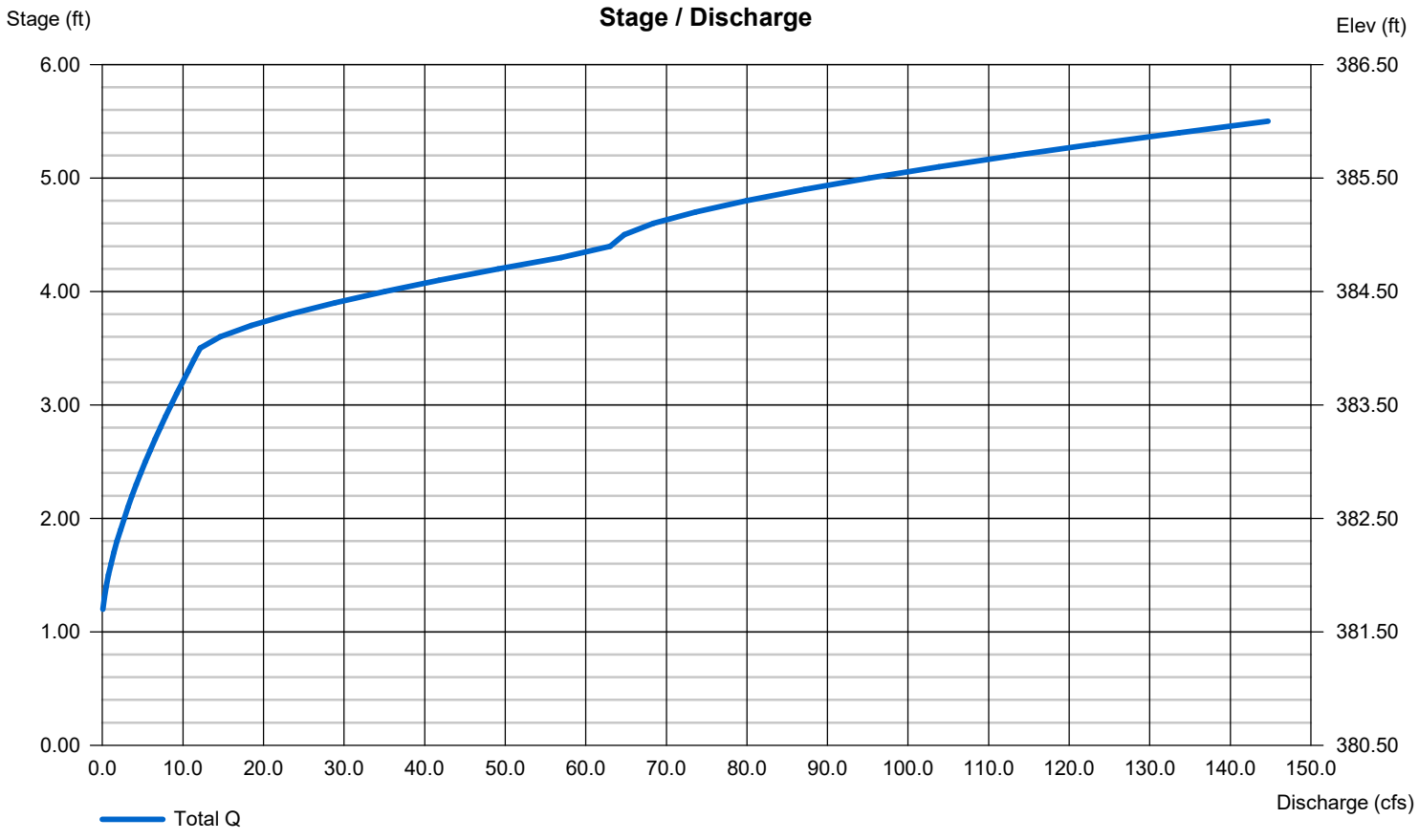
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	1.00	20.00	Inactive
Crest El. (ft)	= 384.00	381.63	385.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	Rect	---
Multi-Stage	= Yes	No	No	No

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

TW Elev. (ft) = 0.00

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

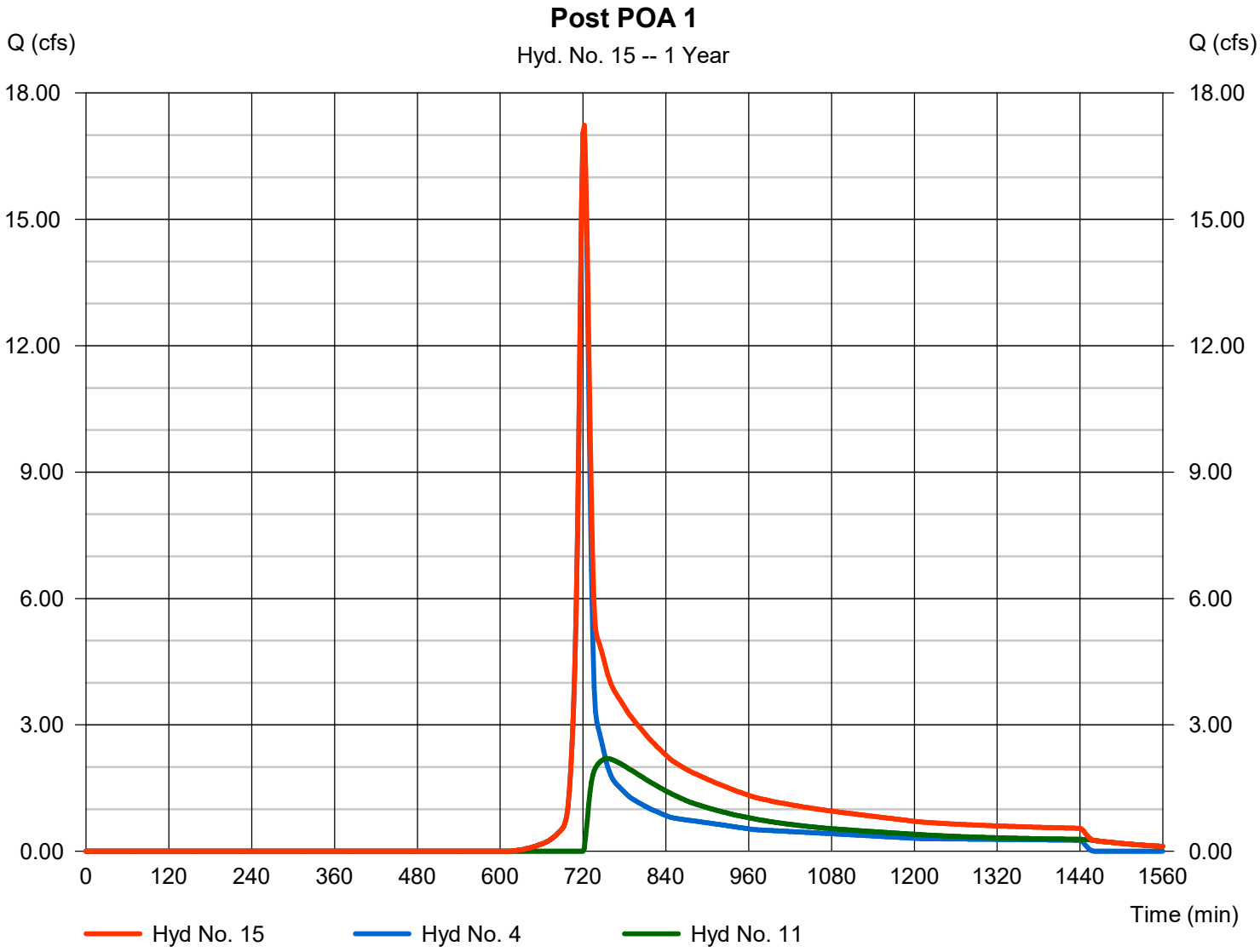


Hydrograph Report

Hyd. No. 15

Post POA 1

Hydrograph type	= Combine	Peak discharge	= 17.23 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 81,200 cuft
Inflow hyds.	= 4, 11	Contrib. drain. area	= 11.100 ac

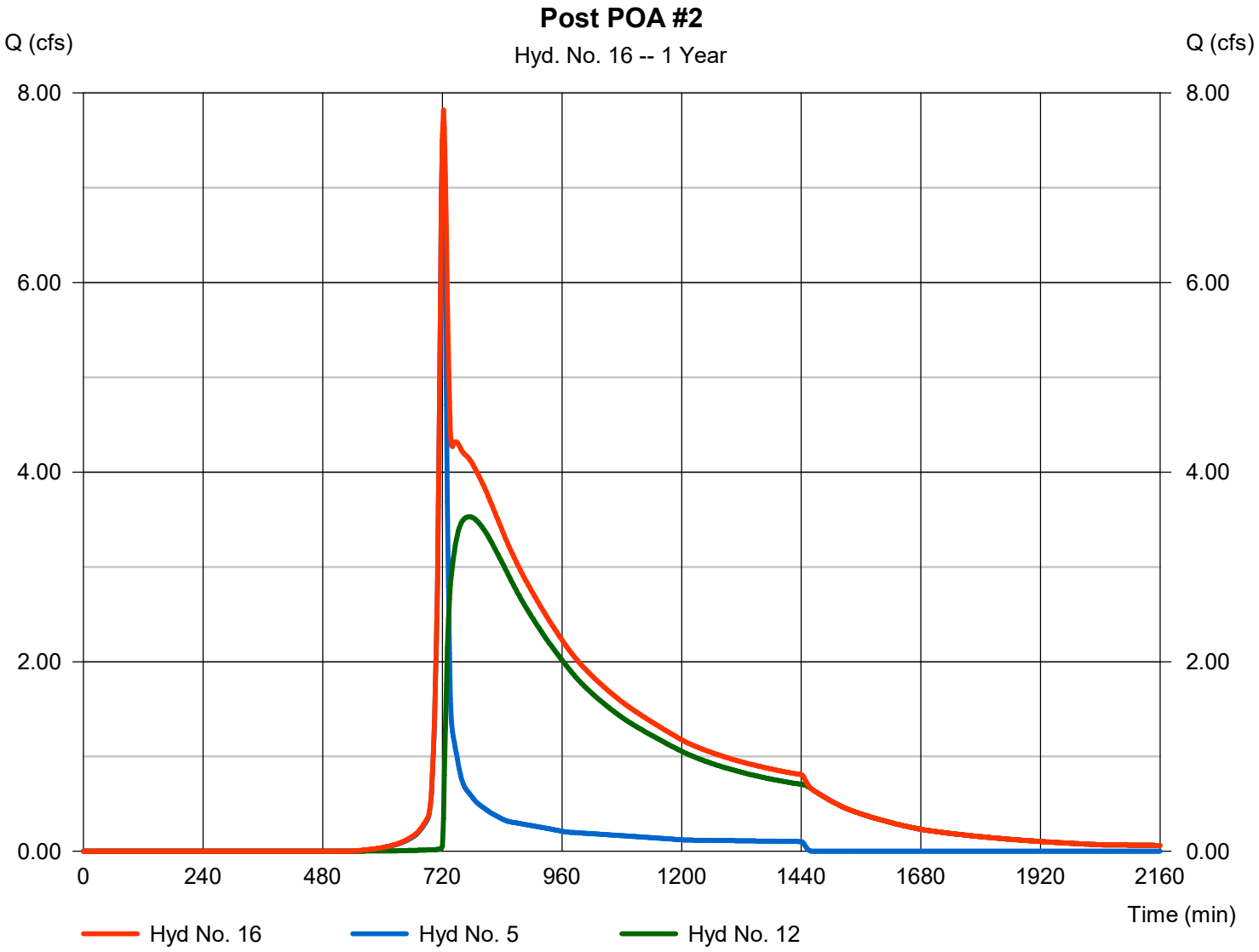


Hydrograph Report

Hyd. No. 16

Post POA #2

Hydrograph type	= Combine	Peak discharge	= 7.821 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 109,485 cuft
Inflow hyds.	= 5, 12	Contrib. drain. area	= 3.910 ac

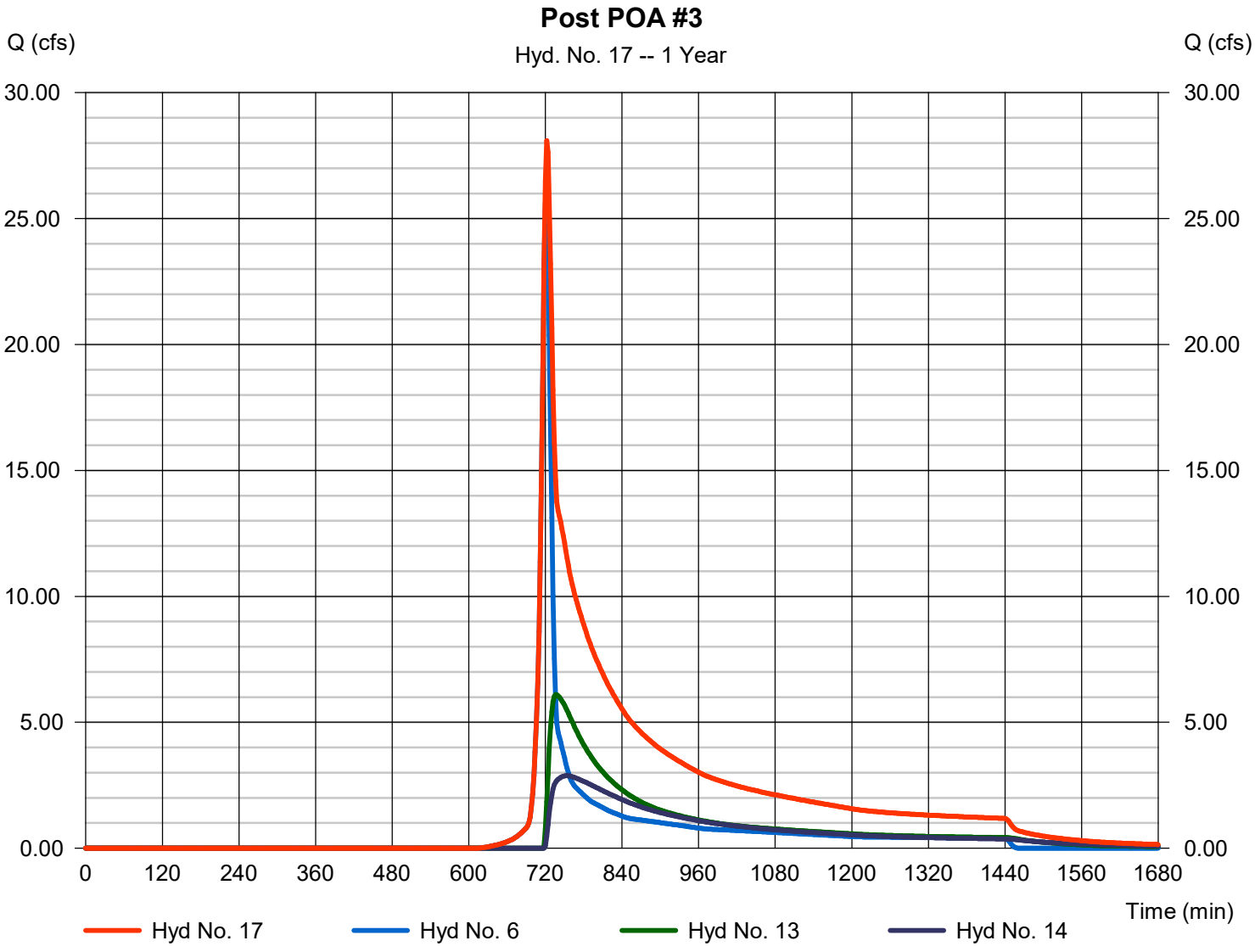


Hydrograph Report

Hyd. No. 17

Post POA #3

Hydrograph type	= Combine	Peak discharge	= 28.10 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 179,042 cuft
Inflow hyds.	= 6, 13, 14	Contrib. drain. area	= 16.680 ac

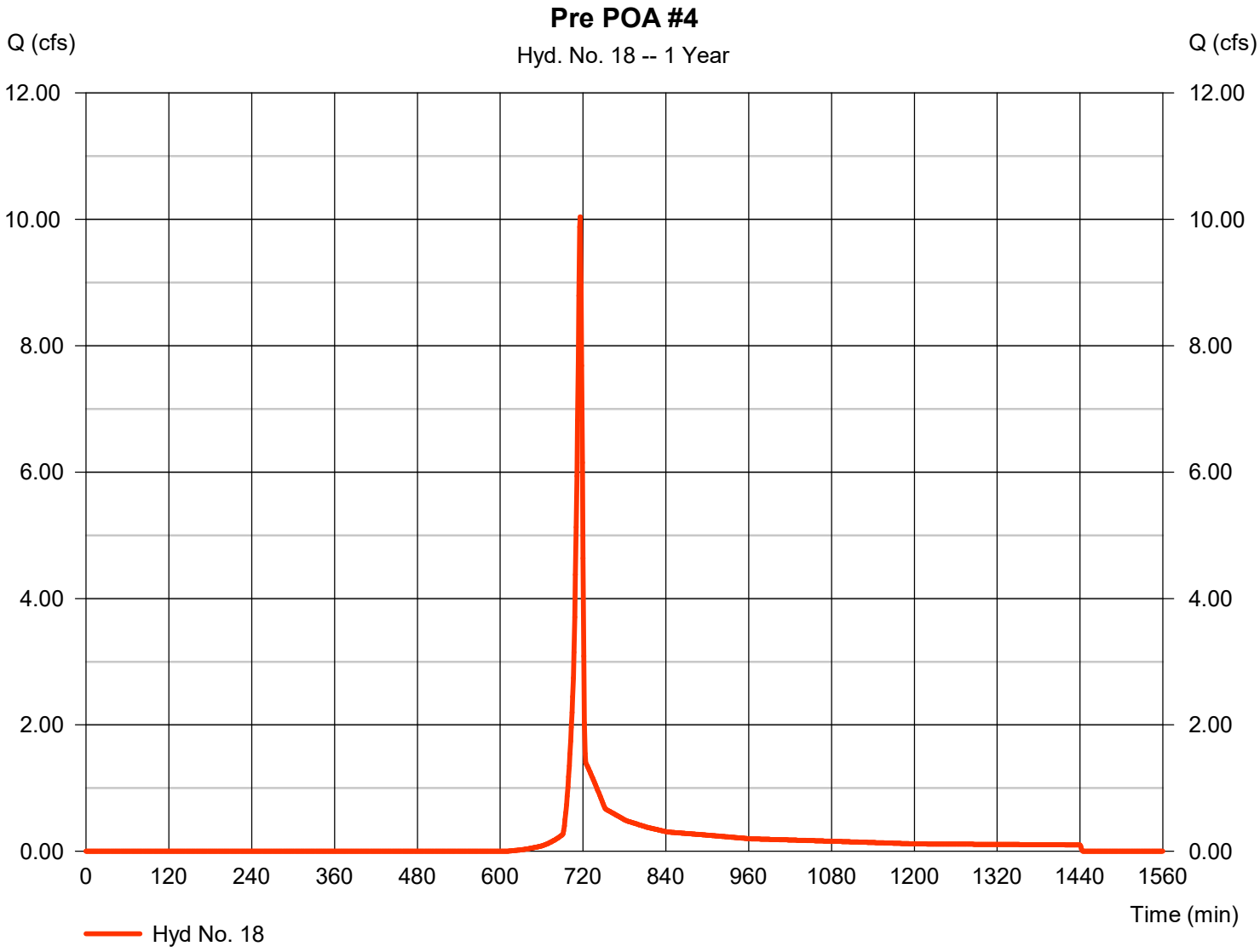


Hydrograph Report

Hyd. No. 18

Pre POA #4

Hydrograph type	= SCS Runoff	Peak discharge	= 10.04 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 1 min	Hyd. volume	= 17,463 cuft
Drainage area	= 4.720 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 2.10 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 18

Pre POA #4

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.20		0.00		0.00		
Land slope (%)	= 8.00		0.00		0.00		
Travel Time (min)	**= 2.02**	**+**	**0.00**	**+**	**0.00**	**=**	**2.02**
Shallow Concentrated Flow							
Flow length (ft)	= 30.00		0.00		0.00		
Watercourse slope (%)	= 8.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.56		0.00		0.00		
Travel Time (min)	**= 0.11**	**+**	**0.00**	**+**	**0.00**	**=**	**0.11**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

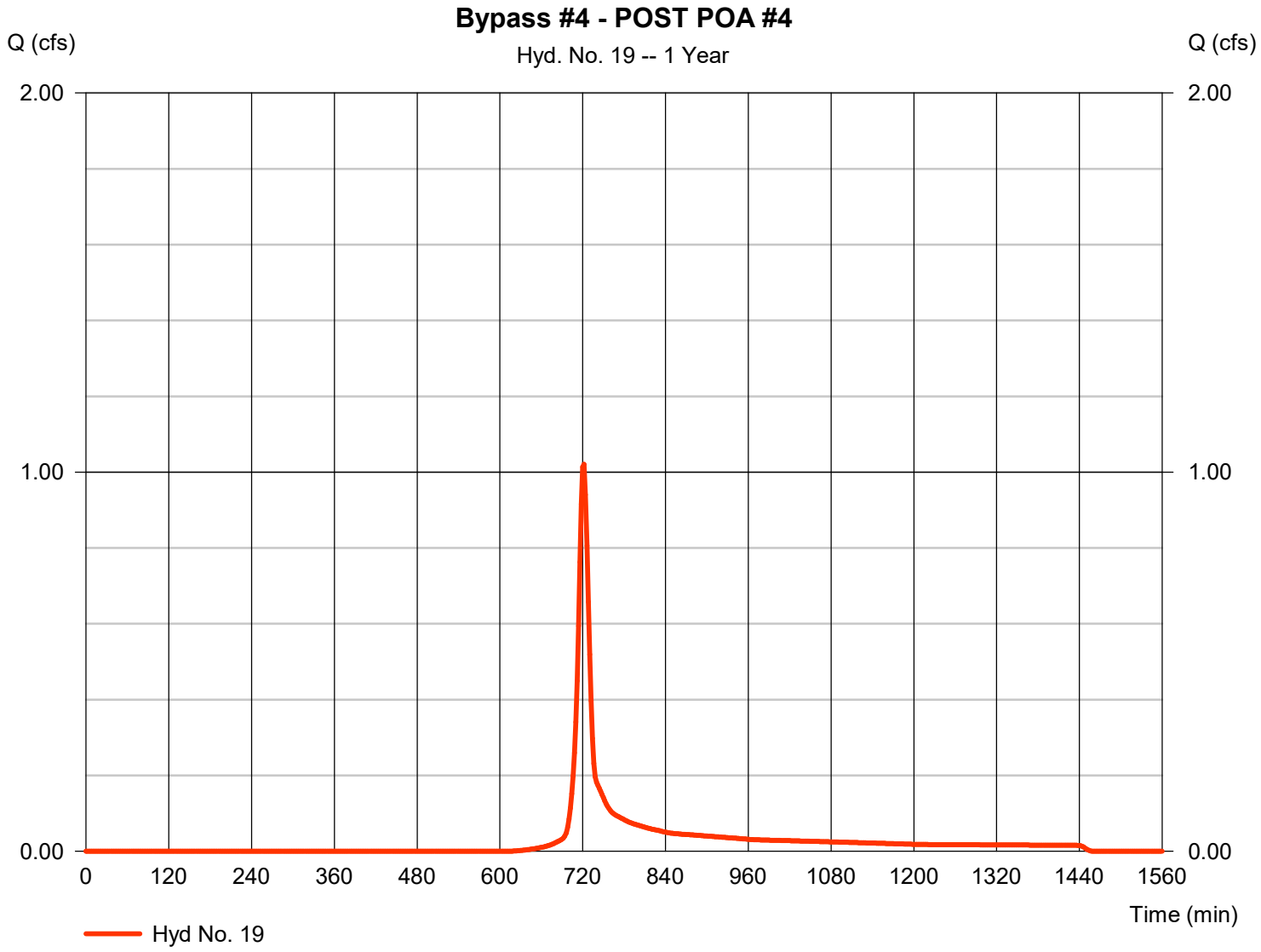
Total Travel Time, Tc ..... 2.10 min

Hydrograph Report

Hyd. No. 19

Bypass #4 - POST POA #4

Hydrograph type	= SCS Runoff	Peak discharge	= 1.021 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 2,686 cuft
Drainage area	= 0.660 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

