MACRO STORM WATER DRAINAGE STUDY

Monticello 4th Phase
SITE ACREAGE: 19.51 ACRES

Lee's Summit, MO

PREPARED BY:

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Revision

Date	Comment	By
4-27-20	Revised per City Comments Dated April 27, 2020	AEP

Matthew J. Schlicht, PE

TABLE OF CONTENTS

3. GENERAL INFORMATION

Monticello 4th Phase is the final phase of the single-family residential development. Monticello is located approximately 1,380 feet south of Bowlin Road along the recently reconstructed and renamed NE Jamestown Road which runs north/south approximately 2,400 feet east of I-470. The 4th phase is generally located in the NW portion of the site. The site is bounded by United States Army Corp of Engineers land on the northeast and east which encompasses Blue Springs Lake, Lake Ridge Meadows and Dalton's Ridge single-family residential subdivisions on the south, Woods Chapel United Methodist Church and University of Kansas Hospital Authority on the west and a large meadow with single family residence on the northwest. The entire Monticello site consists of approximately 68.23 acres +/-. The 4th phase contains 19.51 acres +/-. The site is located in the SW 1/4 of Section 4, Township 48N, Range 31W, Lee's Summit, Jackson County, Missouri.

The civil infrastructure for the first three phases have been approved and constructed. Residences are currently being constructed and occupied in all three phases of the development. The 4th phase is currently under design. This macro drainage study is being completed to assist in the design of required stormwater conveyance and attenuation systems. The 4th phase is generally located in the northwest section of the property. A large portion drains to the 3rd Phase detention basin with the majority of the land draining north to a new retention system to be located along the north property line in Phase 4. Small portions of phase 4 in the northwest corner of the property free release to the church, hospital and neighboring northern property via sheet flow.

See Exhibit A for an aerial image of the proposed project site along with an aerial image of the surrounding area. An image from April 2002 has also been included which confirms the historical land usage of the site which consisted of meadow ground used primarily for hay and protected from grazing prior to development.

3.1 FEMA FLOODPLAIN DETERMINATION

The property is located in an Area of Minimal Flood Hazard, Zone X, according to FEMA Firm Map Numbers 29095C0430G & 29095C0313G, effective January 20, 2017.

See Exhibit B for a FIRMette which includes the proposed project site.

3.2 NRCS SOIL CLASSIFICATION

Soil classifications published by the United States Department of Agriculture/National Resources Conservation Service (USDA/NRCS) website for Jackson County, Missouri, Version 18, September 16, 2017. The existing site contains ten major soil types:

10082	Arisburg-Urban Land Complex, 1 to 5 Percent Slopes Hydrologic Soils Group (HSG): Type C
10113	Oska Silty Clay Loam, 5 to 9 Percent Slopes, Eroded (HSG): Type D
10117	Sampsel Silty Clay Loam, 5 to 9 Percent Slopes (HSG): Type C/D
10120	Sharpsburg Silt Loam, 2 to 5 Percent Slopes (HSG): Type C
10128	Sharpsburg-Urban Land Complex, 2 to 5 Percent Slopes

(HSG): Type D

10129 Sharpsburg-Urban Land Complex, 5 to 9 Percent Slopes
(HSG): Type D

10141 Snead-Rock Outcrop Complex, 14 to 30 Percent Slopes
(HSG): Type D

10142 Snead-Rock Outcrop Complex, 5 to 14 Percent Slopes
(HSG): Type D

10181 Udarents-Urban Land Sampsel Complex, 5 to 9 Percent Slopes
(HSG): Type C/D

60168 Menfro Silt Loam, 5 to 9 Percent Slopes, Eroded
(HSG): Type C

See Exhibit C for a detailed soils report of the proposed project site.

4. METHODOLOGY

This Macro Storm Drainage Study has been prepared to evaluate potential hydrologic impacts from the proposed development and recommend improvements to eliminate potential negative impacts. The study utilized existing city contours to create the Pre-Development Drainage Area Map. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Using the above criteria, the proposed site was evaluated using the Soil Conservation Service, SCS TR-55 method to calculate storm runoff volumes, peak rates of discharge, pre and post developed hydrographs and required storage volumes for detention facilities. TR-55 was first introduced in 1975 by the SCS particularly for small urbanizing watersheds. The analysis contains results for the 2, 10 and 100-year design storms.