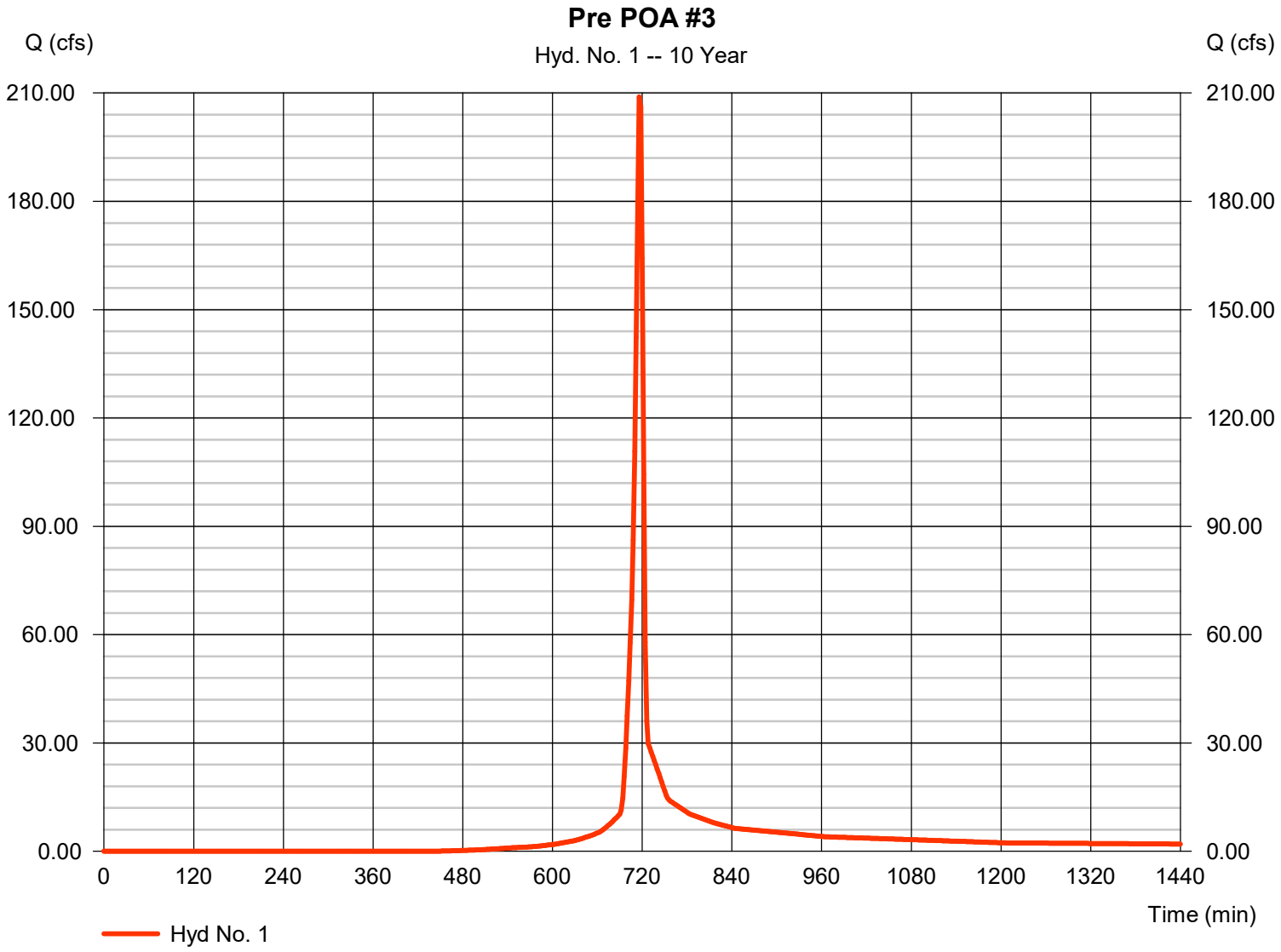
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	208.92	2	716	424,093	------	------	------	Pre POA #3
2	SCS Runoff	97.64	2	716	200,694	------	------	------	Pre POA #2
3	SCS Runoff	89.35	2	718	204,872	------	------	------	Pre POA #1
4	SCS Runoff	45.43	2	720	117,847	------	------	------	Bypass #1
5	SCS Runoff	17.99	2	720	46,989	------	------	------	Bypass #2
6	SCS Runoff	68.27	2	720	177,089	------	------	------	Bypass #3
7	SCS Runoff	45.78	2	720	121,455	------	------	------	Post DA #1
8	SCS Runoff	101.68	2	720	269,765	------	------	------	Post DA #2
9	SCS Runoff	70.10	2	720	185,099	------	------	------	Post DA #3
10	SCS Runoff	57.93	2	720	152,960	------	------	------	Post DA #4
11	Reservoir	23.27	2	730	102,987	7	388.35	54,951	SCM 1 ROUTE
12	Reservoir	45.89	2	730	238,524	8	355.68	127,280	SCM 2 ROUTE
13	Reservoir	56.26	2	726	165,465	9	389.03	56,799	SCM 3 ROUTE
14	Reservoir	23.34	2	730	134,884	10	384.30	71,029	SCM 4 ROUTE
15	Combine	54.36	2	724	220,834	4, 11,	------	------	Post POA 1
16	Combine	54.59	2	728	285,513	5, 12,	------	------	Post POA #2
17	Combine	131.98	2	722	477,438	6, 13, 14,	------	------	Post POA #3
18	SCS Runoff	25.45	1	715	45,556	------	------	------	Pre POA #4
19	SCS Runoff	2.701	2	720	7,007	------	------	------	Bypass #4 - POST POA #4

Hydrograph Report

Hyd. No. 1

Pre POA #3

Hydrograph type	= SCS Runoff	Peak discharge	= 208.92 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 424,093 cuft
Drainage area	= 43.940 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 3.10 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

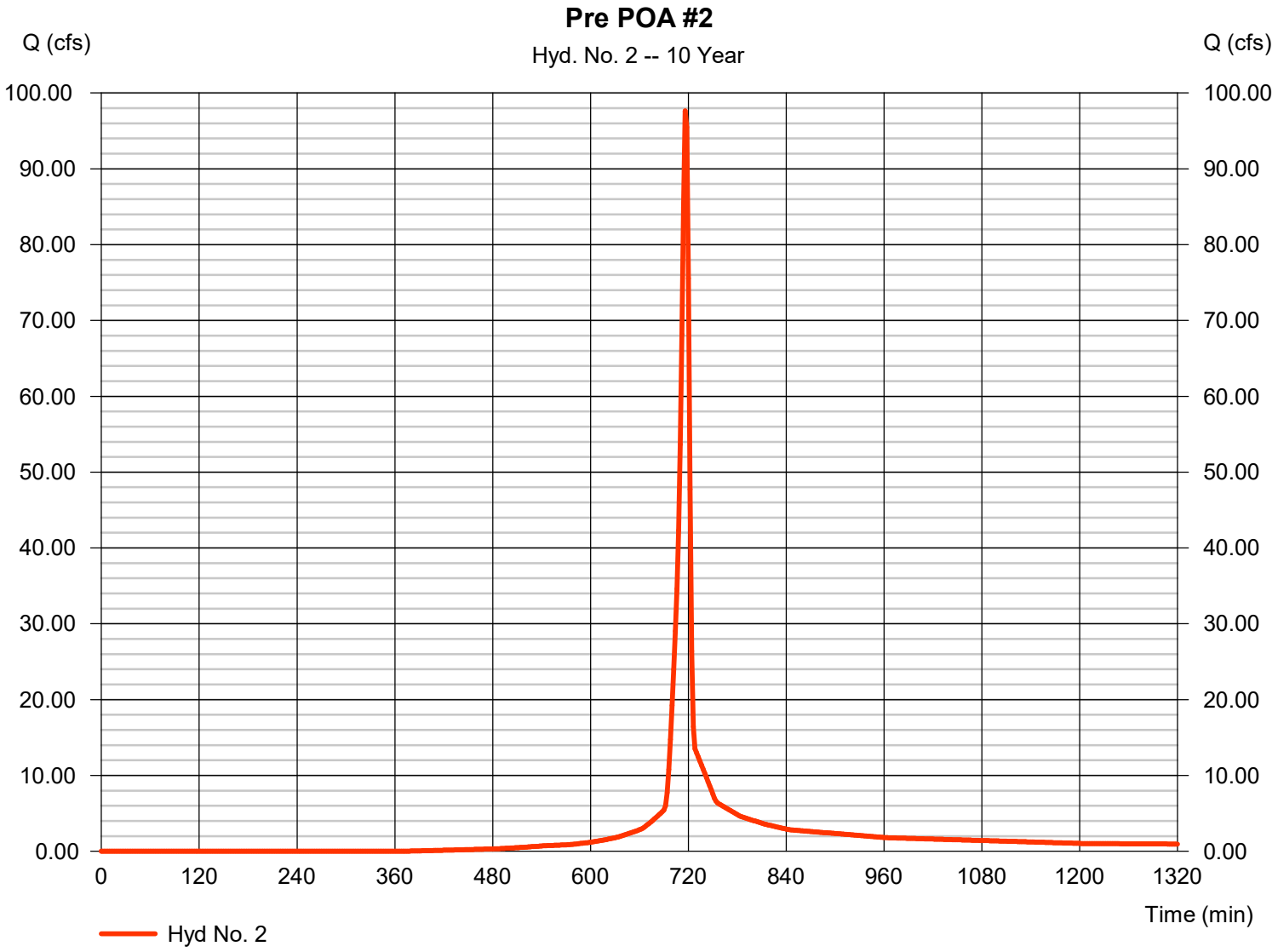


Hydrograph Report

Hyd. No. 2

Pre POA #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	97.64 cfs
Storm frequency	=	10 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	200,694 cuft
Drainage area	=	18.370 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	5.60 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

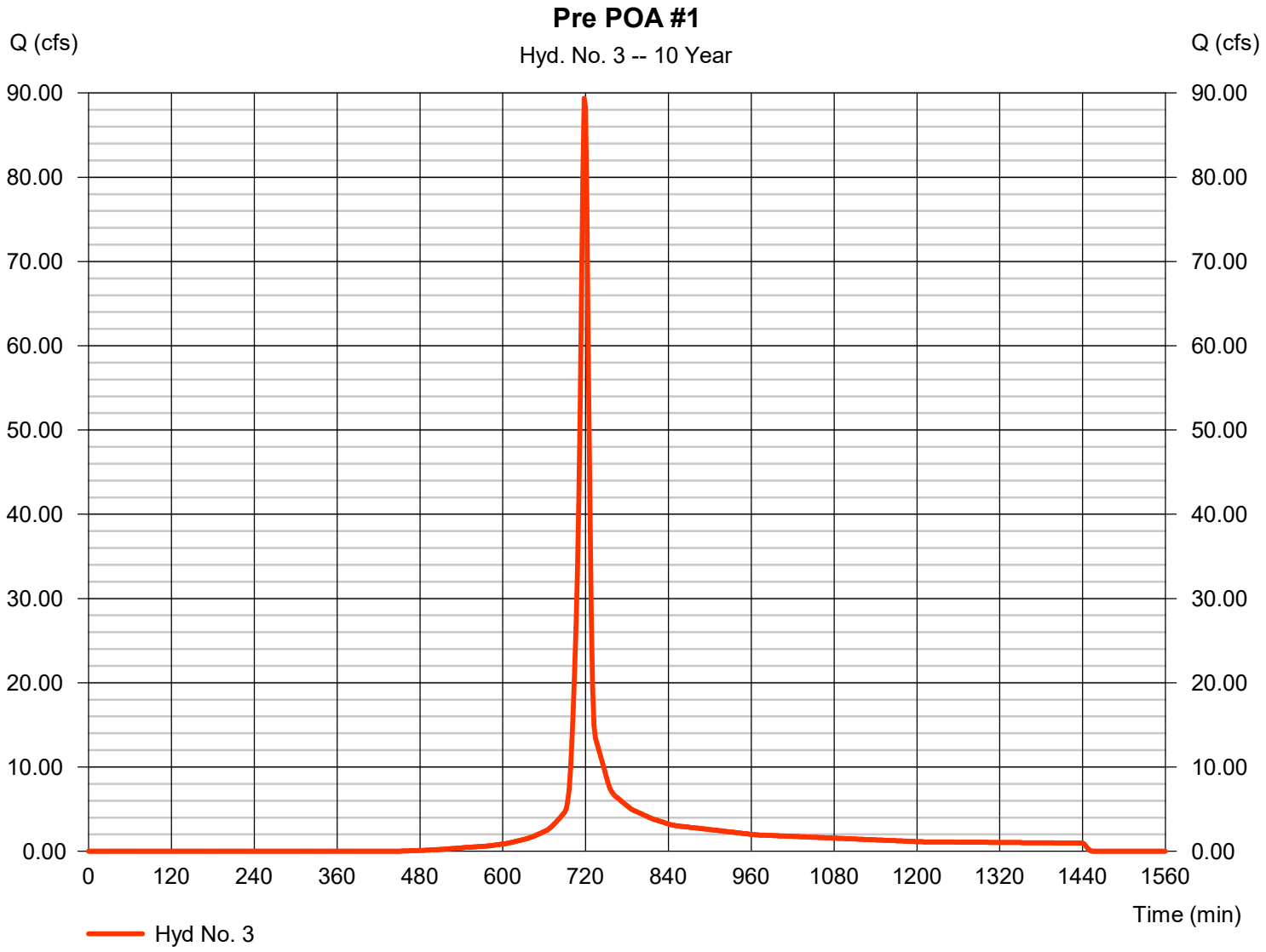


Hydrograph Report

Hyd. No. 3

Pre POA #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	89.35 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	204,872 cuft
Drainage area	=	19.900 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	9.70 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

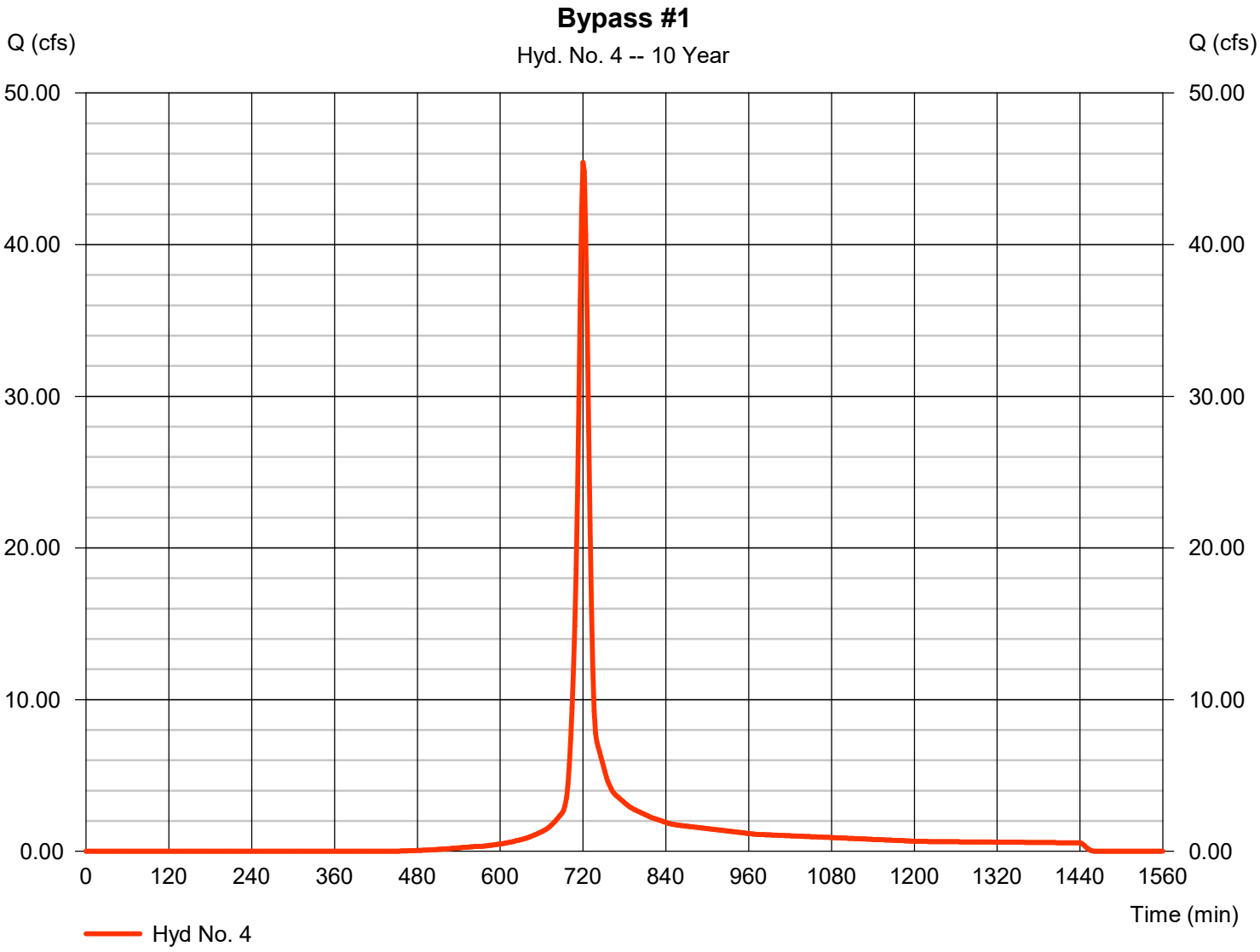


Hydrograph Report

Hyd. No. 4

Bypass #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	45.43 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	117,847 cuft
Drainage area	=	11.100 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

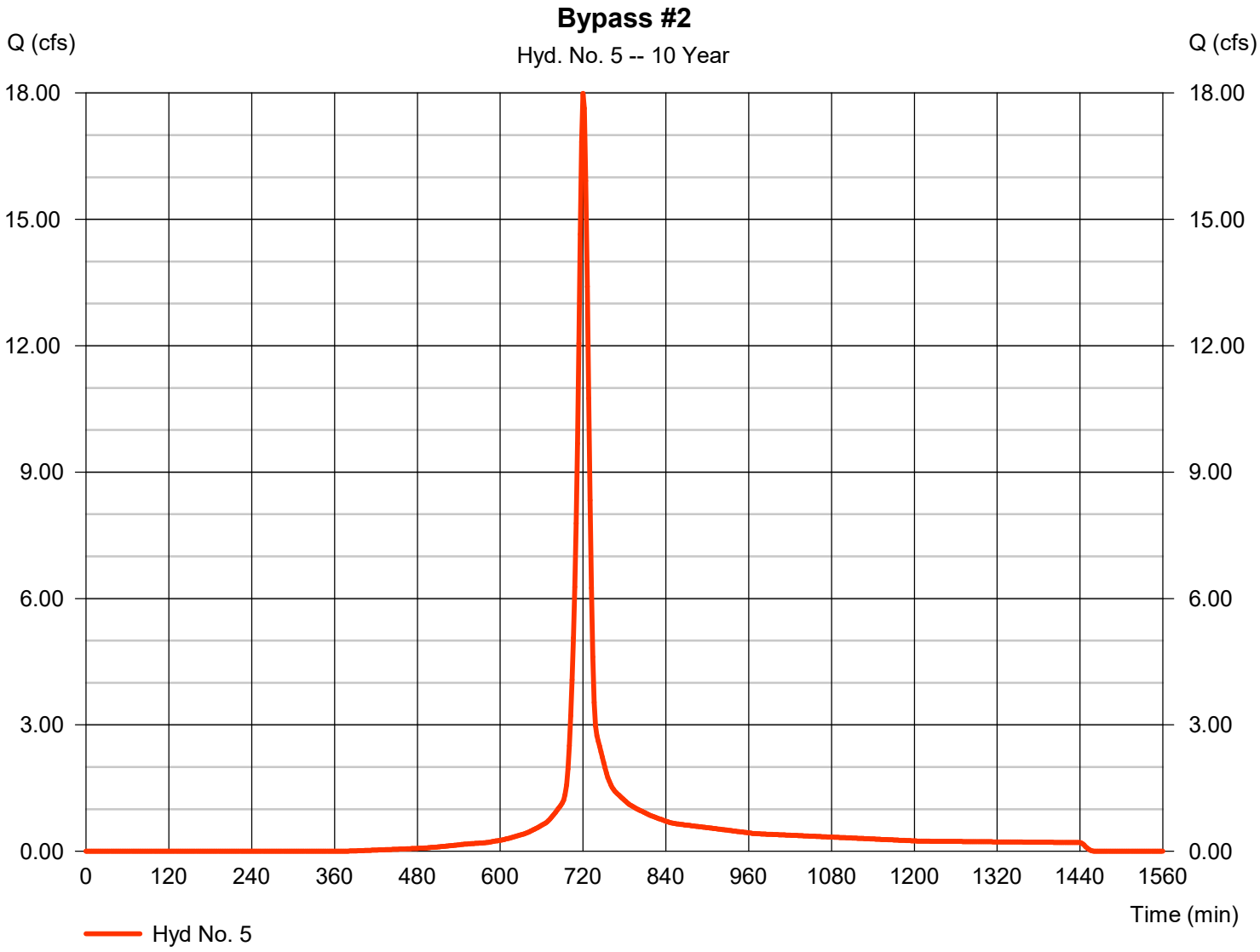


Hydrograph Report

Hyd. No. 5

Bypass #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.99 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	46,989 cuft
Drainage area	=	3.910 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