Hydraflow Hydrographs Extension for AutoCAD Civil 3D was utilized to model the various SCS TR-55 stormwater rainfall runoff events. The following SCS TR-55 Unit Hydrograph variables were utilized;

- AMC II Soil Moisture Conditions
- 24-Hour SCS Type II Rainfall Distribution (Shape Factor 484)
- SCS Runoff Curve Numbers per SCS TR-55 (Tables 2-2a to 2-2c)

Time of Concentration has been calculated using the following formulas:

- Sheet Flow (Max. 100 LF): SCS TR-55 Travel Time, $T_t = 0.007 \times (n * L)^{0.8} / (P_2^{0.5} * S^{0.4} * 60)$
- Shallow Concentrated Flow: SCS TR-55 Appendix F: Unpaved $V=16.1345(S)^{0.5}$
  Paved $V=20.3282(S)^{0.5}$
  Shallow Concentrated Travel Time (min): SCS TR-55 Eq-3-1, $T_t = L / V \times 60$
- Channel Flow Improved: Manning's Equation (Full Flow)
  Channel Flow Unimproved: APWA 5602.7.A. Travel Time, Table 5602-6

Avg. Channel Slope (%)	Velocity (fps)
< 2	7
2 to 5	10
>5	15

5. EXISTING CONDITIONS ANALYSIS

The pre-developed site consisted entirely of a grass meadow used for hay. Monticello contains five sub-basins referred to as Sub-basin A, Sub-basin B, Sub-basin C, Sub-basin D and Sub-basin E for the purposes of this report. Each Sub-basin drains to a Point of Interest which corresponds to its given sub-basin drainage area, i.e., Sub-basin E drains to Point of Interest E. The Pre-Development Drainage Area Map is located in Exhibit D. Information pertaining to the entire Monticello Development may be found throughout the report for general reference however the report focuses on Sub-basins D and E. The existing drainage basins are the same as detailed in the 3rd Phase report. Proposed sub-basins D and E have been modified due to design of the 4th Phase. Following is a brief description of each existing sub-basin.

Sub-basin A is generally located in the northern portion of the property and discharges to the north via a 24" VCP culvert labeled Point A. The sub-basin consists of 19.45 total acres, 19.31 onsite and 0.14 offsite. Sub-basin A contains the majority of the Phase I development which includes a retention basin. The eastern portion of the Phase III development will drain to Point A.

Sub-basin B is generally located in the eastern portion of the property and discharges to an unnamed creek which is Tributary to Blue Springs Lake. The discharge point is labeled as Point B. The USACE land is undeveloped and heavily wooded. The sub-basin consists of 34.42 total acres, 16.27 onsite and 18.15 offsite. Sub-basin B contains the majority of the Phase II development. No runoff from Phase III contributes to Sub-basin B therefore it will not be explored any further in this study.

Sub-basin C is generally located in the southwestern portion of the property and discharges to the west via a 36" HDPE culvert. The discharge point is labeled as Point C. The 36" culvert discharges to the Woods Chapel United Methodist Church retention basin. The sub-basin consists of 17.16 total acres, 15.0 onsite and 2.16 offsite. Sub-basin C contains the majority of the proposed Phase III development.

Sub-basin D is generally located in the northwest portion of the property. The southwest corner of the property is also tributary and discharges to Point D. The sub-basin drains to the west via sheet and shallow concentrated flow where it discharges to the Woods Chapel United Methodist retention basin. The sub-basin consists of 19.02 total acres, 7.61 onsite and 11.41 offsite. Sub-basin D contains mainly future Phase IV development.

Sub-basin E is generally located on the northern portion of the property and is bounded by Sub-basin A to the east, Sub-basin C to the south and Sub-basin D to the west. The sub-basin drains to the north via sheet and shallow concentrated flow where it discharges offsite to an unnamed creek tributary to Blue Springs Lake. The sub-basin consists of 12.42 total acres, 10.03 onsite and 2.39 offsite. Sub-basin E will also contain future Phase IV development.

The following tables summarize the results of the Existing Conditions analysis. A Pre-Development Land Usage Map may be found in Exhibit E which was used to assign appropriate hydrologic soil group classifications to the soil. Composite curve number calculations by sub-basin may be found in Exhibit F. Time of concentration calculations by sub-basin may be found in Exhibit G. A complete breakdown of TR-55 unit hydrographs may be found in Exhibit H.

Table 5-1 Existing Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
D	19.02	85	13.81
E	12.42	73	12.35

Table 5-2 Existing Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
D	51.68	89.62	145.78
E	20.20	42.80	79.46

Per APWA 5608.4 and City of Lee's Summit criteria, post development peak discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

Allowable release rates were calculated at each point of interest except for Point B as previously stated. Allowable release rates are comprised of a combination of peak offsite flows and allowable onsite post development peak flows at each point of interest. Since some offsite areas have substantially higher curve numbers the area ratio method will not be used to determine allowable release rates. Instead, peak flows from onsite areas will be determined for each point of interest and subtracted from the overall peak discharge rates (Table 5-2) then the allowable release rate for onsite area will be added back in to give the allowable peak release rate at each point of interest.

Allowable Release Example Calculation Sub-basin A (2-Yr): 33.43 – 33.19 + (19.31 x 0.5) = 9.90 cfs

Table 5-3 Existing Conditions Onsite Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
D	7.61	76	13.81
E	10.03	72	12.35

Table 5-4 Existing Conditions Sub-basin/Point of Interest Onsite Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
D	13.81	27.76	49.76
E	15.40	33.32	62.68

Table 5-5 Existing Conditions Sub-basin/Point of Interest Allowable Peak Discharge Release Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
D	41.68	77.08	118.85
E	9.82	29.54	46.87

6. PROPOSED CONDITIONS ANALYSIS

The proposed conditions analysis focuses solely on the proposed 19.51 acre Phase IV development located in the northwest corner of the site. Phases I, II and III have been approved and are constructed in the field. The southwestern portion of Phase IV, 7.47 acres, is part of Sub-basin C which is tributary to the detention basin constructed in Phase III. The northwestern portion of Phase IV, 1.66 acres, is part of Sub-basin D and free releases to the west for collection by an enclosed storm sewer system on the church property. A very small portion of Phase IV along the east boundary, 0.10 acres, is located within Sub-basin A1 and free releases to the retention basin constructed with the Phase I Improvements. The remainder of Phase IV located in the north makes up Sub-basins E1+E2 and a portion of E which are 9.72 acres and 0.56 acres respectively. As shown in Section 5 allowable peak discharge rates are higher than the existing peak discharge rates for Sub-basin E therefore retention measures are required to attenuate proposed peak discharge rates below allowable. Existing Sub-basin E was divided into three Sub-basins due to the geography of the land. Sub-basin E2 lies to the west and is tributary to the 1st cell of the multi-cell retention basin. Sub-basin E1 lies to the east and is tributary to the 2nd cell of the r917.4etention system. Sub-basins D and E were modified with the design of Phase IV therefore these sub-basins will be analyzed in detail to ensure no negative impacts are encountered downstream due to runoff generated from the proposed Phase IV improvements. The Post-Development Drainage Area Map is located in Exhibit I. A Proposed Conditions Land Usage Map is located in Exhibit J. Sub-basin E2 is proportionate to E1 and has been assigned the same curve number.

Table 6-1 Proposed Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
D	13.38	90	13.81
E	2.59	76	11.12
E1	6.62	83	11.75
E2	6.48	83	10.71

Table 6-2 Proposed Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
D	42.40	68.69	106.91
E	5.36	10.69	19.10
E1	17.40	31.01	51.35
E2	18.39	32.75	54.21

Sub-basin E will require detention therefore sub-basins E1 and E2 will contain retention basins to attenuate proposed peak discharge rates.