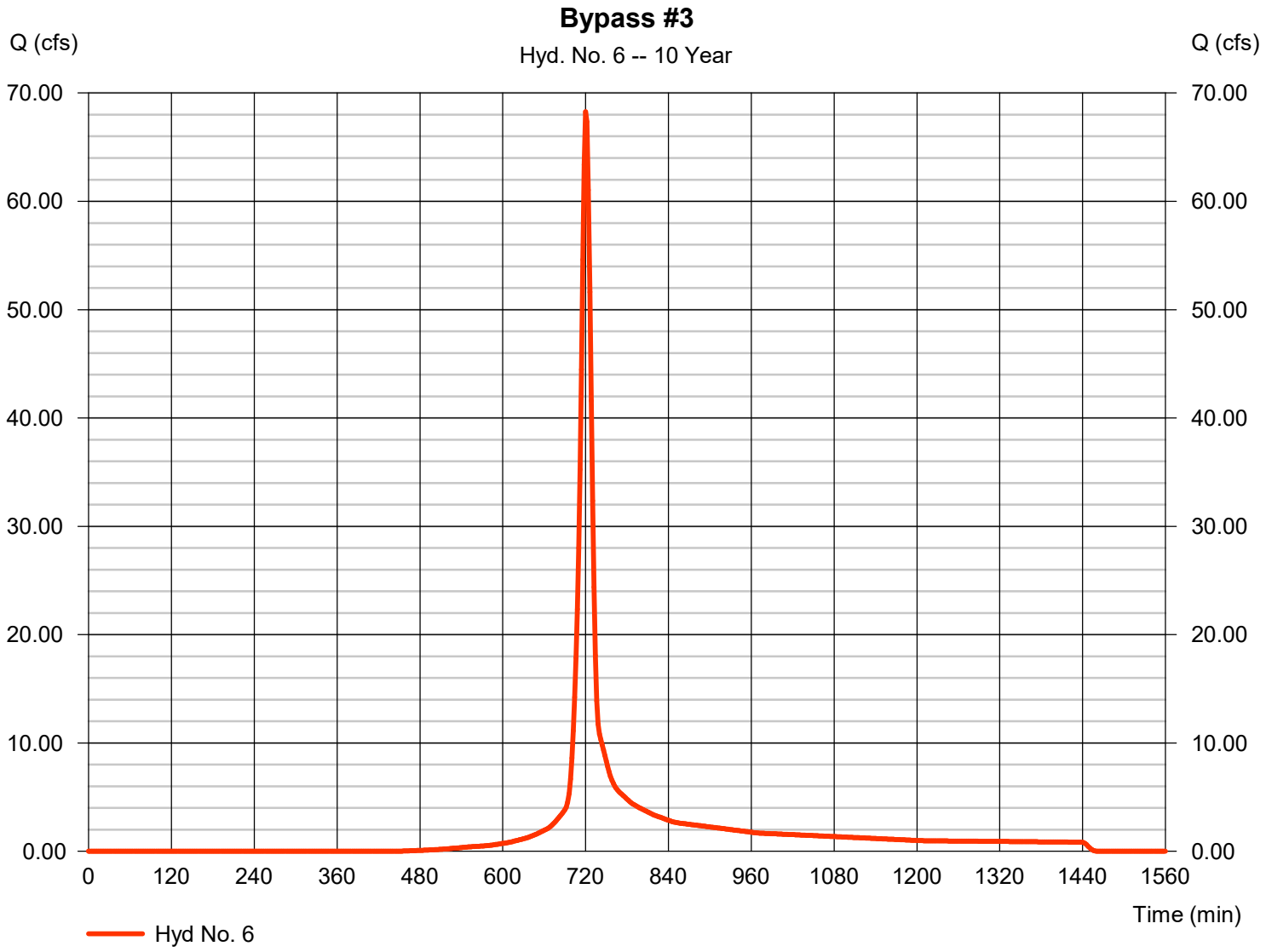


Hydrograph Report

Hyd. No. 6

Bypass #3

Hydrograph type	=	SCS Runoff	Peak discharge	=	68.27 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	177,089 cuft
Drainage area	=	16.680 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

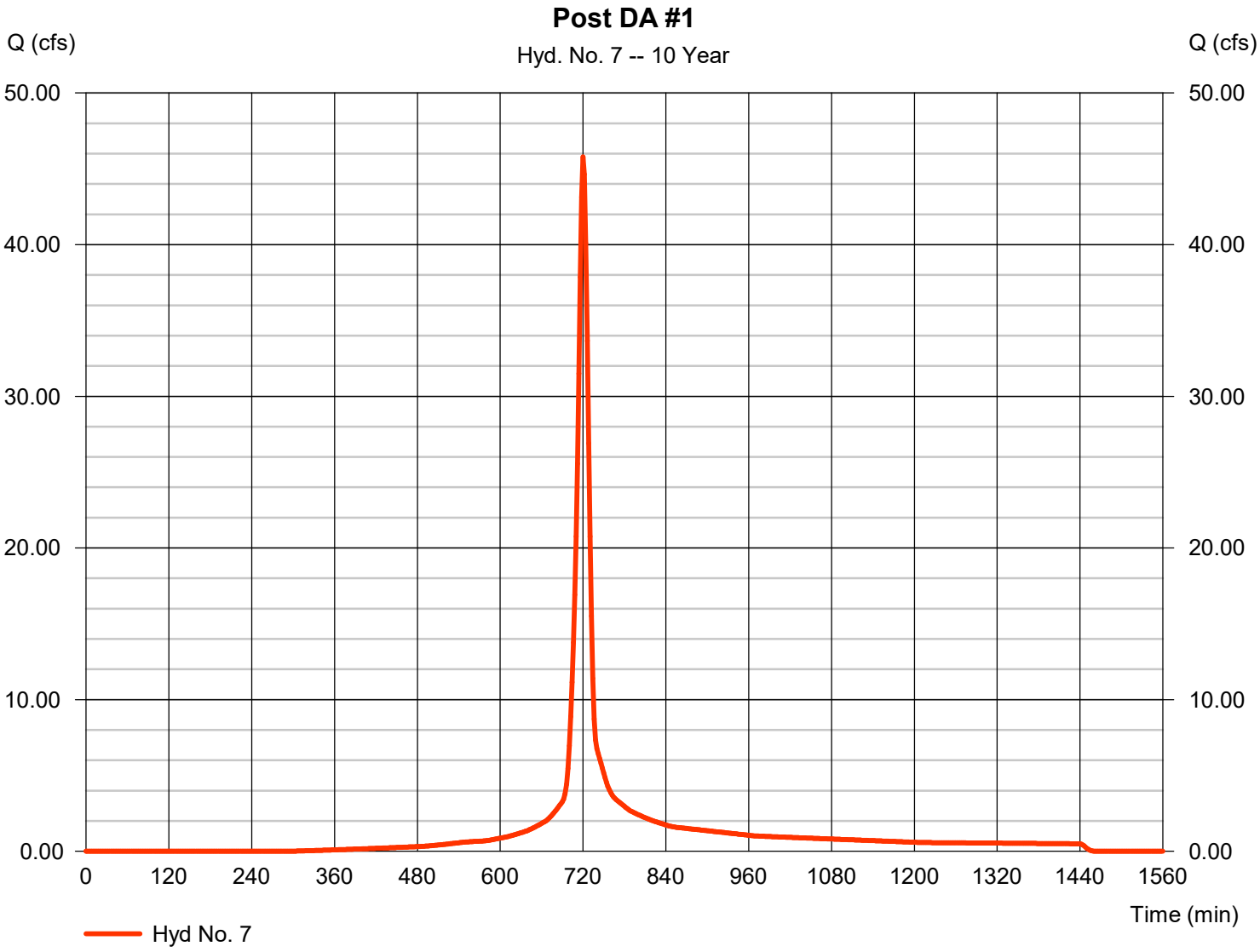


Hydrograph Report

Hyd. No. 7

Post DA #1

Hydrograph type	= SCS Runoff	Peak discharge	= 45.78 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 121,455 cuft
Drainage area	= 9.000 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

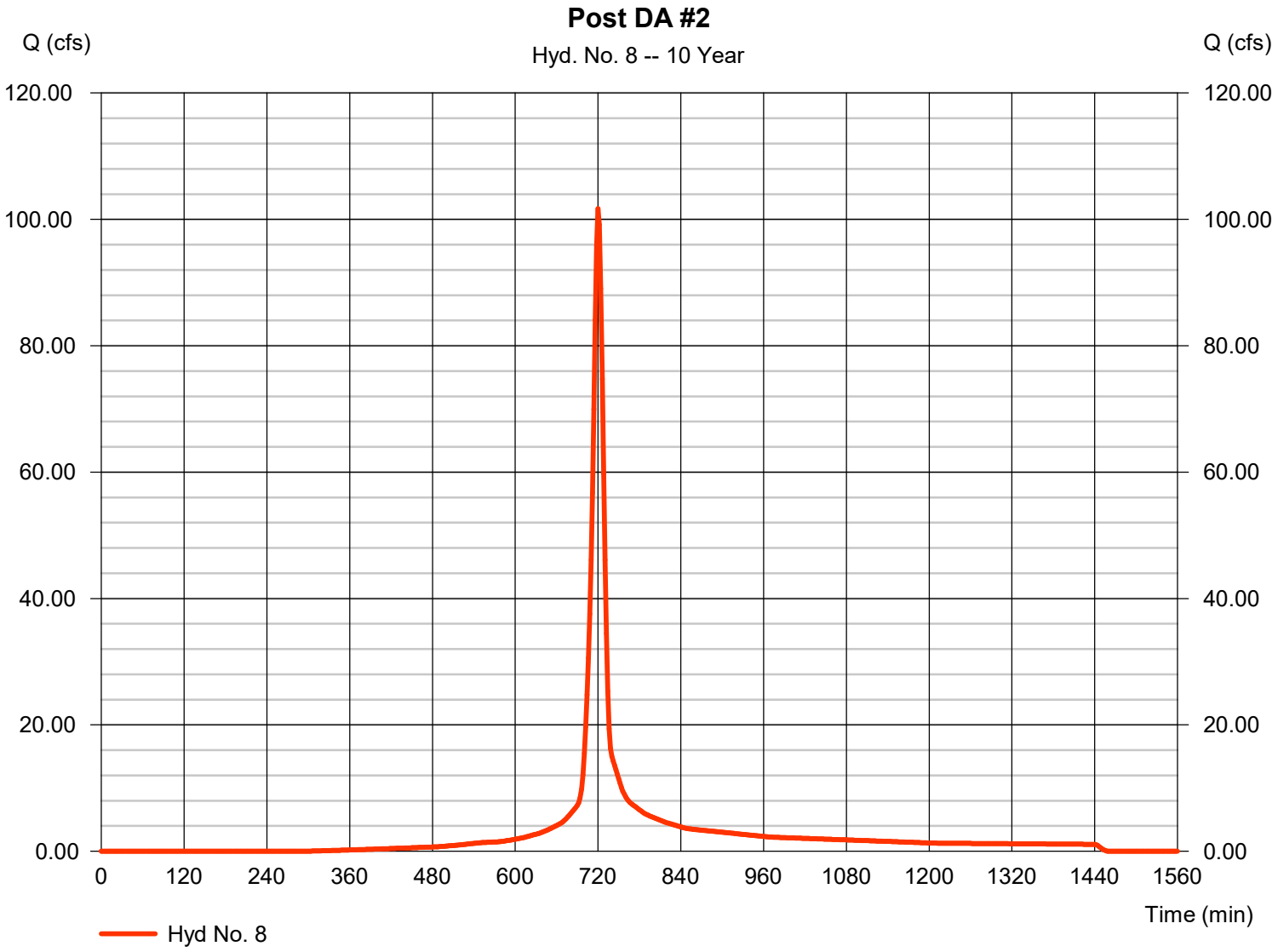


Hydrograph Report

Hyd. No. 8

Post DA #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	101.68 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	269,765 cuft
Drainage area	=	19.990 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

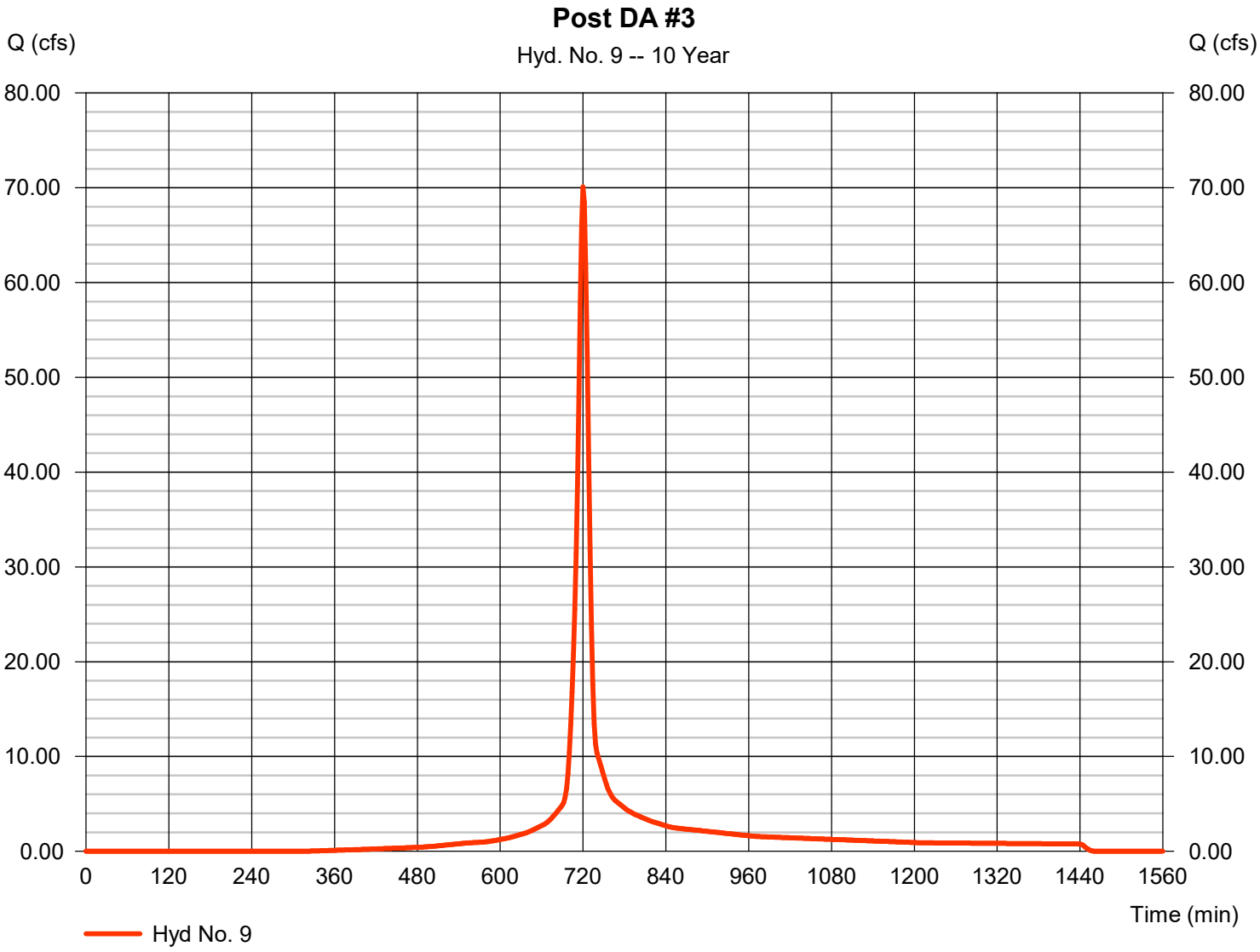


Hydrograph Report

Hyd. No. 9

Post DA #3

Hydrograph type	=	SCS Runoff	Peak discharge	=	70.10 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	185,099 cuft
Drainage area	=	14.110 ac	Curve number	=	86
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

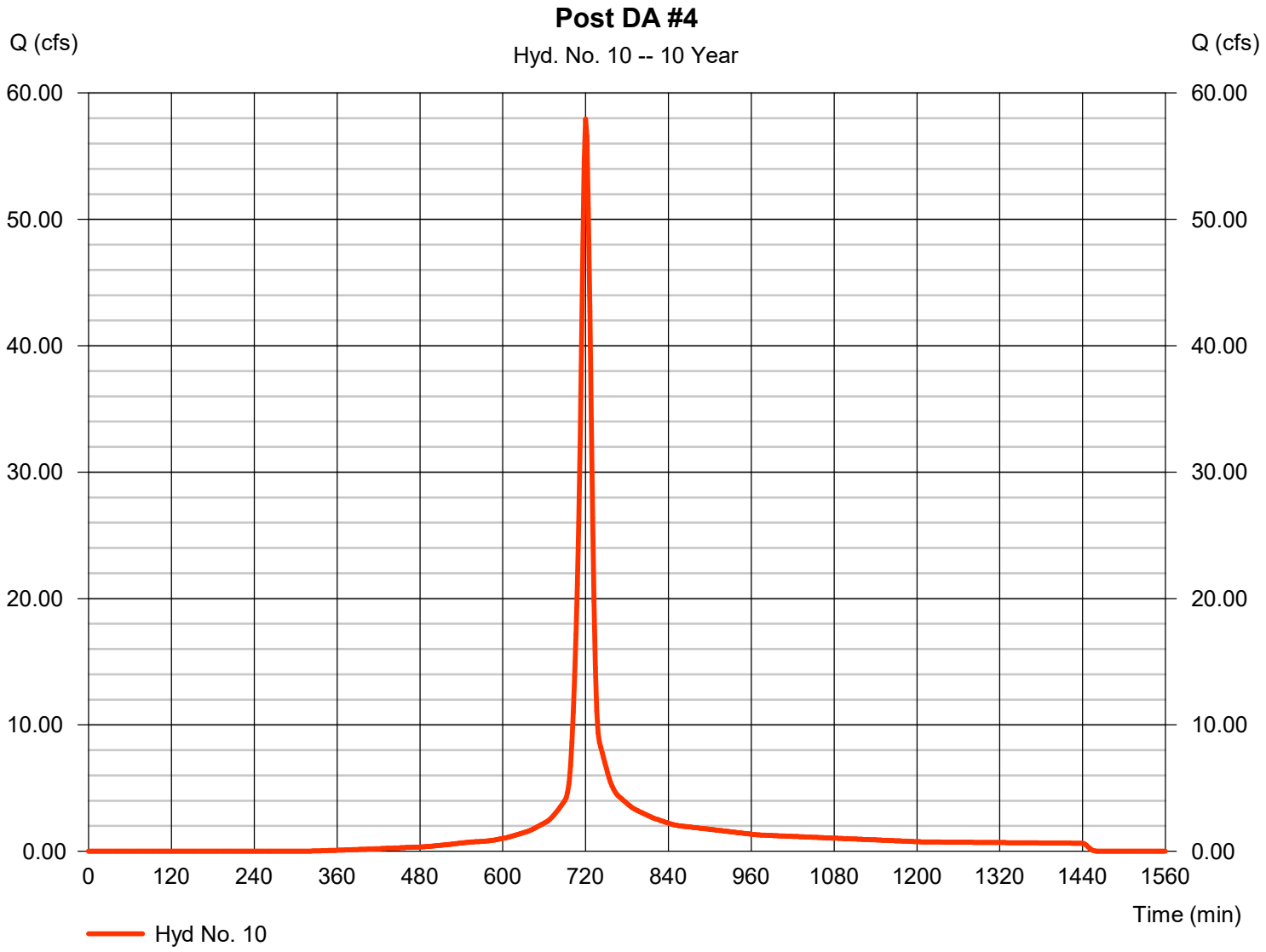


Hydrograph Report

Hyd. No. 10

Post DA #4

Hydrograph type	=	SCS Runoff	Peak discharge	=	57.93 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	152,960 cuft
Drainage area	=	11.660 ac	Curve number	=	86
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



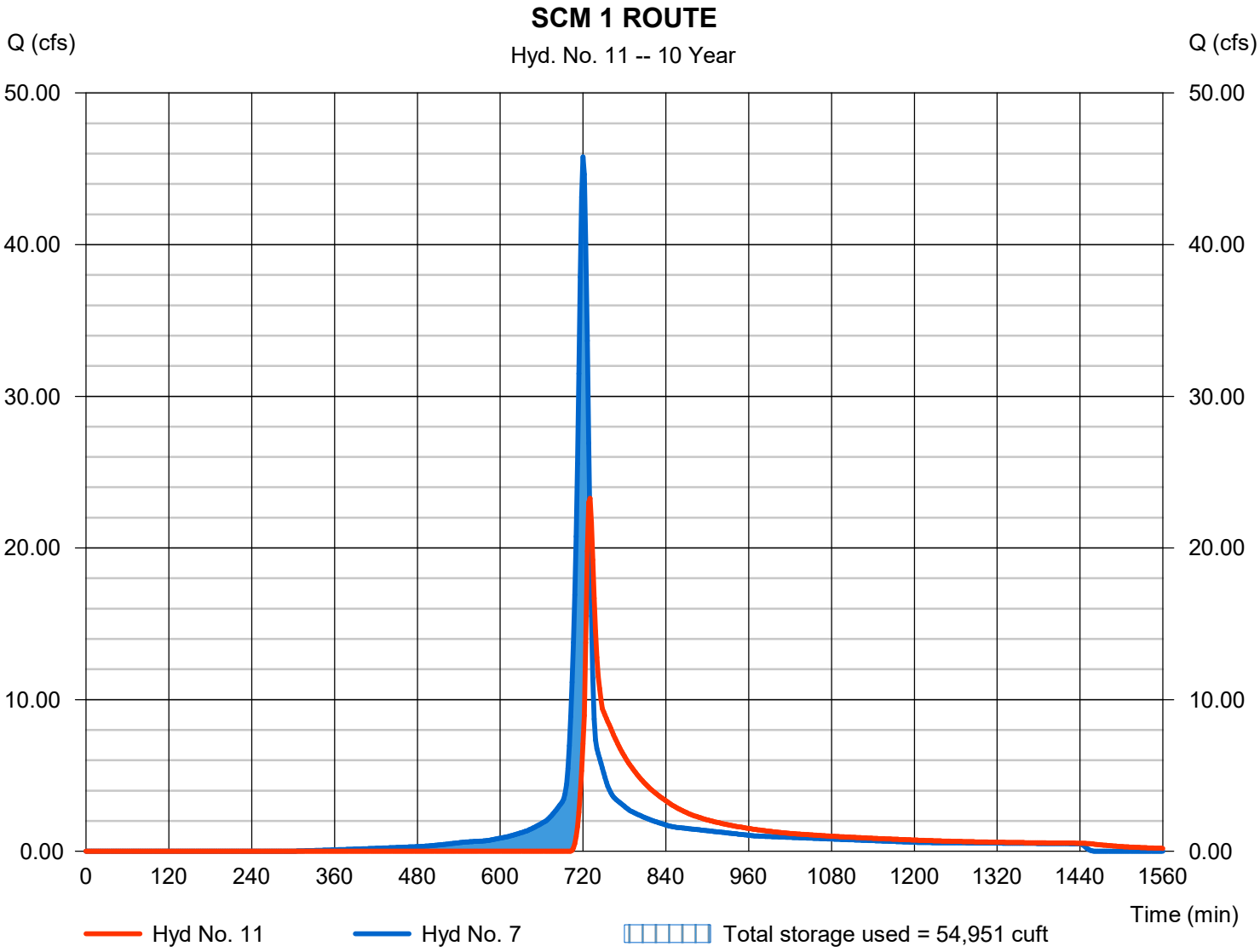
Hydrograph Report

Hyd. No. 11

SCM 1 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	23.27 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	102,987 cuft
Inflow hyd. No.	=	7 - Post DA #1	Max. Elevation	=	388.35 ft
Reservoir name	=	SCM 1	Max. Storage	=	54,951 cuft

Storage Indication method used.