6.1 RETENTION

A new multi-cell earthen retention basin is being proposed in Sub-basin E to attenuate peak discharge rates. The first cell of the basin is located in Sub-basin E2 and serves the west side of the tributary. The second cell is located in Sub-basin E1 and receives runoff from the east side of the tributary in addition to the 1st cell (Sub-basin E2). Following are a list of design parameters for the 1st cell of the retention system.

Designation: Cell 1
Type: Earthen Retention Basin
Side Slopes: 3:1 Max.
Bottom Slope: N/A
Basin Bottom Elevation: 908.00
Basin Top Berm Elevation: 920.00

Basin Volume: 127,958 cf (914.50 - 920.00)
Control Structure: N/A
Baffle Wall Orifices: N/A
Baffle Wall Crest Elevation: N/A
Control Structure Top Elevation: N/A
Overflow Weir Openings: N/A
Control Structure Pipe: 24" HDPE, FL (In) = 914.50, FL (Out) = 908.00, L=52.66', S=12.34%, Miter Ends to Slope Inlet and Outlet
Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=918.50, Crest Length=70'

The Retention Basin Plan may be found in Exhibit K. Emergency spillway calculations may be found in Exhibit L. See Table 6-3 for a summary of Cell 1 retention basin data.

Table 6-3 Cell 1 Retention Basin Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
Cell 1 (Sub-basin E2)						
2-Year	18.39	720	3.62	734	915.51	19,591
10-Year	32.75	720	6.40	734	916.30	36,020
100-Year	54.21	720	8.99	735	917.44	61,875

As shown in the table above all Sub-basin E2 peak flowrates have been attenuated. Following are a list of design parameters for the 2nd cell of the retention system.

Designation: Cell 2
Type: Earthen Retention Basin
Side Slopes: 3:1 Max.
Bottom Slope: 0.5%
Basin Bottom Elevation: 903.00
Basin Top Berm Elevation: 912.00
Basin Volume: 118,140 cf (907.50 – 912.00)
Control Structure: N/A
Baffle Wall Orifices: N/A
Baffle Wall Crest Elevation: N/A
Control Structure Top Elevation: N/A
Overflow Weir Openings: N/A
Control Structure Pipe: 24" HDPE, FL (In)= 907.50, FL (Out)= 902.50, L=24.50', S=20.4%, Miter Ends to Slope Inlet and Outlet
Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=910.65, Crest Length=230', Q100 (Consecutive) 105.56 cfs, HGL=910.96, Freeboard=1.04'

See Table 6-4 for a summary of Cell 2 or overall retention basin data.

Table 6-4 Cell 2 Retention Basin Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
Cell 2 (Sub-basin E1)						
2-Year	19.63	722	5.17	748	908.48	21,590
10-Year	36.04	721	12.20	735	909.16	37,704
100-Year	58.82	721	19.22	735	910.12	62,554

As shown in the table above all Sub-basin E1 peak flowrates have been attenuated. See Table 6-5 below for a summary of proposed peak discharge rates at Point of Interest E. Hydrographs tributary to each point of interest have been combined to determine subsequent peak discharge rates.

Table 6-5 Proposed Conditions Post Detention Point of Interest Peak Discharge Rates

Point of Interest	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
E	7.74	18.30	33.66

As can be seen in the above table all peak discharge rates attributable to Phase IV improvements have been attenuated below existing rates as outlined in Table 5-2. Table 6-6 below provides a comparison of runoff data between Existing and Proposed Conditions on addition to allowable release rates for Monticello Phase IV.

Table 6-6 Point of Interest Discharge Comparison

		Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Point D	Proposed	42.40	68.69	106.91
	Existing	51.68	89.62	145.78
	Difference	-9.28	-20.93	-38.87
	Allowable	41.68	77.08	118.85
	Difference	0.72	-8.39	-11.94
Point E	Proposed	7.74	18.30	33.66
	Existing	20.20	42.80	79.46
	Difference	-12.46	-24.50	-45.80
	Allowable	9.82	29.54	46.87
	Difference	-2.08	-11.24	-13.21

Peak discharge rates for Point D will be further reduced from Approved calculated Phase III levels for all design storms with the development of Phase IV. Point E peak discharge rates will be reduced well below both Existing and Allowable peak discharge rates.

7. 40 HOUR EXTENDED DETENTION

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The proposed retention facilities will release the water quality event over a period of 40-72 hours. See Exhibit H for water quality extended detention hydrographs. The 1-year storm represents the 1.37" water quality storm event. The stage storage discharge relationship of the retention basin provides extended detention without the need for a specialized control structure.

8. CONCLUSIONS & RECOMMENDATIONS

This macro storm water drainage study shows that the development of the Monticello Single Family Residential Subdivision and more specifically the 4th Phase will not generate any negative downstream hydraulic impacts. A new two cell earthen retention basin located generally along the north property line will provide attenuation for the majority of the Phase IV development along with pieces of both Phase I and Phase III.

In conclusion, proposed peak discharge rates for Sub-basin E are calculated to be well below both Existing and Allowable peak discharge rates. A waiver was previously granted during Phase III for Sub-basin D Allowable (2-Yr) peak discharge rate. The new development further reduces Sub-basin D peak discharge rates for all design storms therefore no further action is required. The study is in conformance with all applicable City of Lee's Summit standards and criteria.

Waivers: N/A

Exhibit A

Aerial Image, Aerial Image of Surrounding Area & Historical Image


NE Bowlin Rd
PROJECT SITE
Google Earth
Image © 2018 DigitalGlobe
N
500 ft


NE Bewley Rd
PROJECT SITE
Google Earth
500 ft
N

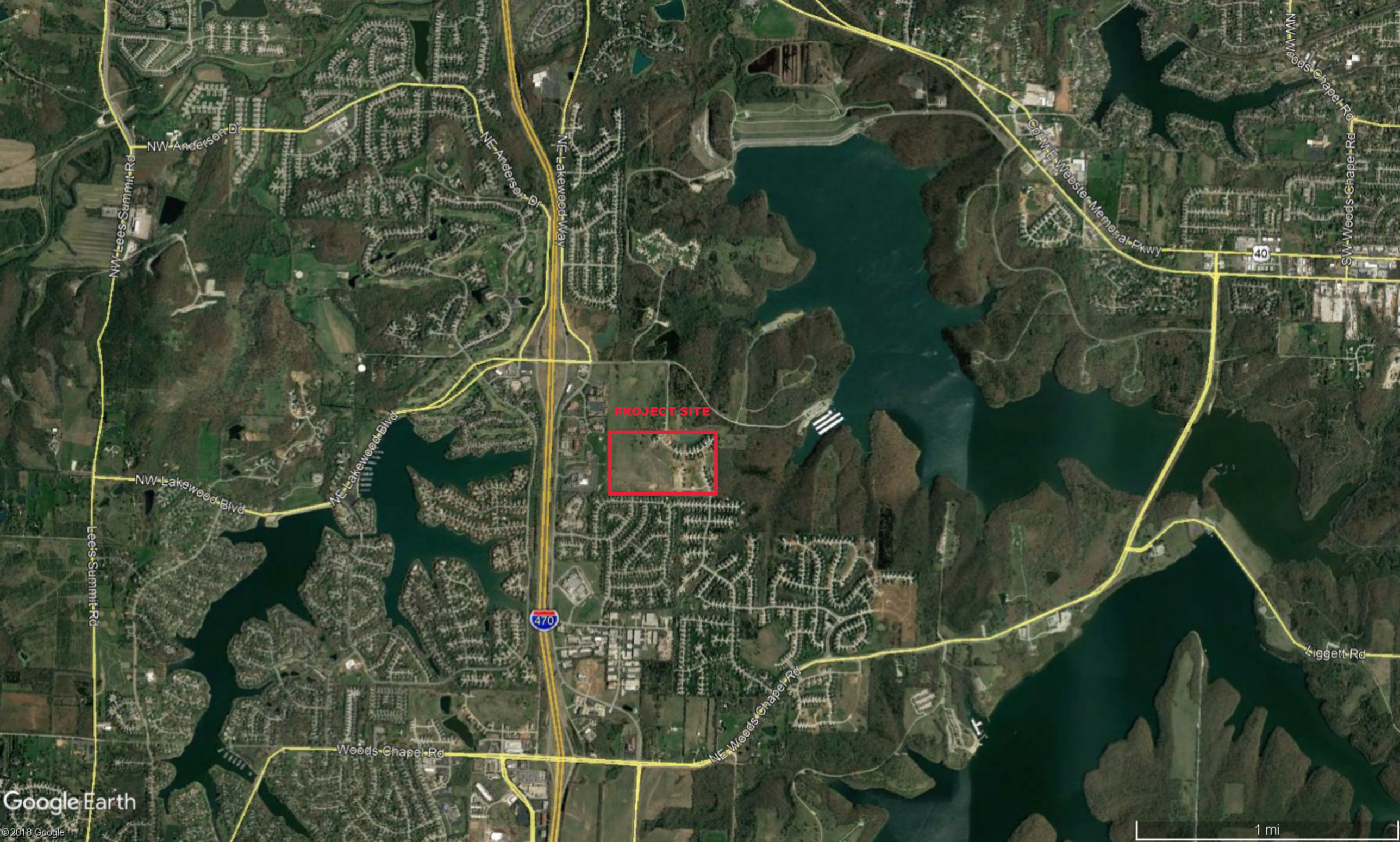
PROJECT SITE
NW Anderson Dr
NE Anderson Dr
NW Lees Summit Rd
NE Lakewood Way
NW Lakewood Blvd
NE Lakewood Blvd
Lee's Summit Rd
Woods Chapel Rd
NE Woods Chapel Rd
NW Woods Chapel Rd
SW Woods Chapel Rd
Liggett Rd
Cpl M E Webster Memorial Pkwy
470
40
Google Earth
© 2018 Google
1 mi