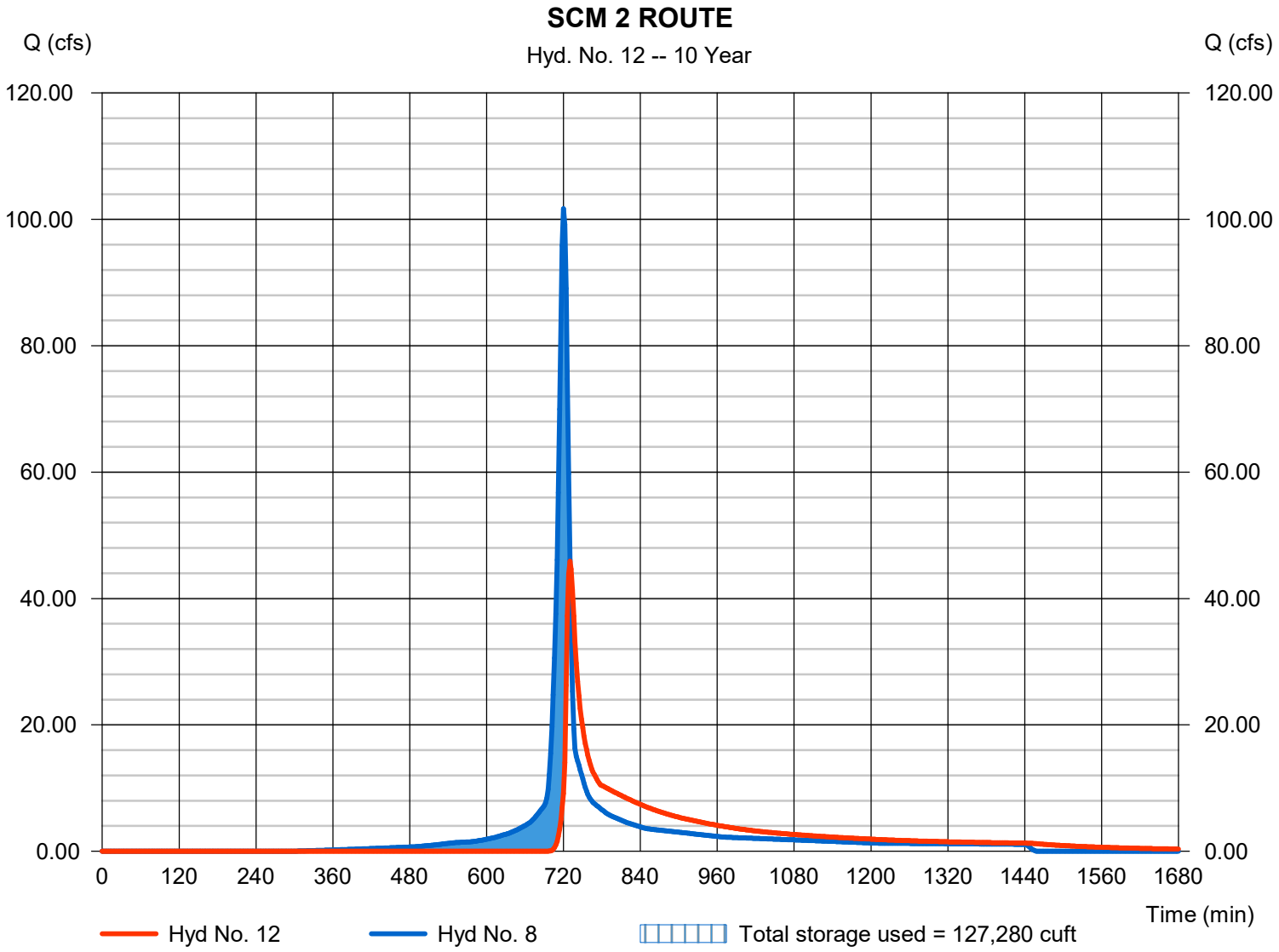
Hydrograph Report

Hyd. No. 12

SCM 2 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	45.89 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	238,524 cuft
Inflow hyd. No.	=	8 - Post DA #2	Max. Elevation	=	355.68 ft
Reservoir name	=	SCM 2	Max. Storage	=	127,280 cuft

Storage Indication method used.



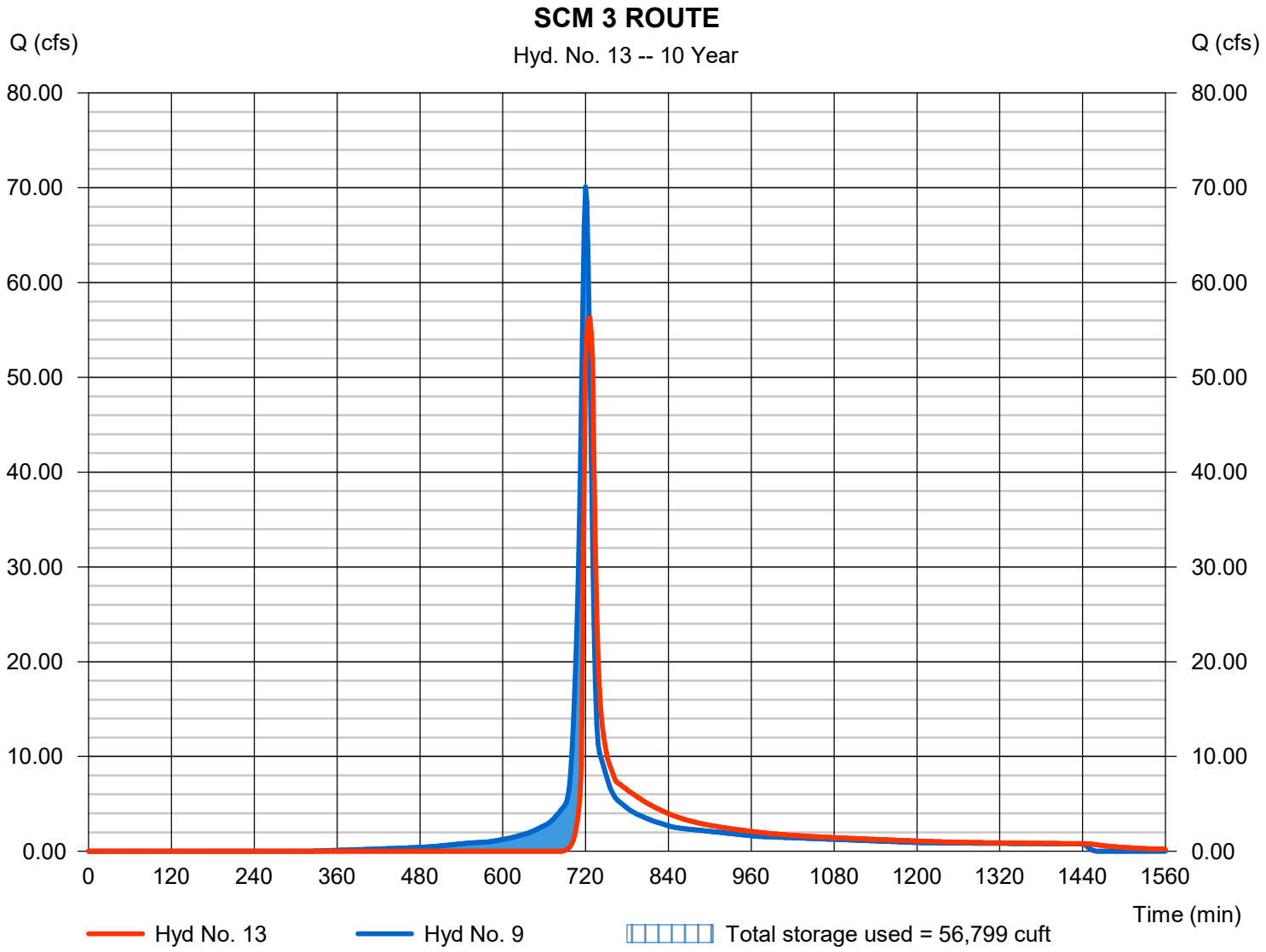
Hydrograph Report

Hyd. No. 13

SCM 3 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	56.26 cfs
Storm frequency	=	10 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	165,465 cuft
Inflow hyd. No.	=	9 - Post DA #3	Max. Elevation	=	389.03 ft
Reservoir name	=	SCM 3	Max. Storage	=	56,799 cuft

Storage Indication method used.



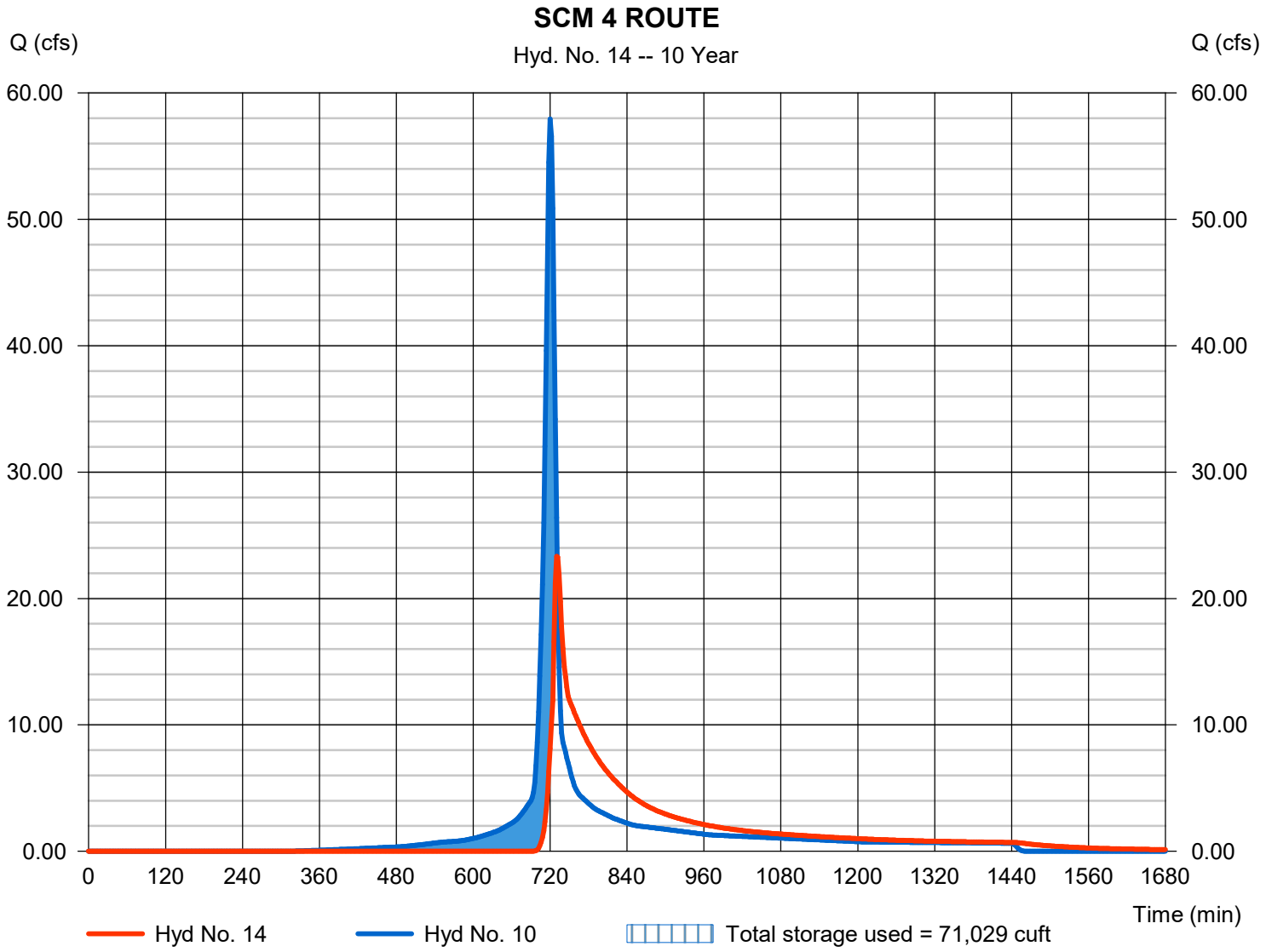
Hydrograph Report

Hyd. No. 14

SCM 4 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	23.34 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	134,884 cuft
Inflow hyd. No.	=	10 - Post DA #4	Max. Elevation	=	384.30 ft
Reservoir name	=	SCM 4	Max. Storage	=	71,029 cuft

Storage Indication method used.

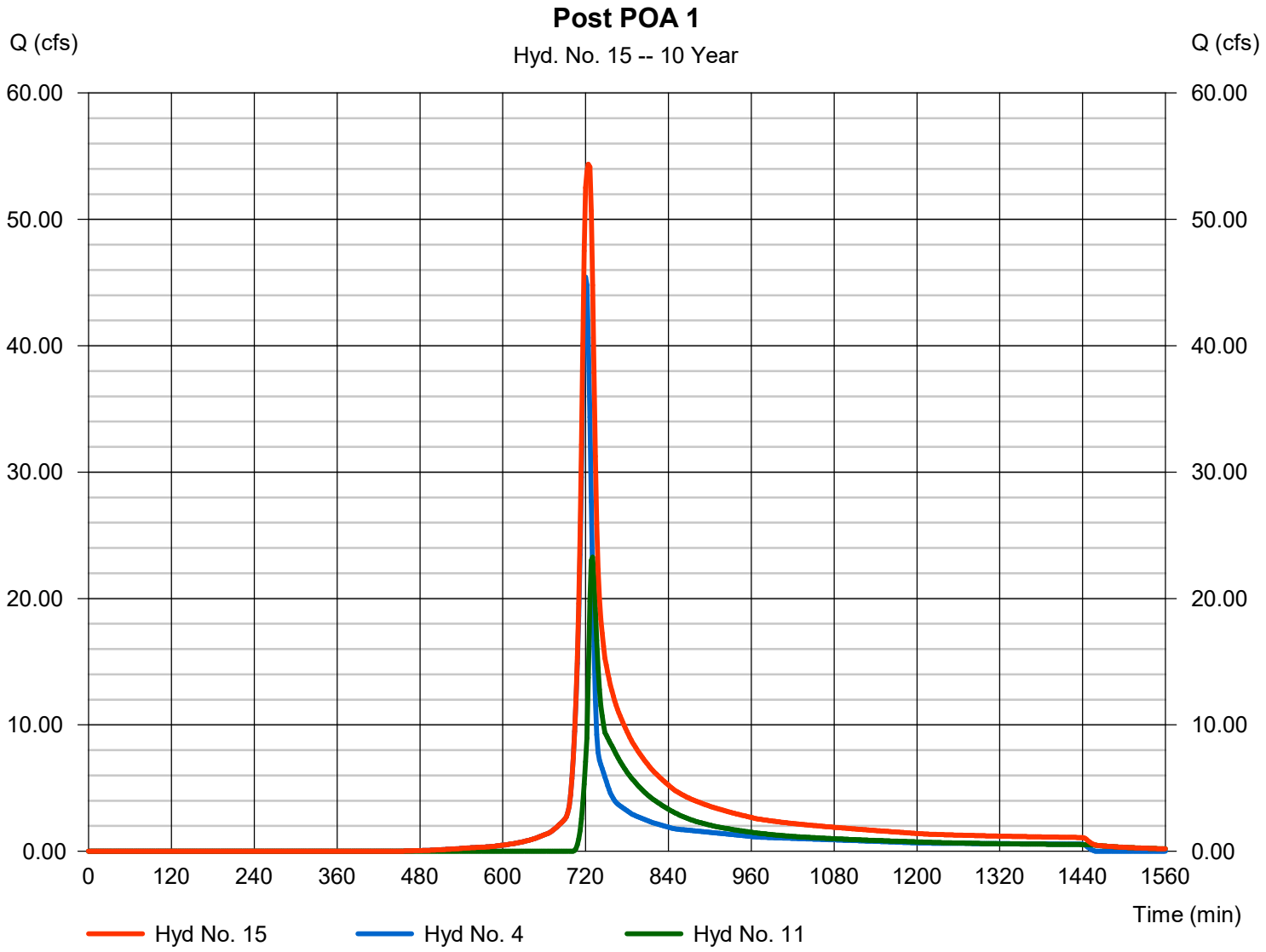


Hydrograph Report

Hyd. No. 15

Post POA 1

Hydrograph type	= Combine	Peak discharge	= 54.36 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 220,834 cuft
Inflow hyds.	= 4, 11	Contrib. drain. area	= 11.100 ac

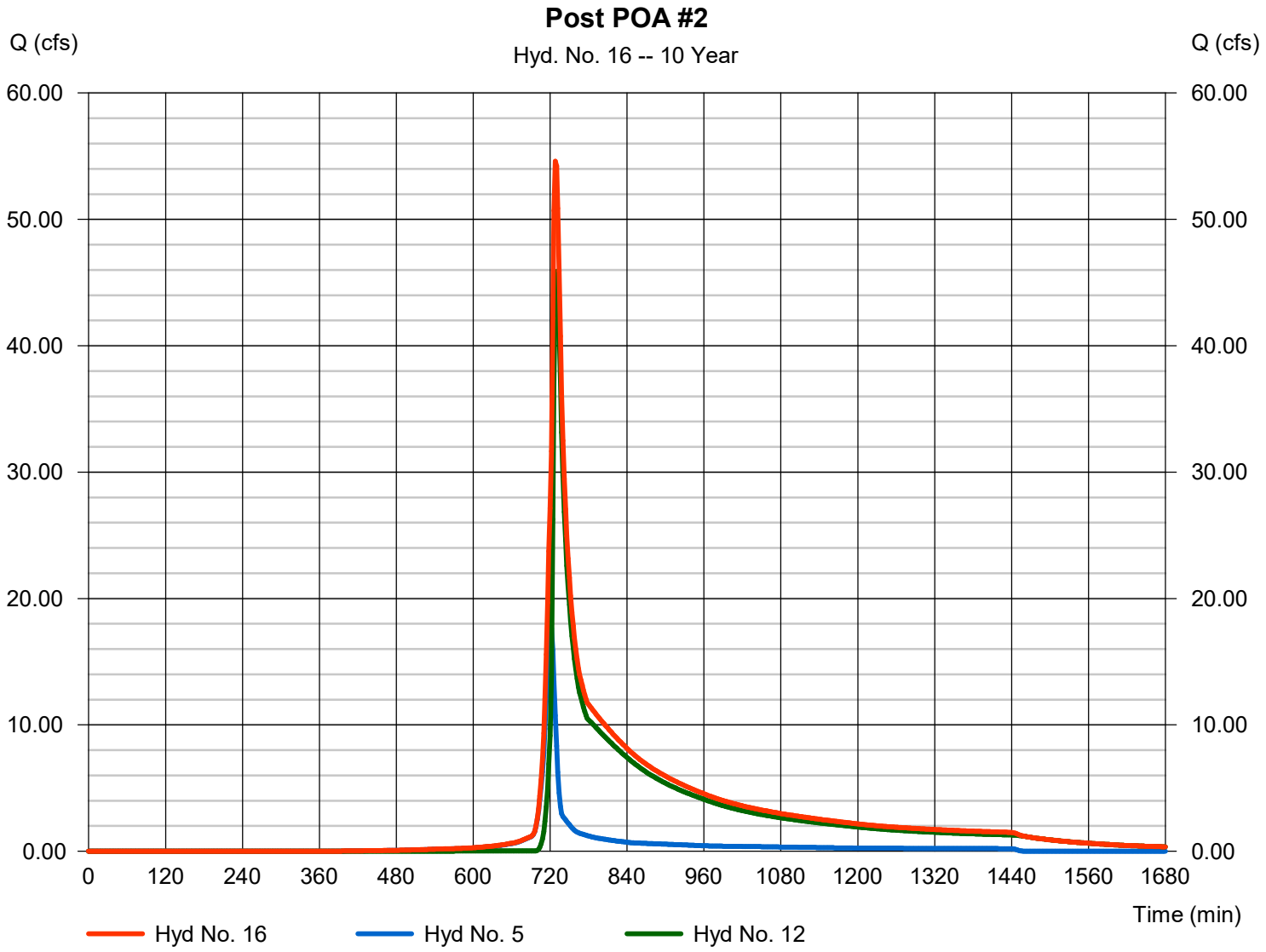


Hydrograph Report

Hyd. No. 16

Post POA #2

Hydrograph type	= Combine	Peak discharge	= 54.59 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 285,513 cuft
Inflow hyds.	= 5, 12	Contrib. drain. area	= 3.910 ac