Exhibit B

FEMA FIRMette

National Flood Hazard Layer FIRMette

FEMA

Legend

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

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

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

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

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

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

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

N

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/28/2018 at 4:27:01 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Exhibit C

NRCS Soil Classification 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 Jackson County, Missouri

Monticello

June 29, 2018

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.

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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: 1:3,820 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 18, Sep 16, 2017

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	1.5	2.2%
10113	Oska silty clay loam, 5 to 9 percent slopes, eroded	9.1	13.3%
10117	Sampsel silty clay loam, 5 to 9 percent slopes	13.8	20.3%
10120	Sharpsburg silt loam, 2 to 5 percent slopes	27.7	40.6%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	1.2	1.7%
10129	Sharpsburg-Urban land complex, 5 to 9 percent slopes	0.6	0.8%
10141	Snead-Rock outcrop complex, 14 to 30 percent slopes	0.8	1.1%
10142	Snead-Rock outcrop complex, 5 to 14 percent slopes	4.2	6.1%
10181	Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes	0.4	0.5%
60168	Menfro silt loam, 5 to 9 percent slopes, eroded	9.1	13.3%
Totals for Area of Interest		**68.3**	**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.

Jackson County, Missouri

10082—Arisburg-Urban land complex, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w7ld
Elevation: 750 to 1,130 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Arisburg and similar soils: 61 percent
Urban land: 30 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arisburg

Setting

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

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 13 inches: silt loam
Bt - 13 to 19 inches: silty clay loam
Btg - 19 to 56 inches: silty clay loam
BCg - 56 to 79 inches: silty clay loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: Loess Upland Prairie (R107BY007MO)
Hydric soil rating: No

Description of Urban Land

Interpretive groups

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

Minor Components

Sharpsburg

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loess Upland Prairie (R109XY002MO)
Hydric soil rating: No

Sampsel

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: Interbedded Sedimentary Upland Savanna (R109XY010MO)
Hydric soil rating: Yes

Greenton

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Loess Upland Prairie (R109XY002MO)
Hydric soil rating: No

10113—Oska silty clay loam, 5 to 9 percent slopes, eroded

Map Unit Setting

National map unit symbol: yrm7
Elevation: 600 to 1,200 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Oska and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oska

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum

Typical profile

A - 0 to 7 inches: silty clay loam
Bt - 7 to 34 inches: silty clay loam
R - 34 to 80 inches: bedrock

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: Limestone Upland Prairie (R112XY020MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