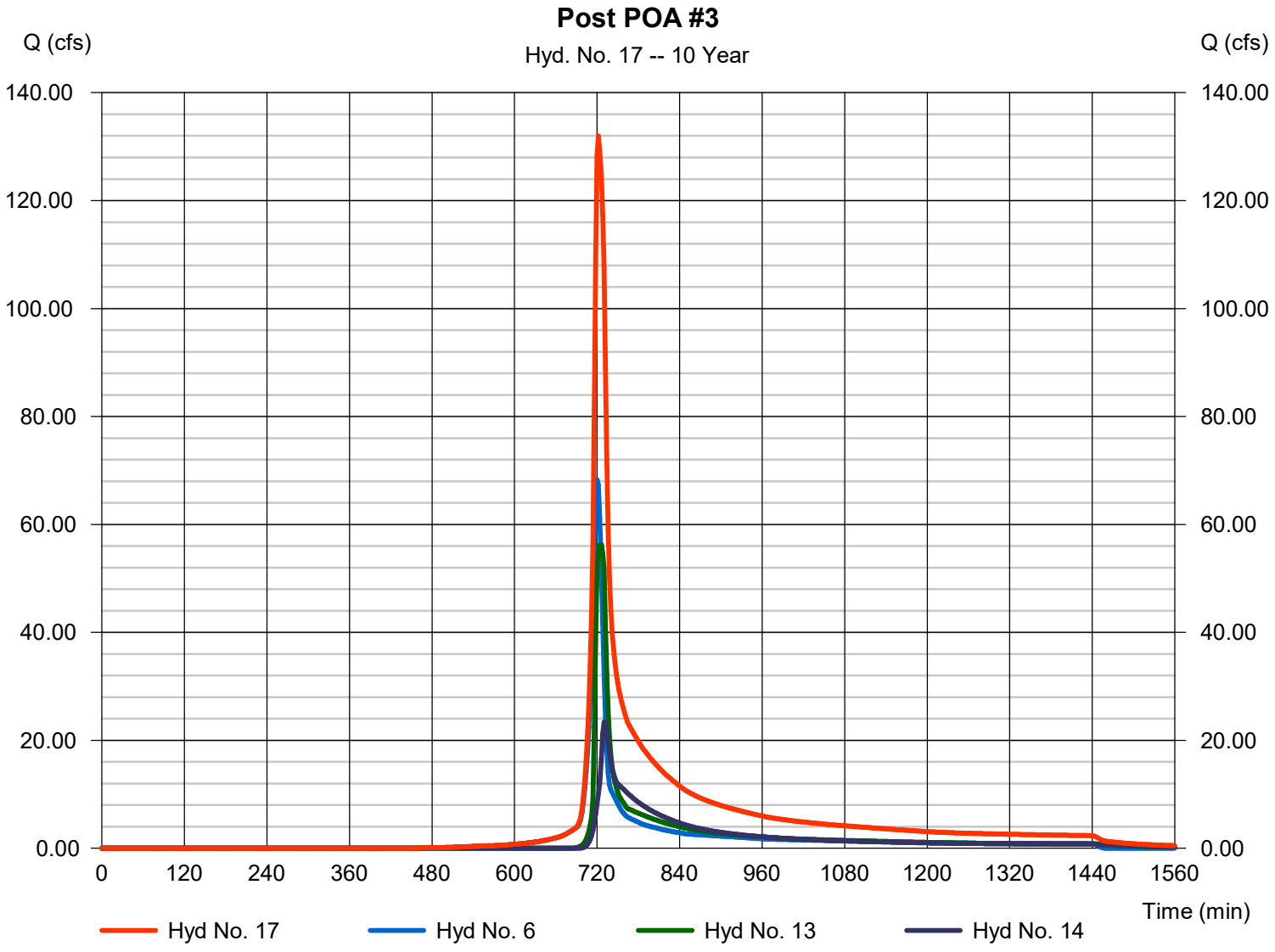


Hydrograph Report

Hyd. No. 17

Post POA #3

Hydrograph type	= Combine	Peak discharge	= 131.98 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 477,438 cuft
Inflow hyds.	= 6, 13, 14	Contrib. drain. area	= 16.680 ac

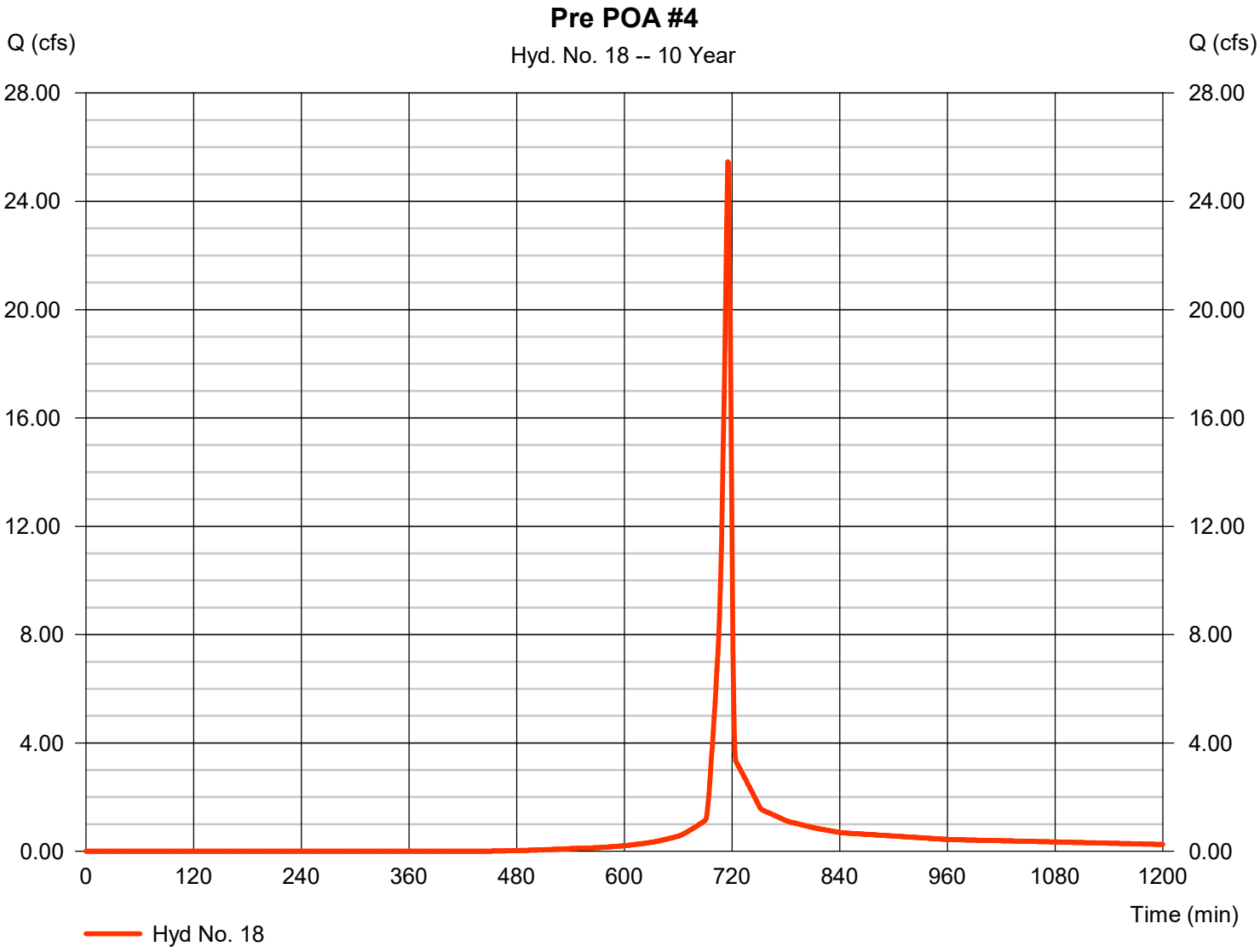


Hydrograph Report

Hyd. No. 18

Pre POA #4

Hydrograph type	= SCS Runoff	Peak discharge	= 25.45 cfs
Storm frequency	= 10 yrs	Time to peak	= 715 min
Time interval	= 1 min	Hyd. volume	= 45,556 cuft
Drainage area	= 4.720 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 2.10 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

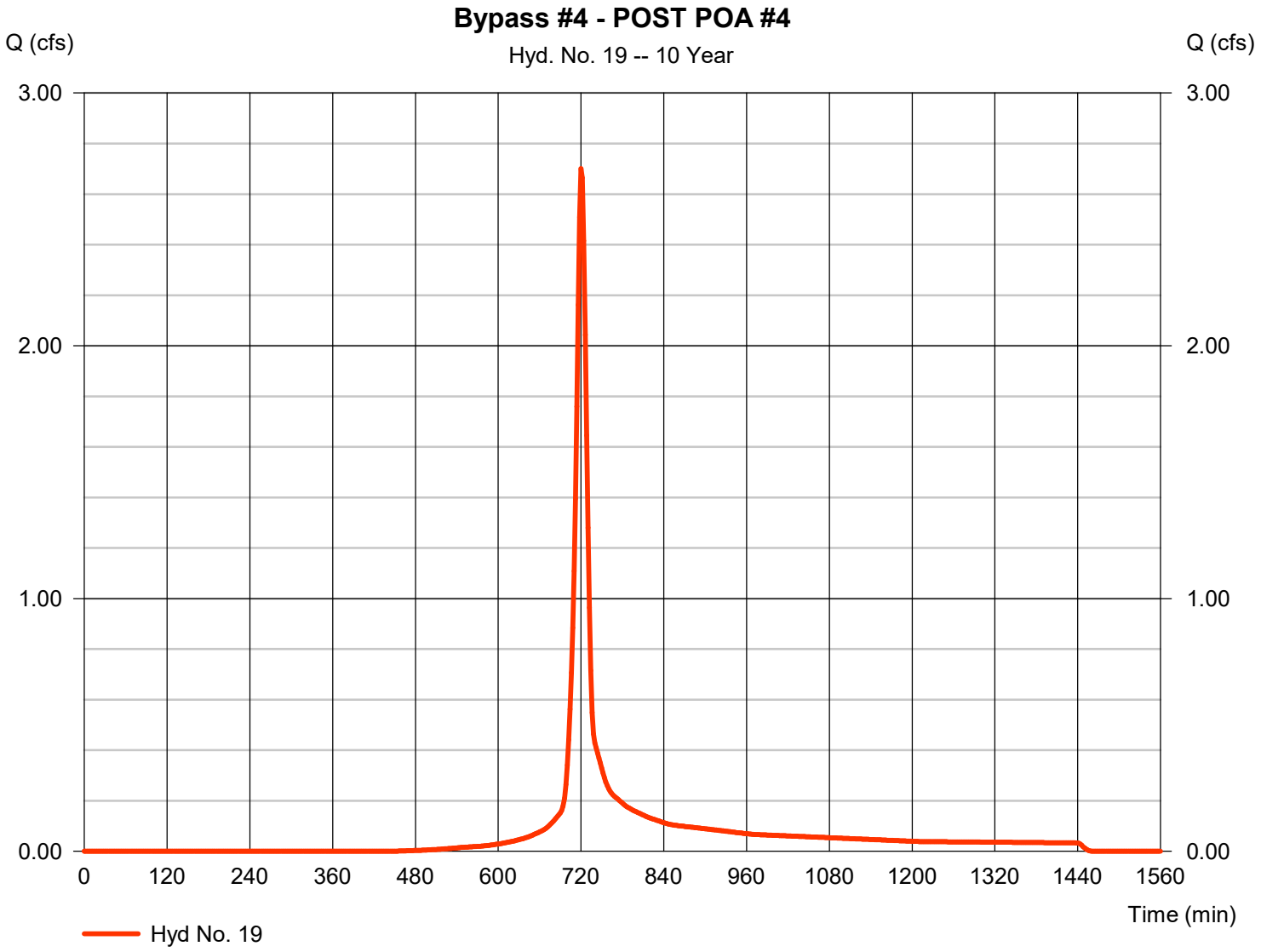


Hydrograph Report

Hyd. No. 19

Bypass #4 - POST POA #4

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.701 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	7,007 cuft
Drainage area	=	0.660 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

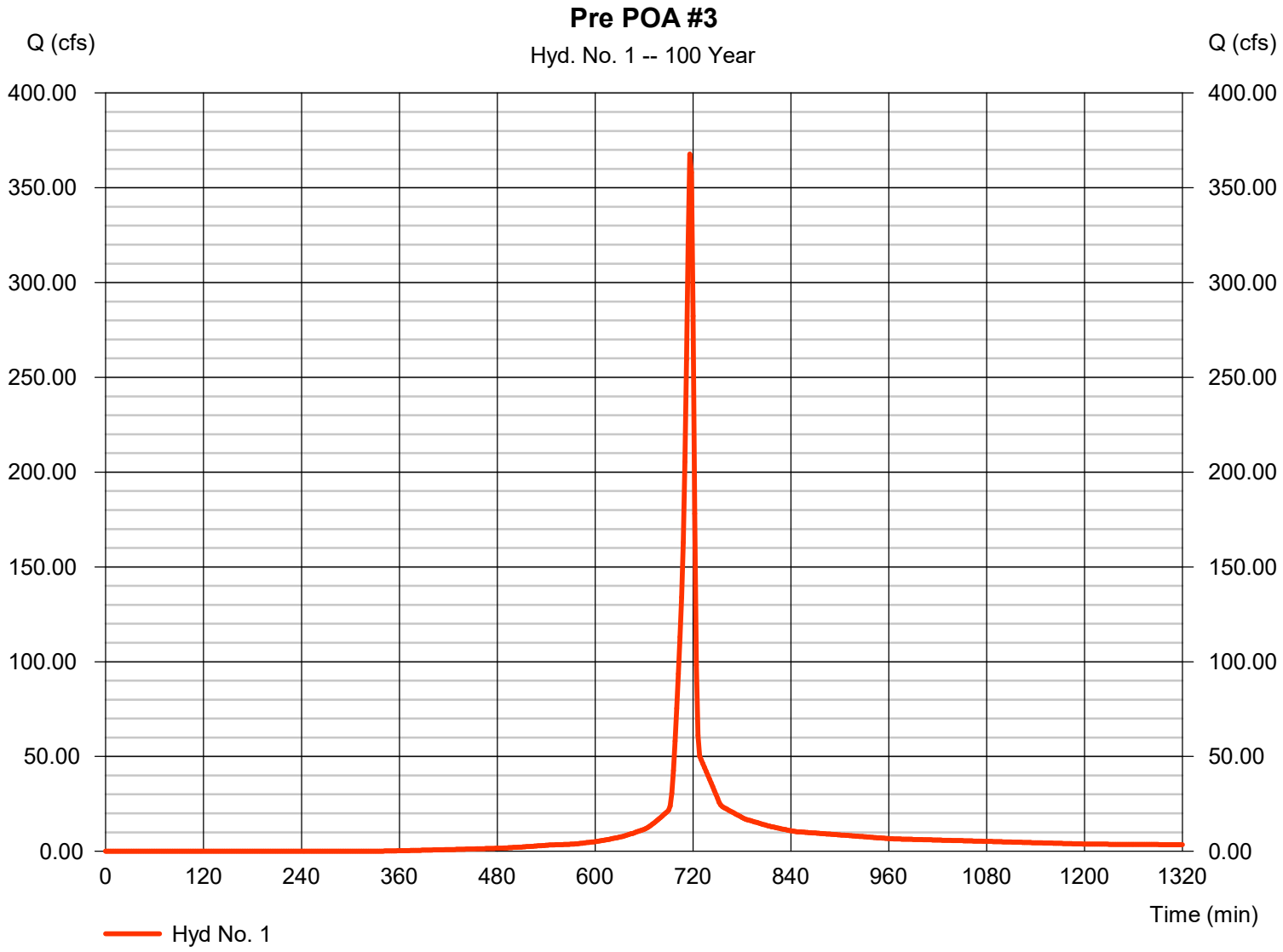
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	367.67	2	716	762,560	------	------	------	Pre POA #3
2	SCS Runoff	164.45	2	716	347,475	------	------	------	Pre POA #2
3	SCS Runoff	157.92	2	718	368,380	------	------	------	Pre POA #1
4	SCS Runoff	80.61	2	720	211,900	------	------	------	Bypass #1
5	SCS Runoff	30.50	2	720	81,355	------	------	------	Bypass #2
6	SCS Runoff	121.13	2	720	318,422	------	------	------	Bypass #3
7	SCS Runoff	74.50	2	720	202,884	------	------	------	Post DA #1
8	SCS Runoff	165.46	2	720	450,628	------	------	------	Post DA #2
9	SCS Runoff	115.21	2	720	311,930	------	------	------	Post DA #3
10	SCS Runoff	95.20	2	720	257,768	------	------	------	Post DA #4
11	Reservoir	57.41	2	726	184,416	7	389.02	66,694	SCM 1 ROUTE
12	Reservoir	117.84	2	726	419,300	8	356.79	167,294	SCM 2 ROUTE
13	Reservoir	105.11	2	724	292,295	9	389.72	67,974	SCM 3 ROUTE
14	Reservoir	69.40	2	726	239,692	10	385.12	89,233	SCM 4 ROUTE
15	Combine	134.51	2	722	396,316	4, 11,	------	------	Post POA 1
16	Combine	140.19	2	726	500,654	5, 12,	------	------	Post POA #2
17	Combine	286.72	2	722	850,409	6, 13, 14,	------	------	Post POA #3
18	SCS Runoff	44.48	1	715	81,914	------	------	------	Pre POA #4
19	SCS Runoff	4.793	2	720	12,599	------	------	------	Bypass #4 - POST POA #4

Hydrograph Report

Hyd. No. 1

Pre POA #3

Hydrograph type	=	SCS Runoff	Peak discharge	=	367.67 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	762,560 cuft
Drainage area	=	43.940 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	3.10 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

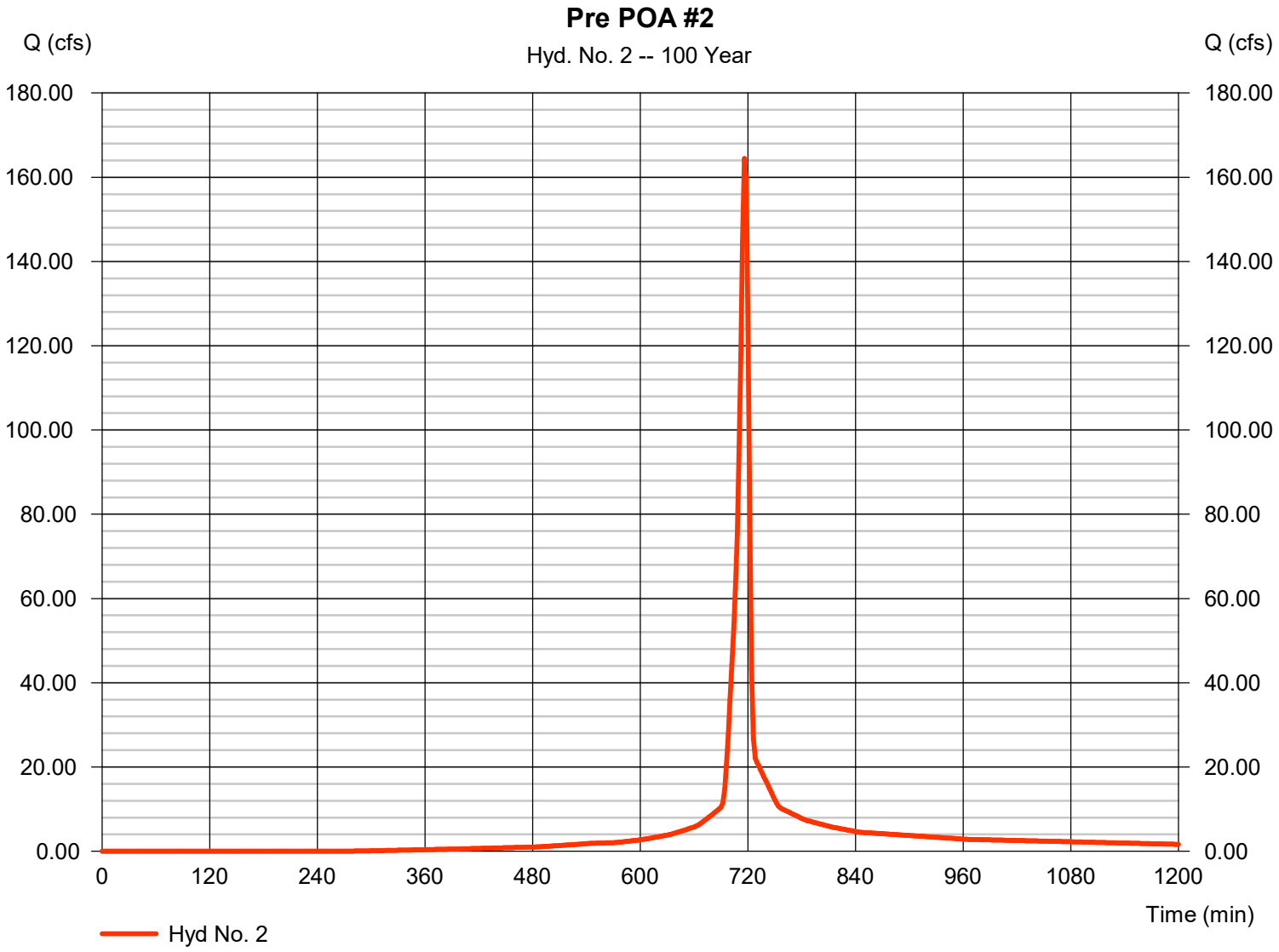


Hydrograph Report

Hyd. No. 2

Pre POA #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	164.45 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	347,475 cuft
Drainage area	=	18.370 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	5.60 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

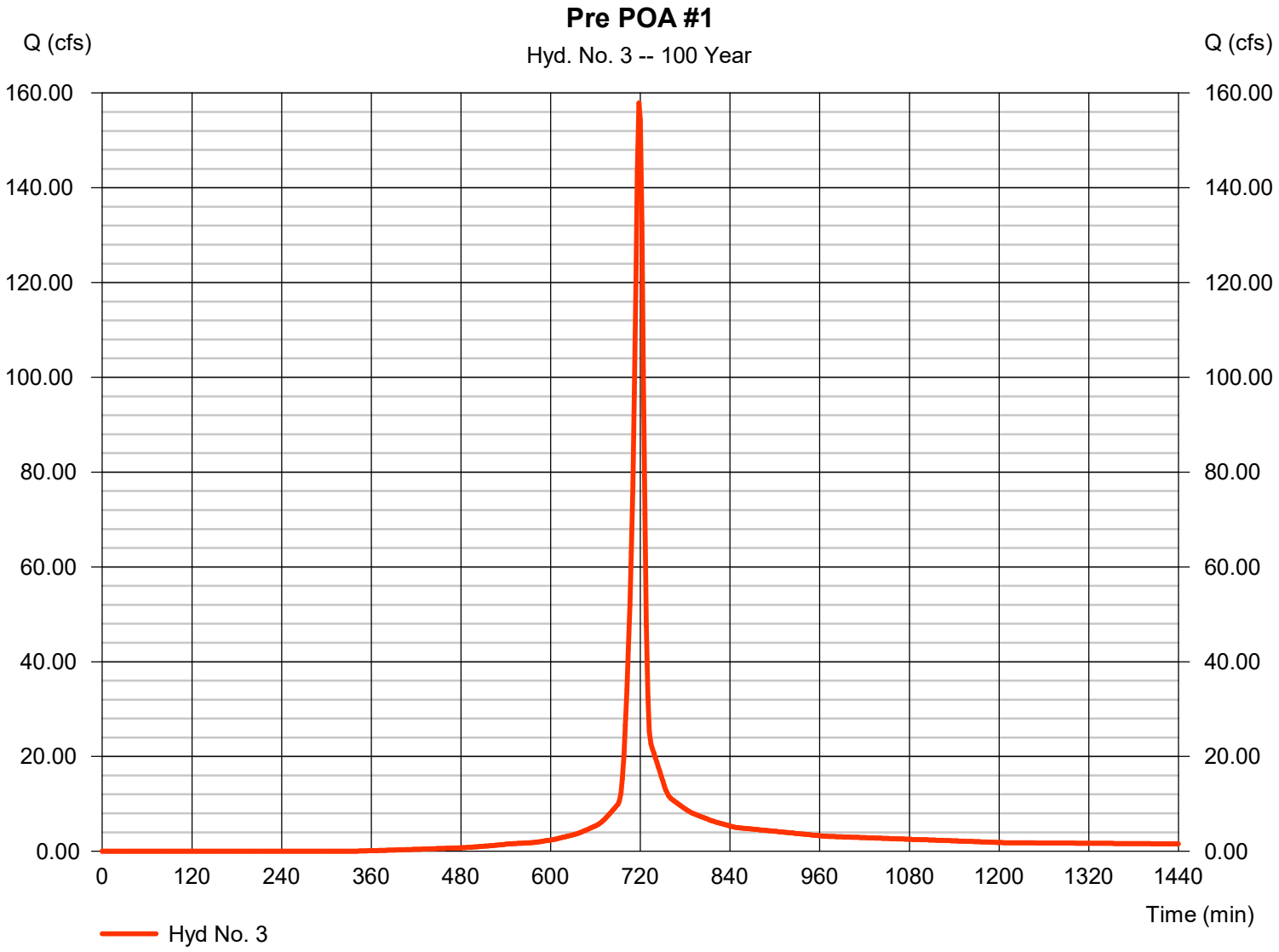


Hydrograph Report

Hyd. No. 3

Pre POA #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	157.92 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	368,380 cuft
Drainage area	=	19.900 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	9.70 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

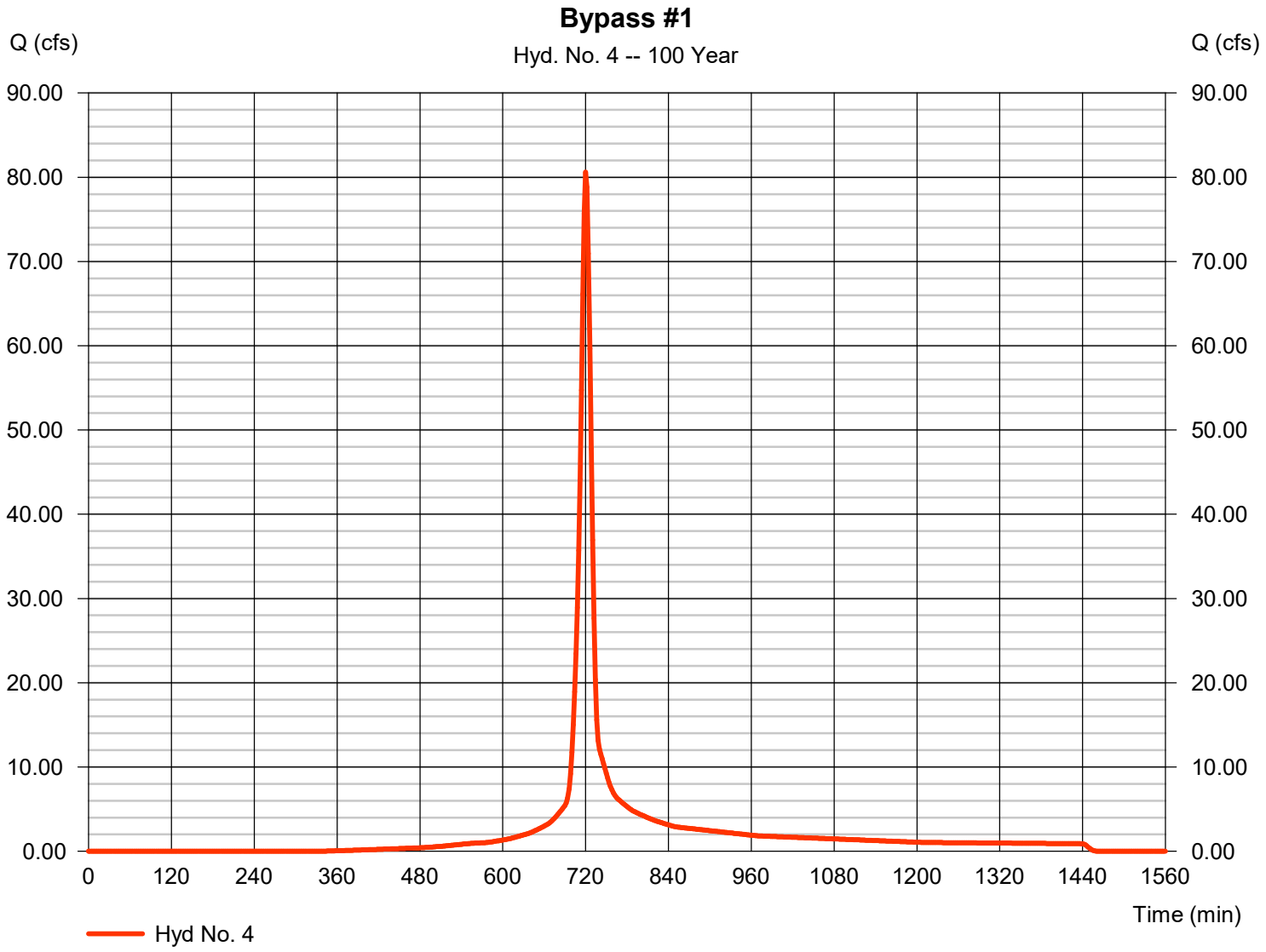


Hydrograph Report

Hyd. No. 4

Bypass #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	80.61 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	211,900 cuft
Drainage area	=	11.100 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

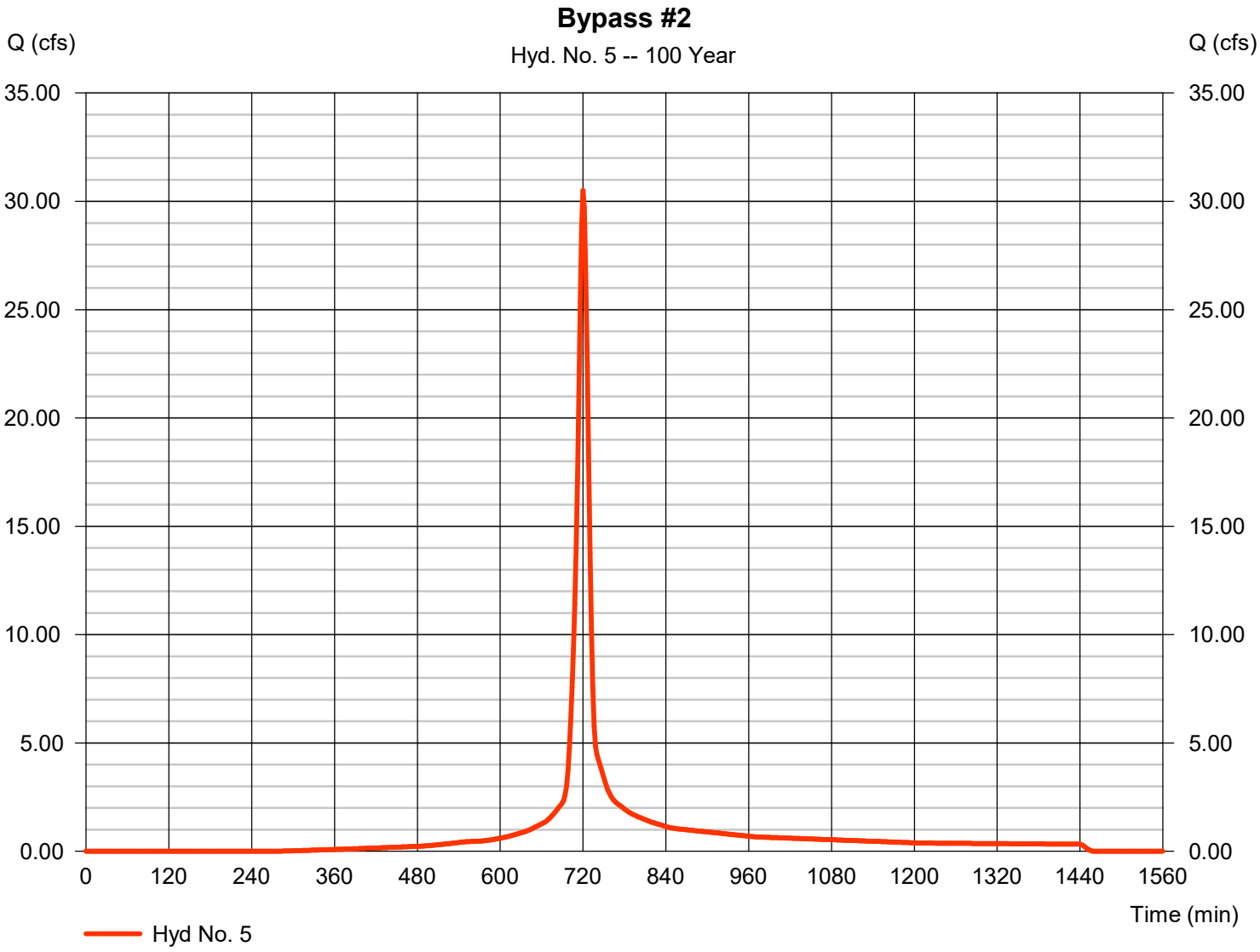


Hydrograph Report

Hyd. No. 5

Bypass #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	30.50 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	81,355 cuft
Drainage area	=	3.910 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

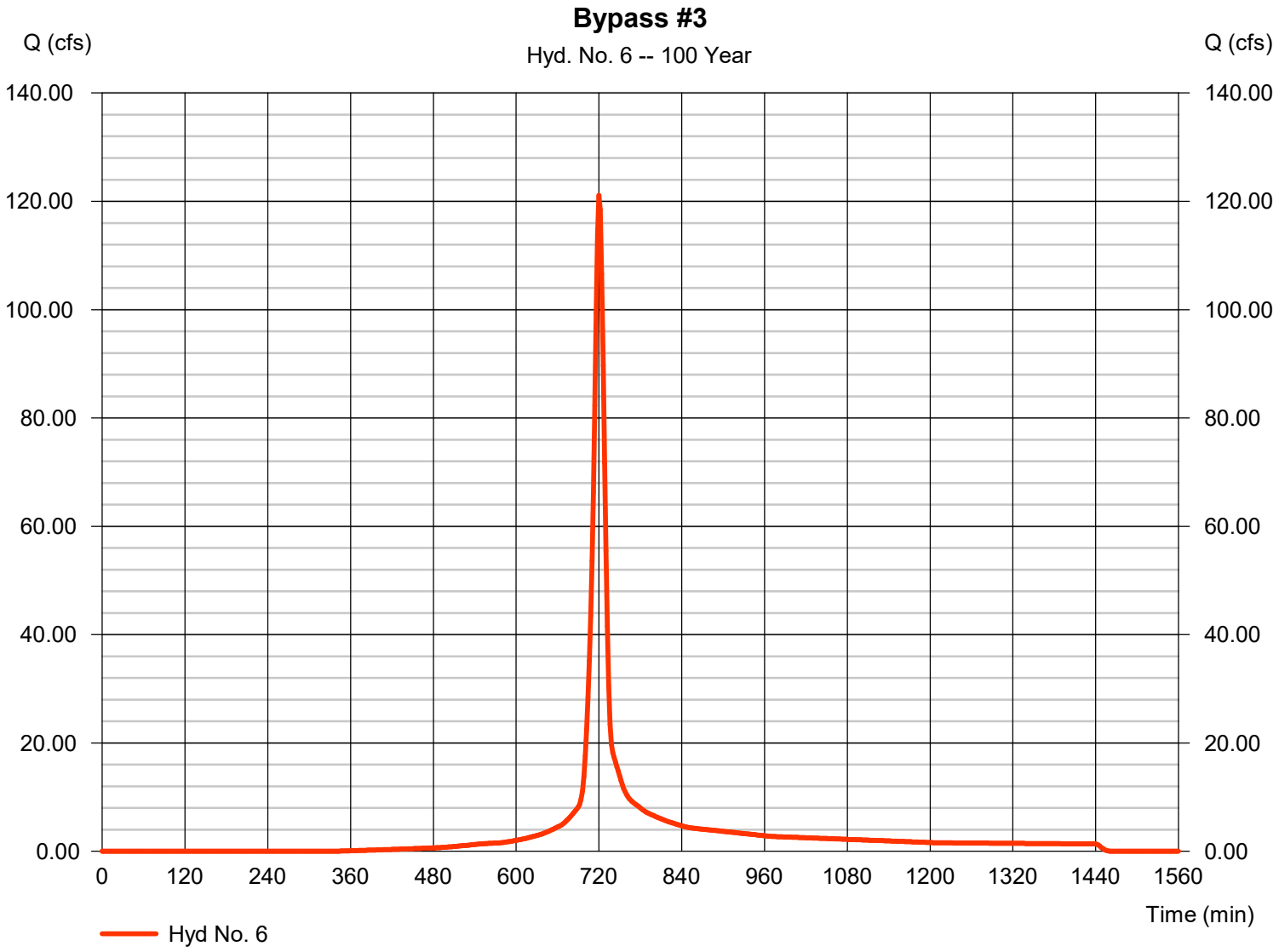


Hydrograph Report

Hyd. No. 6

Bypass #3

Hydrograph type	=	SCS Runoff	Peak discharge	=	121.13 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	318,422 cuft
Drainage area	=	16.680 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

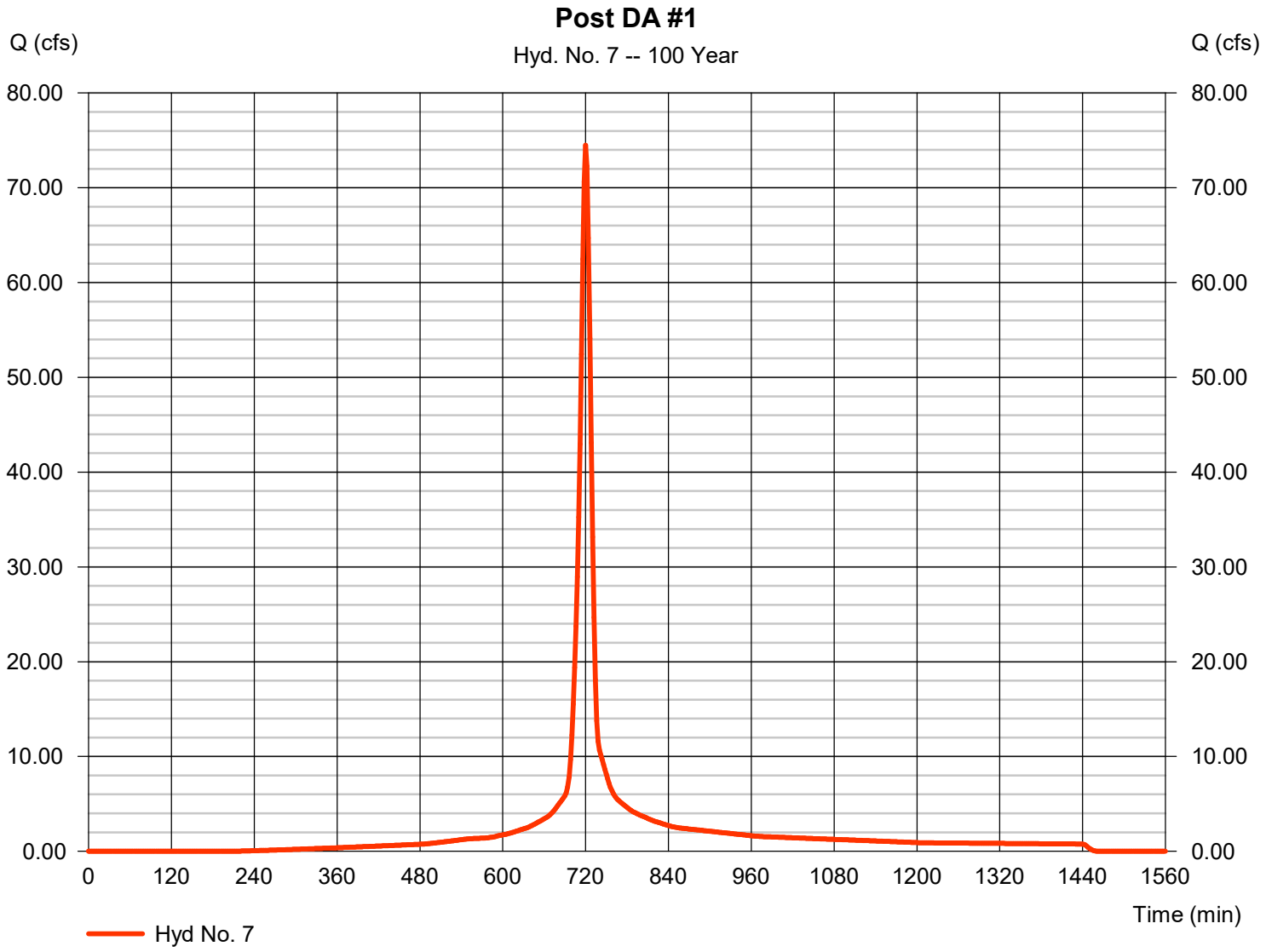


Hydrograph Report

Hyd. No. 7

Post DA #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	74.50 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	202,884 cuft
Drainage area	=	9.000 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

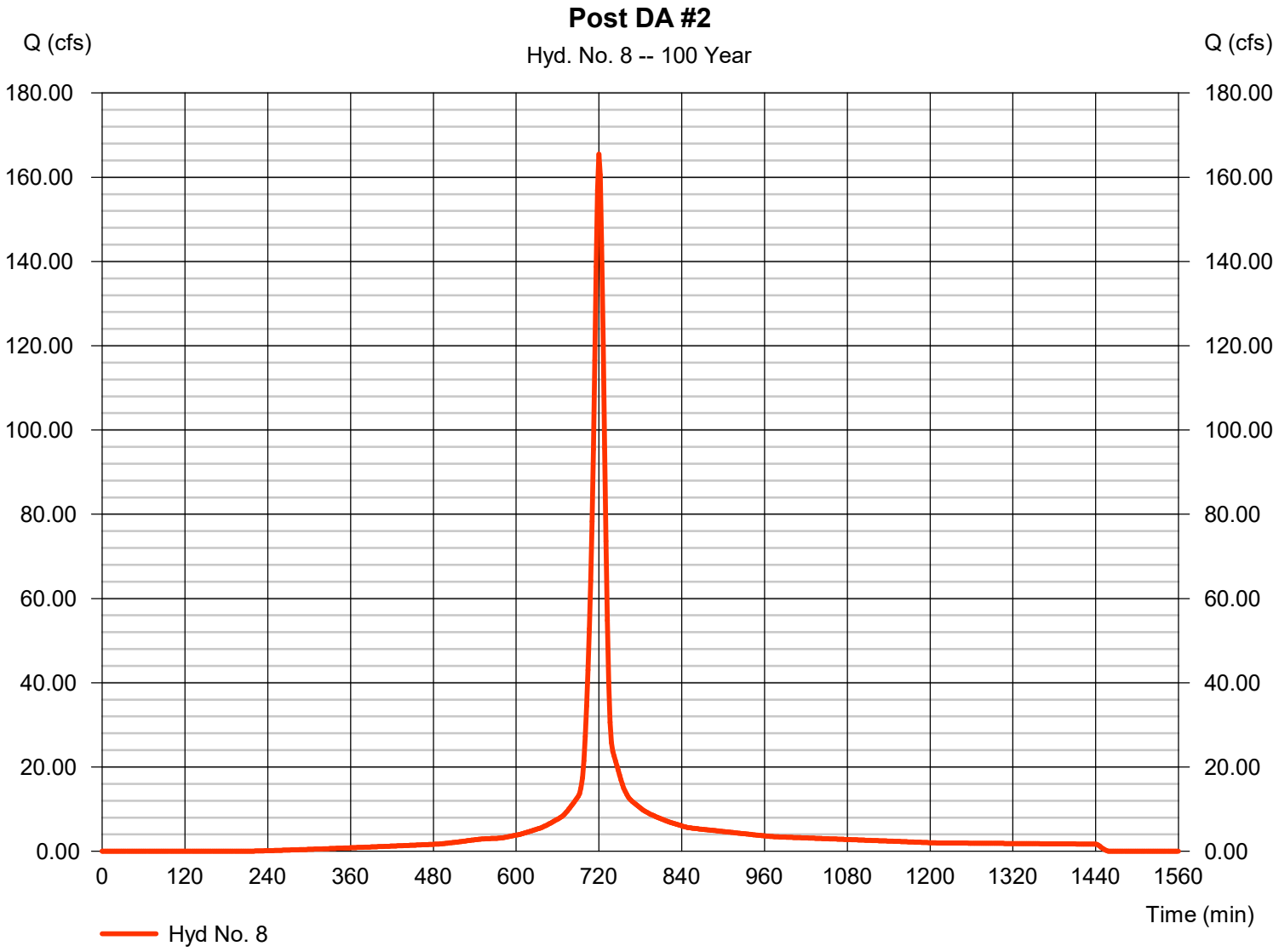


Hydrograph Report

Hyd. No. 8

Post DA #2

Hydrograph type	=	SCS Runoff	Peak discharge	=	165.46 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	450,628 cuft
Drainage area	=	19.990 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

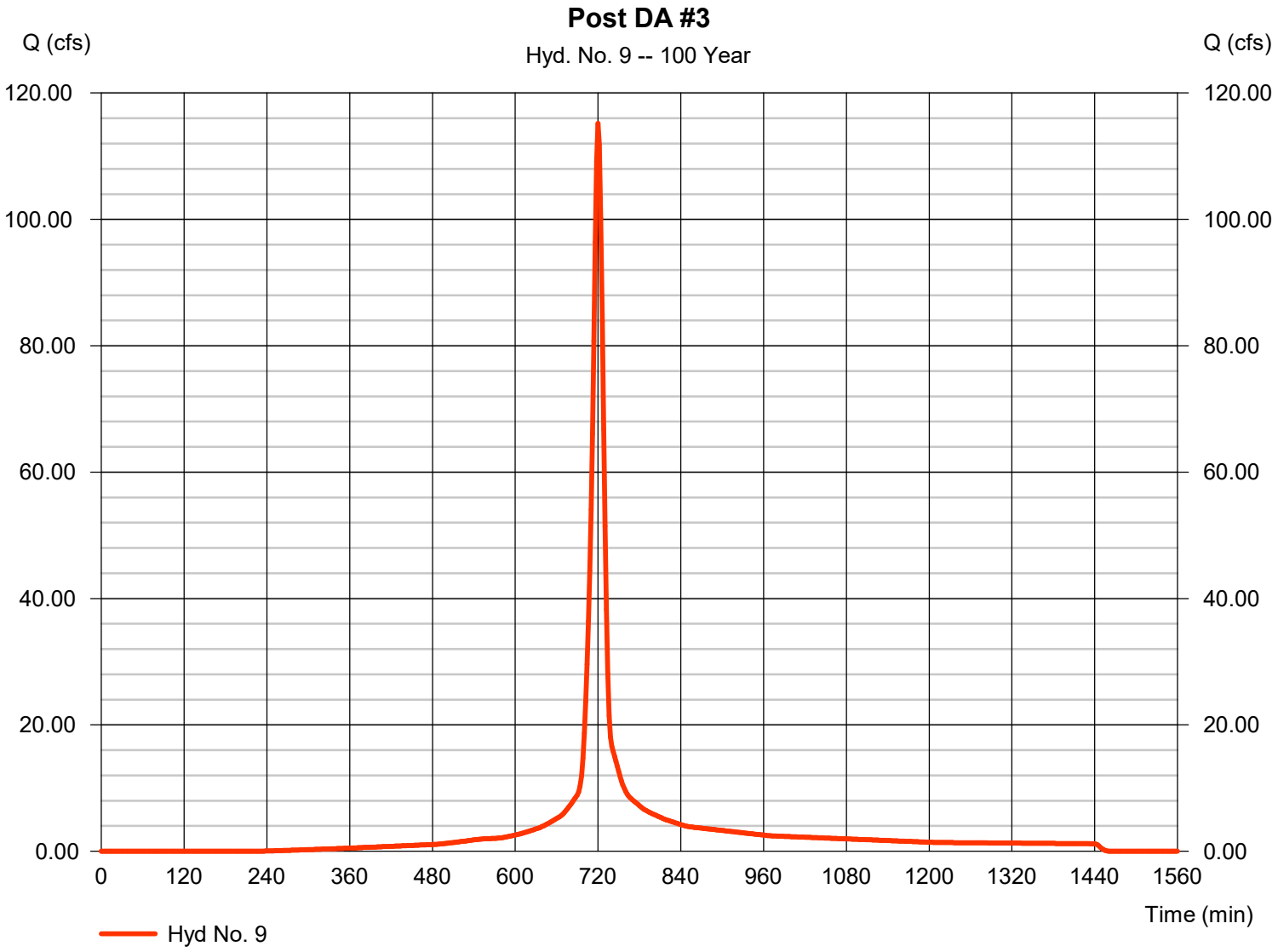


Hydrograph Report

Hyd. No. 9

Post DA #3

Hydrograph type	= SCS Runoff	Peak discharge	= 115.21 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 311,930 cuft
Drainage area	= 14.110 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.56 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

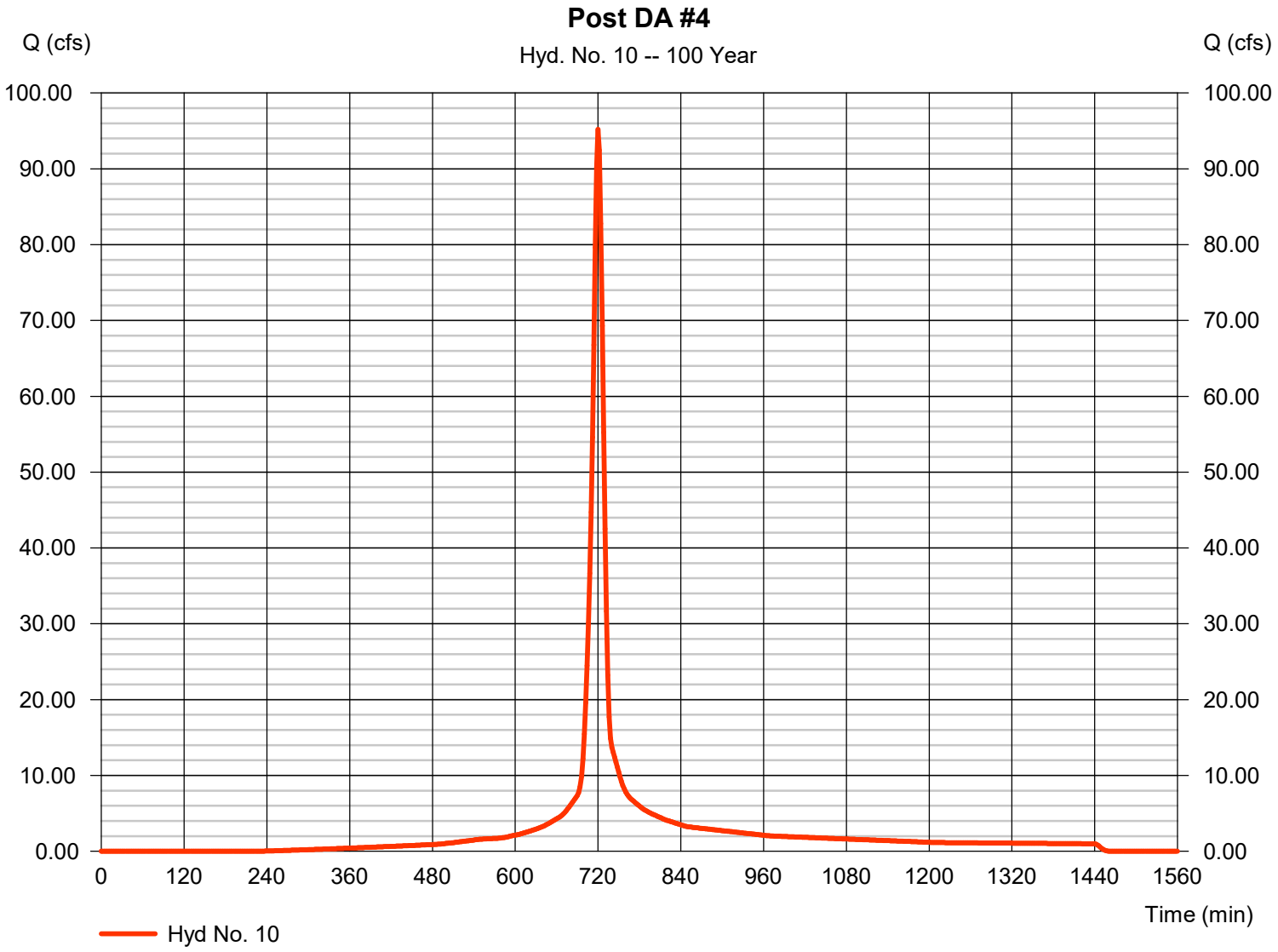


Hydrograph Report

Hyd. No. 10

Post DA #4

Hydrograph type	=	SCS Runoff	Peak discharge	=	95.20 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	257,768 cuft
Drainage area	=	11.660 ac	Curve number	=	86
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

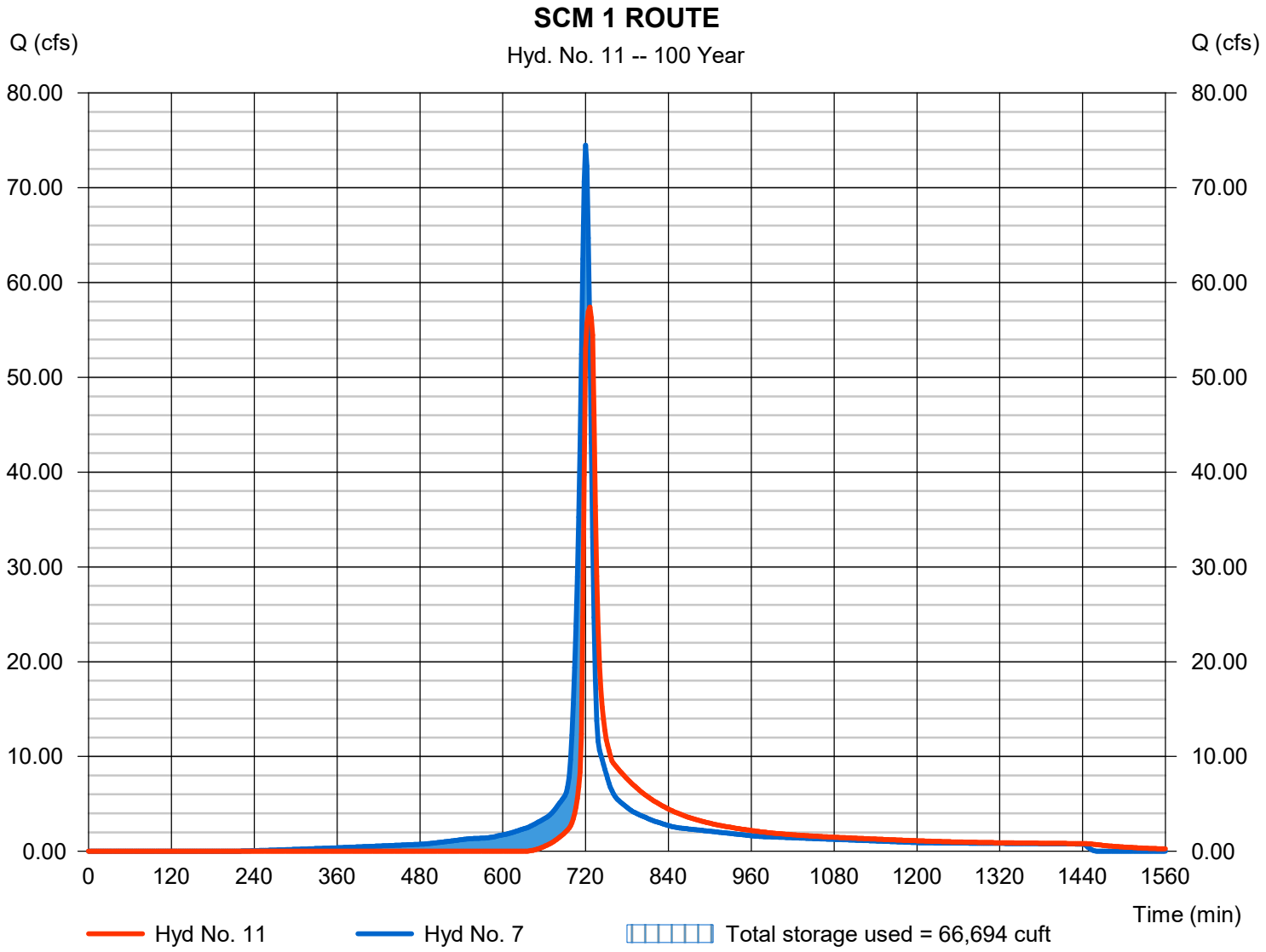
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Thursday, 06 / 1 / 2023

Hyd. No. 11

SCM 1 ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 57.41 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 184,416 cuft
Inflow hyd. No.	= 7 - Post DA #1	Max. Elevation	= 389.02 ft
Reservoir name	= SCM 1	Max. Storage	= 66,694 cuft

Storage Indication method used.



Hydrograph Report

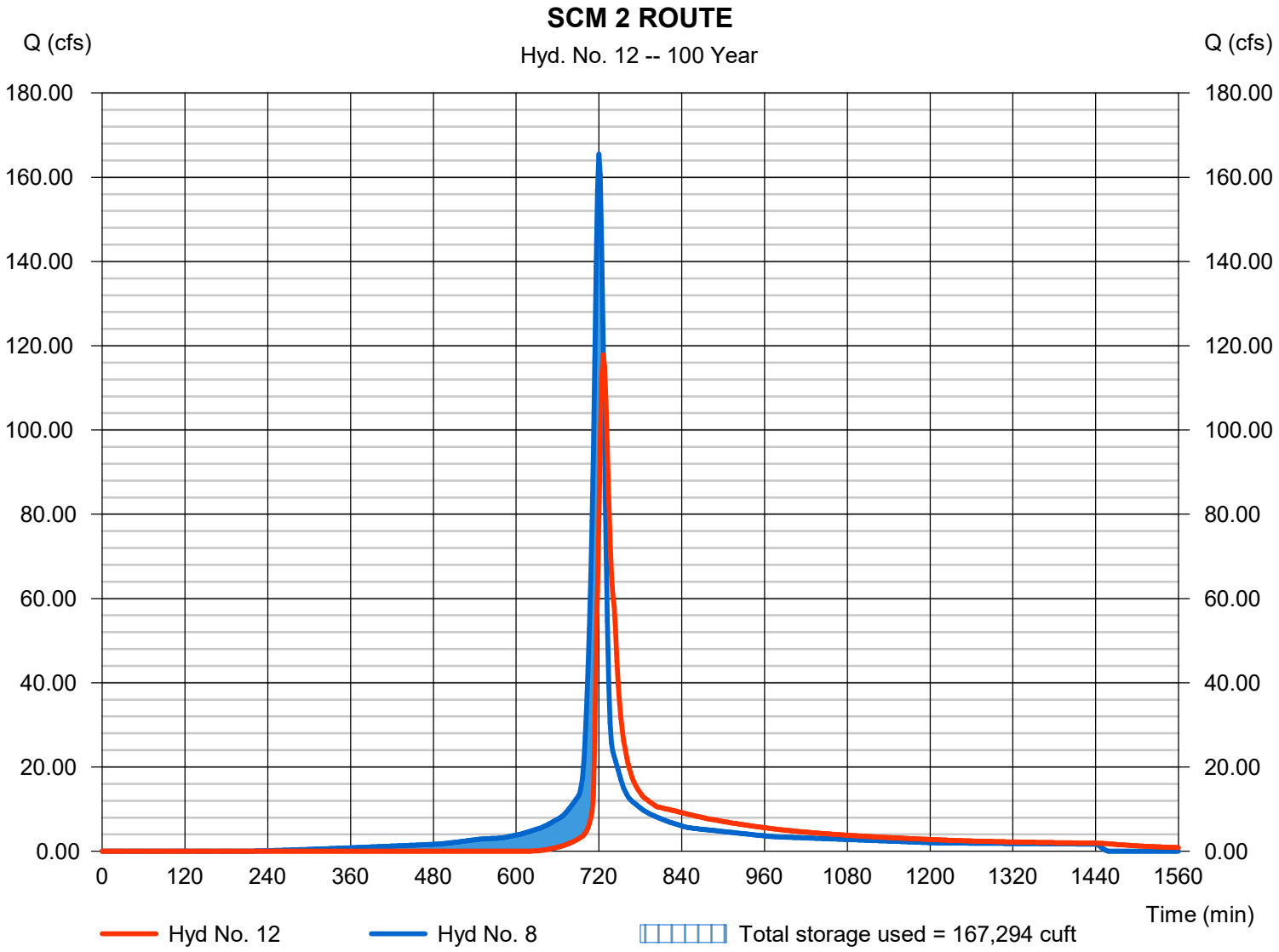
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Thursday, 06 / 1 / 2023

Hyd. No. 12

SCM 2 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	117.84 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	419,300 cuft
Inflow hyd. No.	=	8 - Post DA #2	Max. Elevation	=	356.79 ft
Reservoir name	=	SCM 2	Max. Storage	=	167,294 cuft

Storage Indication method used.



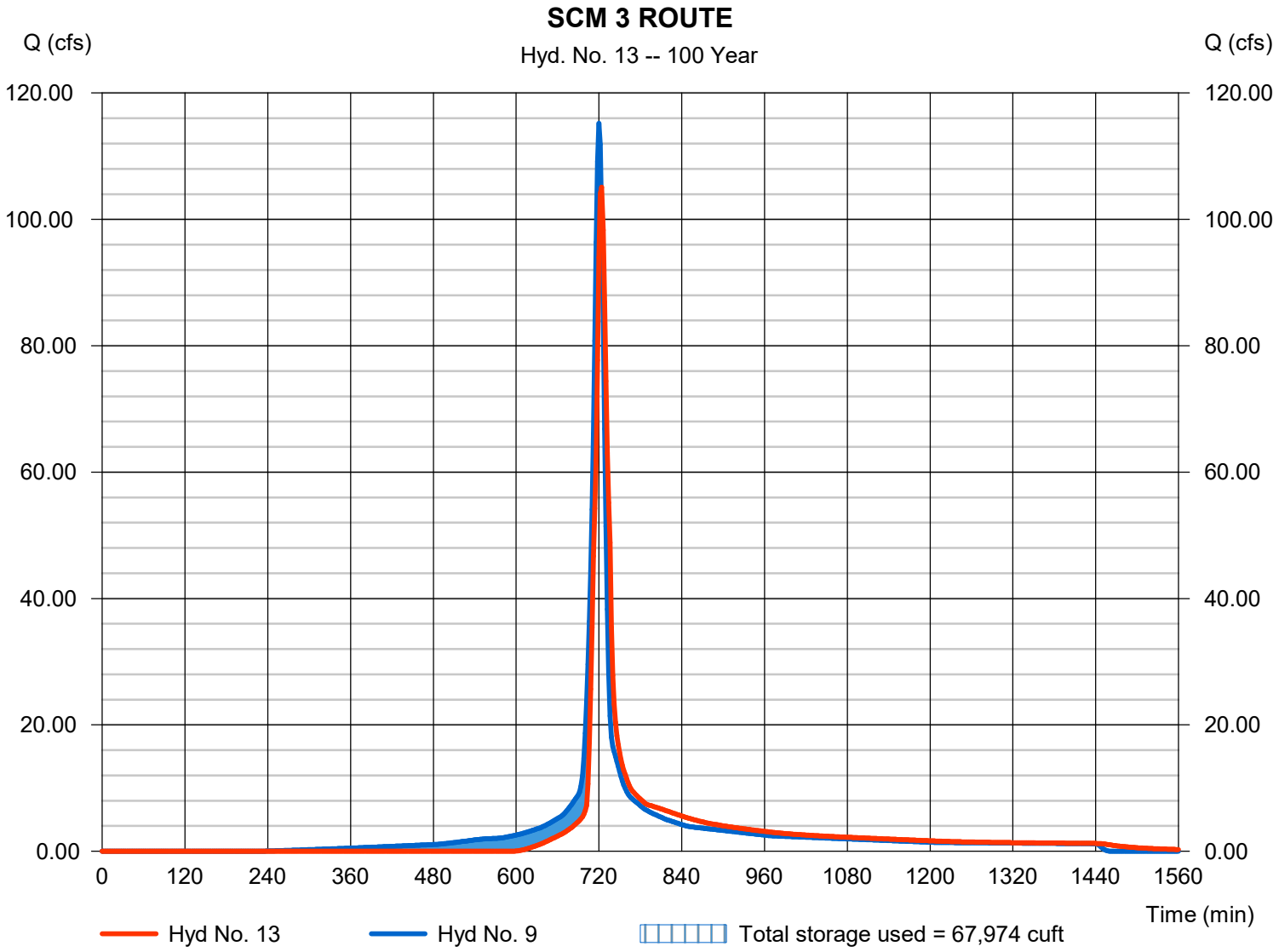
Hydrograph Report

Hyd. No. 13

SCM 3 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	105.11 cfs
Storm frequency	=	100 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	292,295 cuft
Inflow hyd. No.	=	9 - Post DA #3	Max. Elevation	=	389.72 ft
Reservoir name	=	SCM 3	Max. Storage	=	67,974 cuft

Storage Indication method used.



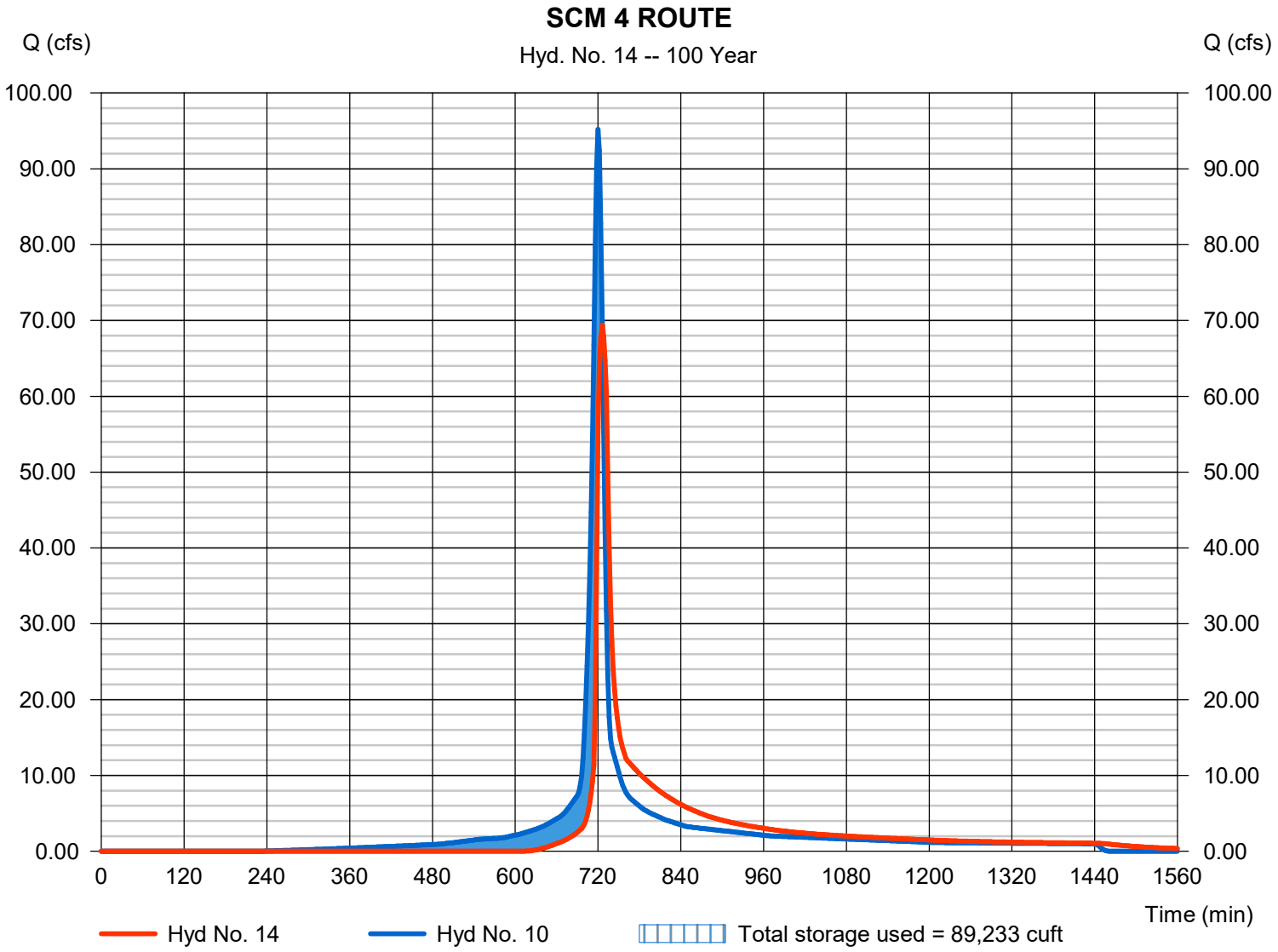
Hydrograph Report

Hyd. No. 14

SCM 4 ROUTE

Hydrograph type	=	Reservoir	Peak discharge	=	69.40 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	239,692 cuft
Inflow hyd. No.	=	10 - Post DA #4	Max. Elevation	=	385.12 ft
Reservoir name	=	SCM 4	Max. Storage	=	89,233 cuft

Storage Indication method used.

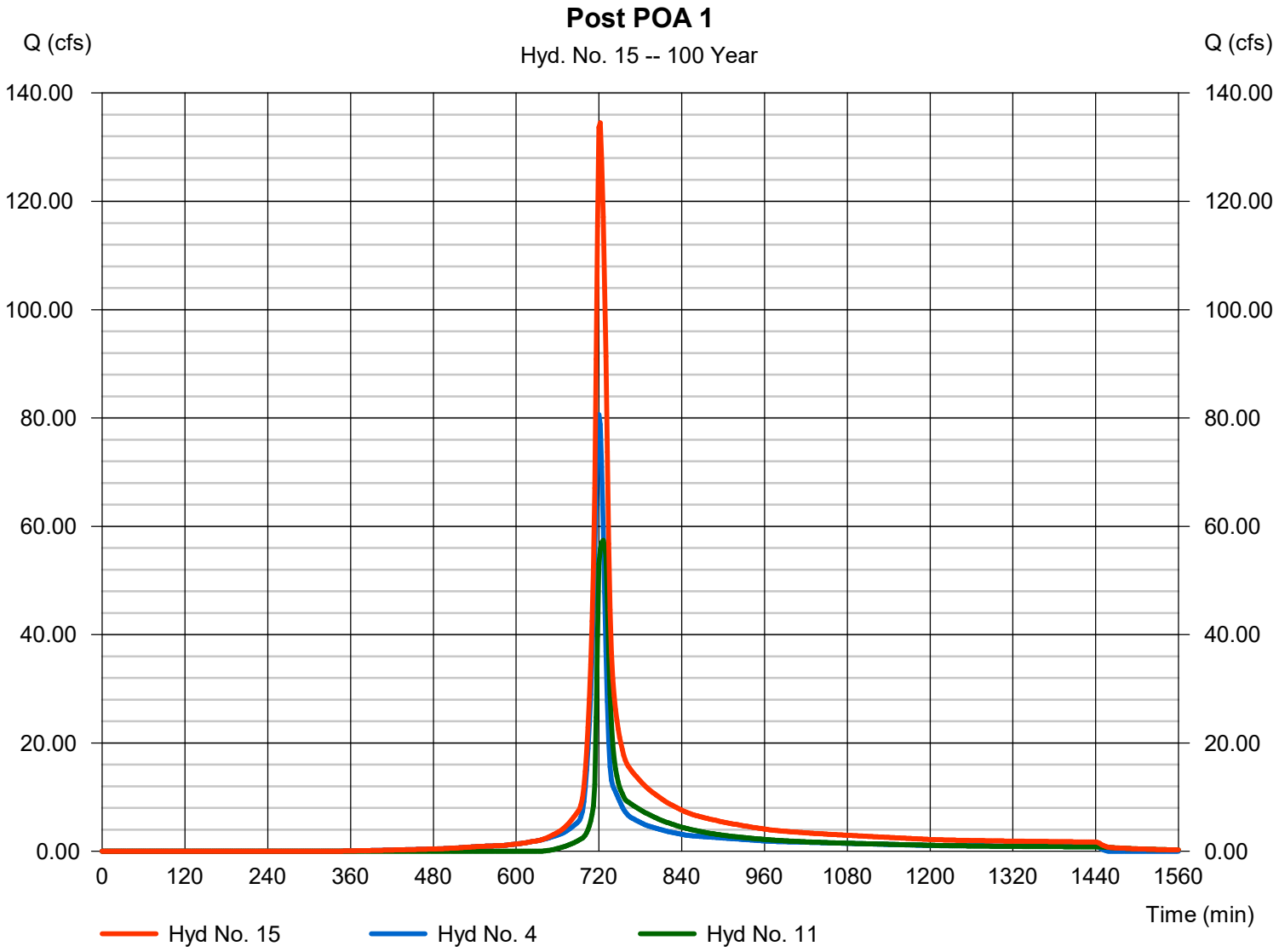


Hydrograph Report

Hyd. No. 15

Post POA 1

Hydrograph type	= Combine	Peak discharge	= 134.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 396,316 cuft
Inflow hyds.	= 4, 11	Contrib. drain. area	= 11.100 ac

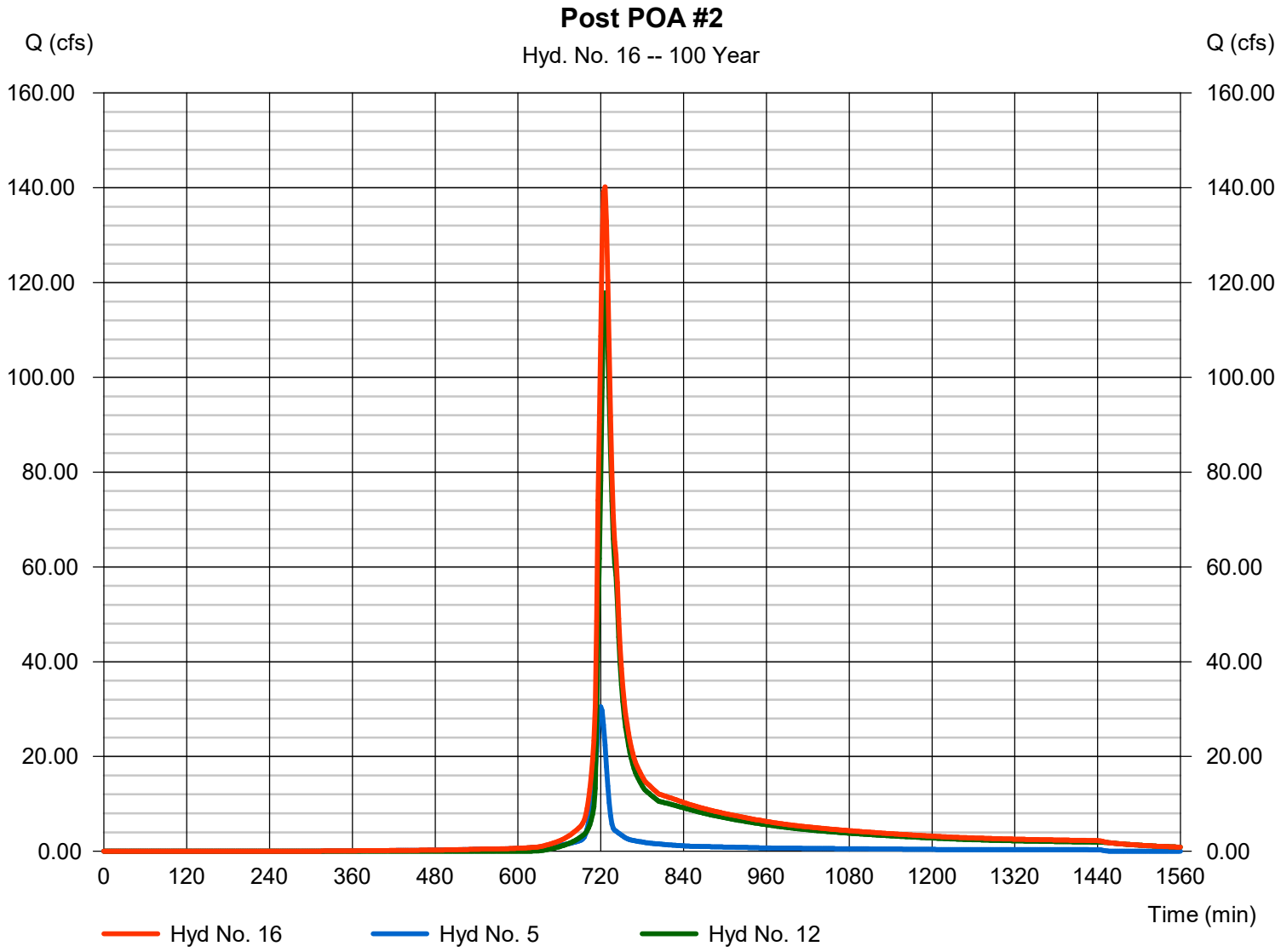


Hydrograph Report

Hyd. No. 16

Post POA #2

Hydrograph type	= Combine	Peak discharge	= 140.19 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 500,654 cuft
Inflow hyds.	= 5, 12	Contrib. drain. area	= 3.910 ac

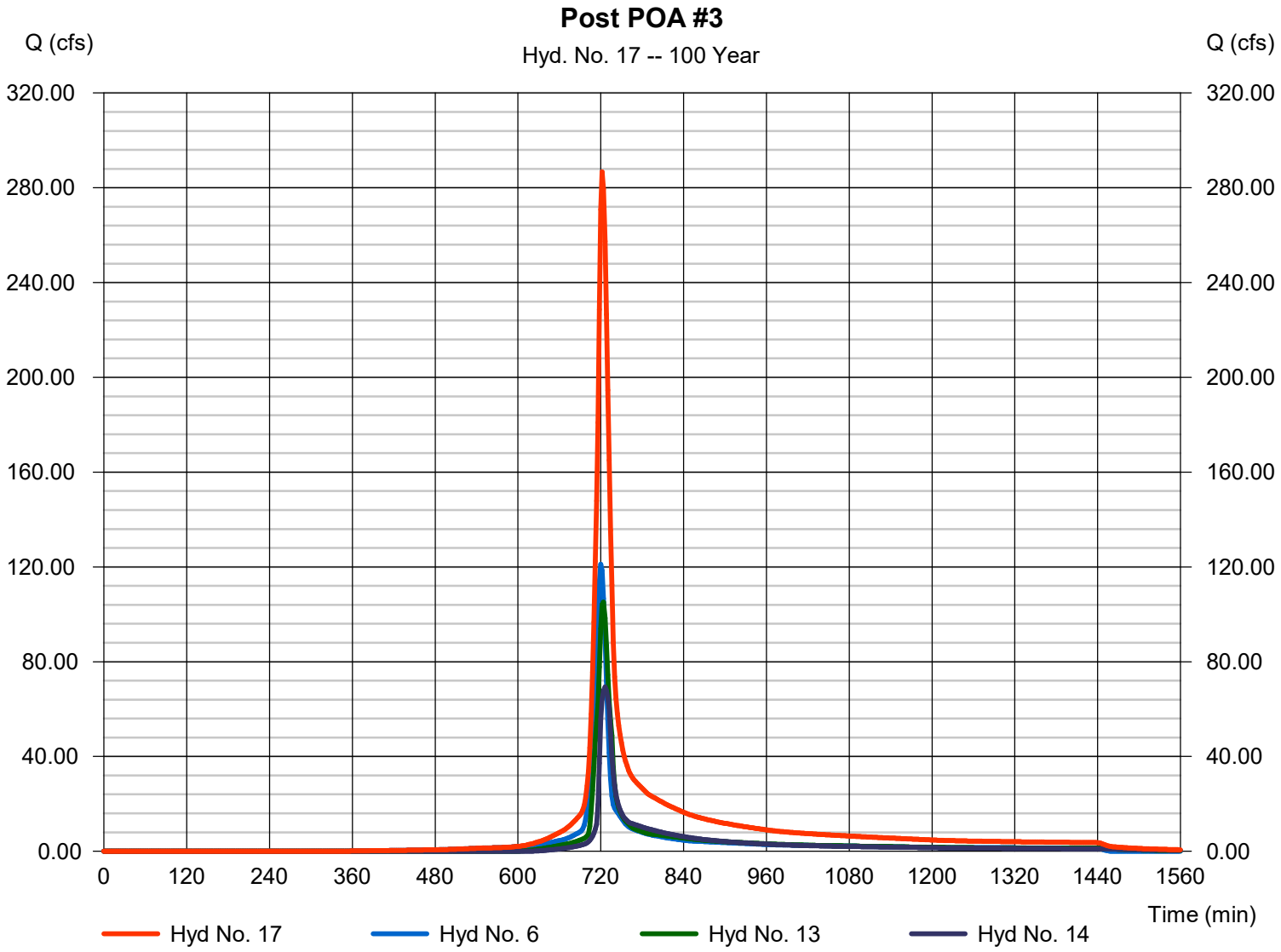


Hydrograph Report

Hyd. No. 17

Post POA #3

Hydrograph type	= Combine	Peak discharge	= 286.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 850,409 cuft
Inflow hyds.	= 6, 13, 14	Contrib. drain. area	= 16.680 ac

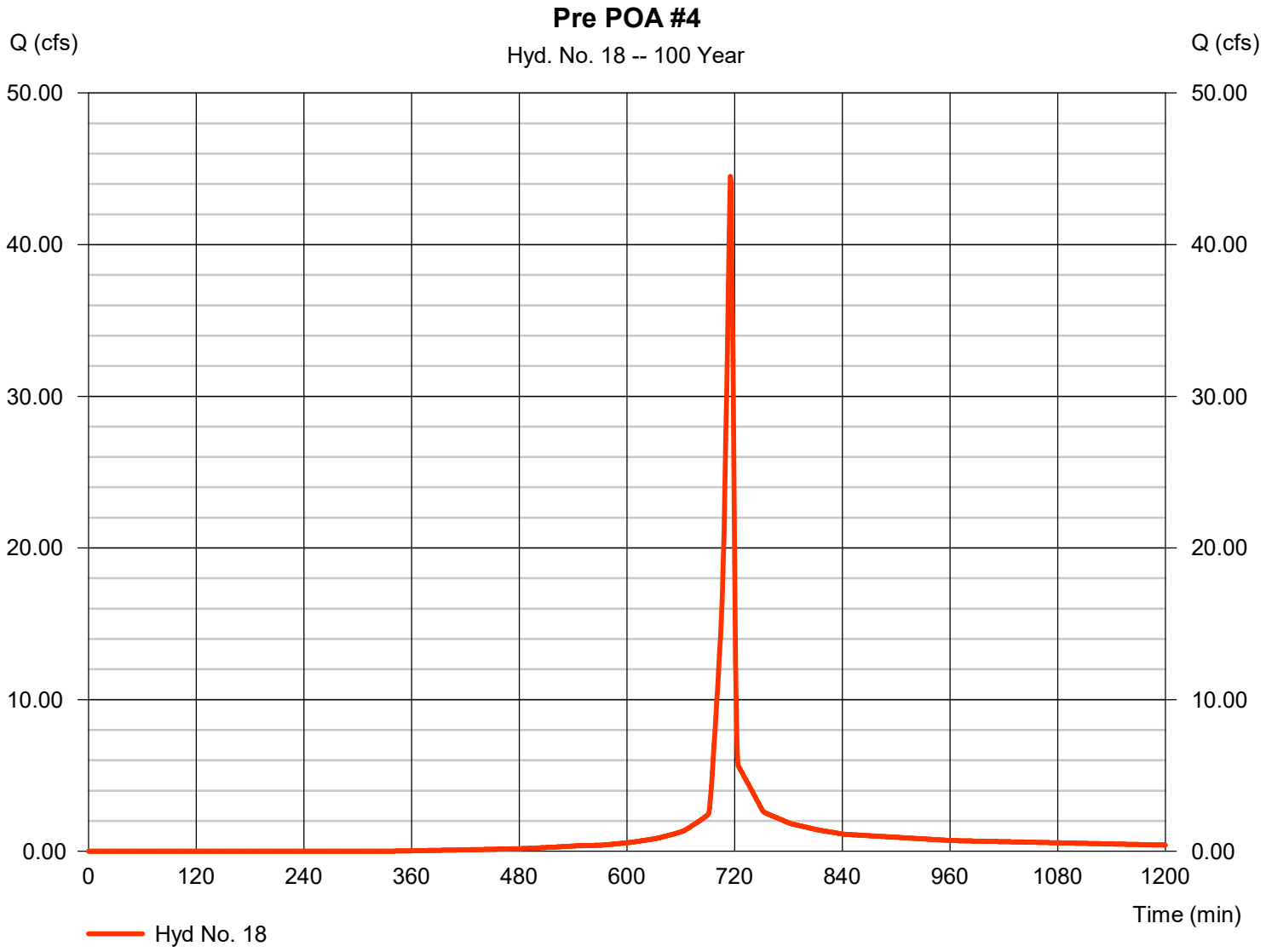


Hydrograph Report

Hyd. No. 18

Pre POA #4

Hydrograph type	=	SCS Runoff	Peak discharge	=	44.48 cfs
Storm frequency	=	100 yrs	Time to peak	=	715 min
Time interval	=	1 min	Hyd. volume	=	81,914 cuft
Drainage area	=	4.720 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	2.10 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

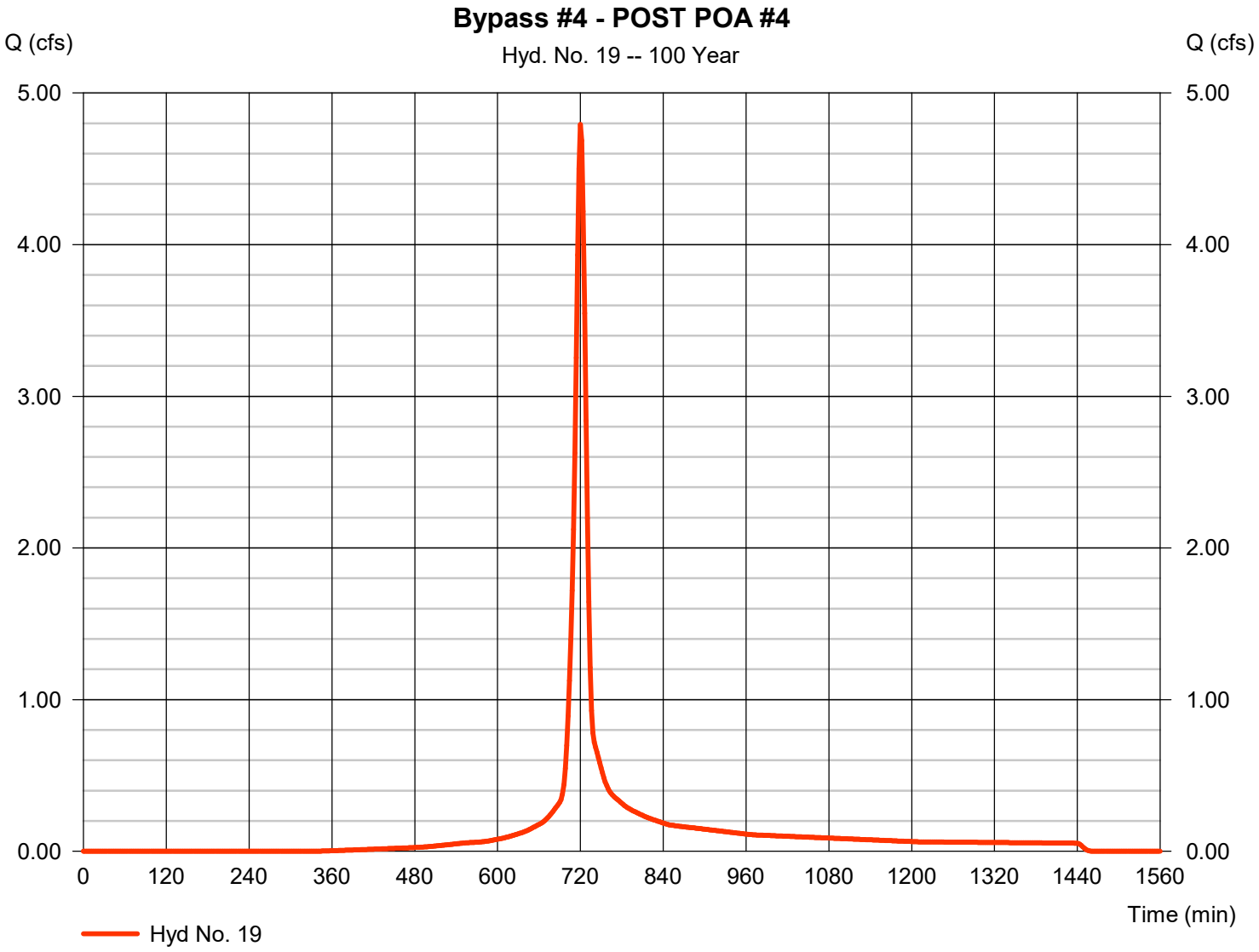


Hydrograph Report

Hyd. No. 19

Bypass #4 - POST POA #4

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.793 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	12,599 cuft
Drainage area	=	0.660 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.56 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	51.0918	10.3000	0.8101	--------
3	0.0000	0.0000	0.0000	--------
5	49.6368	10.3000	0.7553	--------
10	51.1095	10.4000	0.7327	--------
25	54.6954	10.5000	0.7118	--------
50	58.0360	10.6000	0.7004	--------
100	61.9189	10.8000	0.6926	--------

File name: rolesville.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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.61	4.46	3.73	3.22	2.85	2.56	2.33	2.14	1.98	1.85	1.73	1.63
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	6.33	5.11	4.33	3.78	3.36	3.04	2.79	2.57	2.40	2.24	2.11	2.00
10	6.89	5.61	4.78	4.19	3.75	3.40	3.12	2.89	2.70	2.53	2.39	2.26
25	7.77	6.37	5.46	4.80	4.31	3.92	3.61	3.35	3.14	2.95	2.79	2.65
50	8.47	6.97	5.99	5.29	4.75	4.34	4.00	3.72	3.48	3.28	3.10	2.94
100	9.16	7.57	6.52	5.77	5.20	4.75	4.38	4.08	3.82	3.60	3.41	3.24

Tc = time in minutes. Values may exceed 60.

name: G:\NCA\Projects\Lennar\8430-03 - Lennar - School Street - Rolesville\04 - Calculations\Storm\rolesville prec.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	2.86	3.45	0.00	3.30	5.04	6.00	6.80	7.56
SCS 6-Hr	2.04	2.44	0.00	0.00	3.54	4.22	0.00	5.45
Huff-1st	0.00	0.00	0.00	2.75	0.00	0.00	6.50	0.00
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	0.00	0.00	2.80	0.00	0.00	6.00	0.00

ATTACHMENT 8: TOTAL NITROGEN CALCULATIONS