10117—Sampsel silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2qkzz
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Sampsel and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampsel

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex, concave
Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 13 inches: silty clay loam
Bt - 13 to 80 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: Interbedded Sedimentary Upland Savanna (R109XY010MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

10120—Sharpsburg silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql02
Elevation: 1,000 to 1,300 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sharpsburg and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sharpsburg

Setting

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

Typical profile

A - 0 to 17 inches: silt loam
Bt - 17 to 55 inches: silty clay loam
C - 55 to 60 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: Loess Upland Prairie (R109XY002MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

10128—Sharpsburg-Urban land complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql09
Elevation: 1,000 to 1,300 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Sharpsburg

Setting

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

Typical profile

A - 0 to 17 inches: silt loam
Bt - 17 to 55 inches: silty clay loam
C - 55 to 60 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 35 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Ecological site: Loess Upland Prairie (R109XY002MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve

Interpretive groups

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

10129—Sharpsburg-Urban land complex, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2ql0b
Elevation: 1,000 to 1,300 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Sharpsburg

Setting

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

Typical profile

A - 0 to 7 inches: silt loam
Bt - 7 to 48 inches: silty clay loam
C - 48 to 60 inches: silty clay loam

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 35 inches

Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Loess Upland Prairie (R109XY002MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest

Interpretive groups

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

10141—Snead-Rock outcrop complex, 14 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2ql0p
Elevation: 600 to 1,100 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Snead and similar soils: 70 percent
Rock outcrop: 15 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Snead

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from calcareous shale

Typical profile

Ap - 0 to 3 inches: silty clay loam
Bw - 3 to 24 inches: silty clay
Cr - 24 to 80 inches: bedrock

Properties and qualities

Slope: 14 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Interbedded Sedimentary Backslope Savanna (R109XY012MO)
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 80 inches: bedrock

Properties and qualities

Slope: 14 to 30 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Interpretive groups

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

Minor Components

Sampsel

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Concave
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

10142—Snead-Rock outcrop complex, 5 to 14 percent slopes

Map Unit Setting

National map unit symbol: 2ql0q
Elevation: 600 to 1,100 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Snead and similar soils: 80 percent
Rock outcrop: 10 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Snead

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from calcareous shale

Typical profile

Ap - 0 to 5 inches: silty clay loam
Bw - 5 to 24 inches: silty clay loam
Cr - 24 to 80 inches: bedrock

Properties and qualities

Slope: 5 to 14 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 11 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: D
Ecological site: Interbedded Sedimentary Upland Savanna (R109XY010MO)
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Description of Rock Outcrop

Setting
Landform: Hillslopes

Typical profile
R - 0 to 80 inches: bedrock

Properties and qualities
Slope: 5 to 14 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.60 in/hr)

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

Minor Components

Sampsel
Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Concave
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

10181—Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes

Map Unit Setting
National map unit symbol: 1n85g
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 43 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 175 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Udarents and similar soils: 41 percent
Urban land: 39 percent

Sampsel and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udarents

Setting

Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mine spoil or earthy fill

Typical profile

C1 - 0 to 5 inches: silt loam
C2 - 5 to 80 inches: silty clay loam

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Deep Loess Upland Prairie (R107BY002MO)
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Across-slope shape: Convex

Interpretive groups

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

Description of Sampsel

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave

Across-slope shape: Convex
Parent material: Residuum weathered from shale

Typical profile
Ap - 0 to 13 inches: silty clay loam
Bt - 13 to 80 inches: silty clay

Properties and qualities
Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: Interbedded Sedimentary Upland Savanna (R109XY010MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

60168—Menfro silt loam, 5 to 9 percent slopes, eroded

Map Unit Setting
National map unit symbol: 2tbqp
Elevation: 400 to 900 feet
Mean annual precipitation: 37 to 47 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 184 to 228 days
Farmland classification: Farmland of statewide importance

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

Description of Menfro

Setting
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 7 inches: silt loam
Bt1 - 7 to 33 inches: silty clay loam
Bt2 - 33 to 79 inches: silty clay loam

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Deep Loess Upland Woodland (F115BY001MO)
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

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Exhibit D

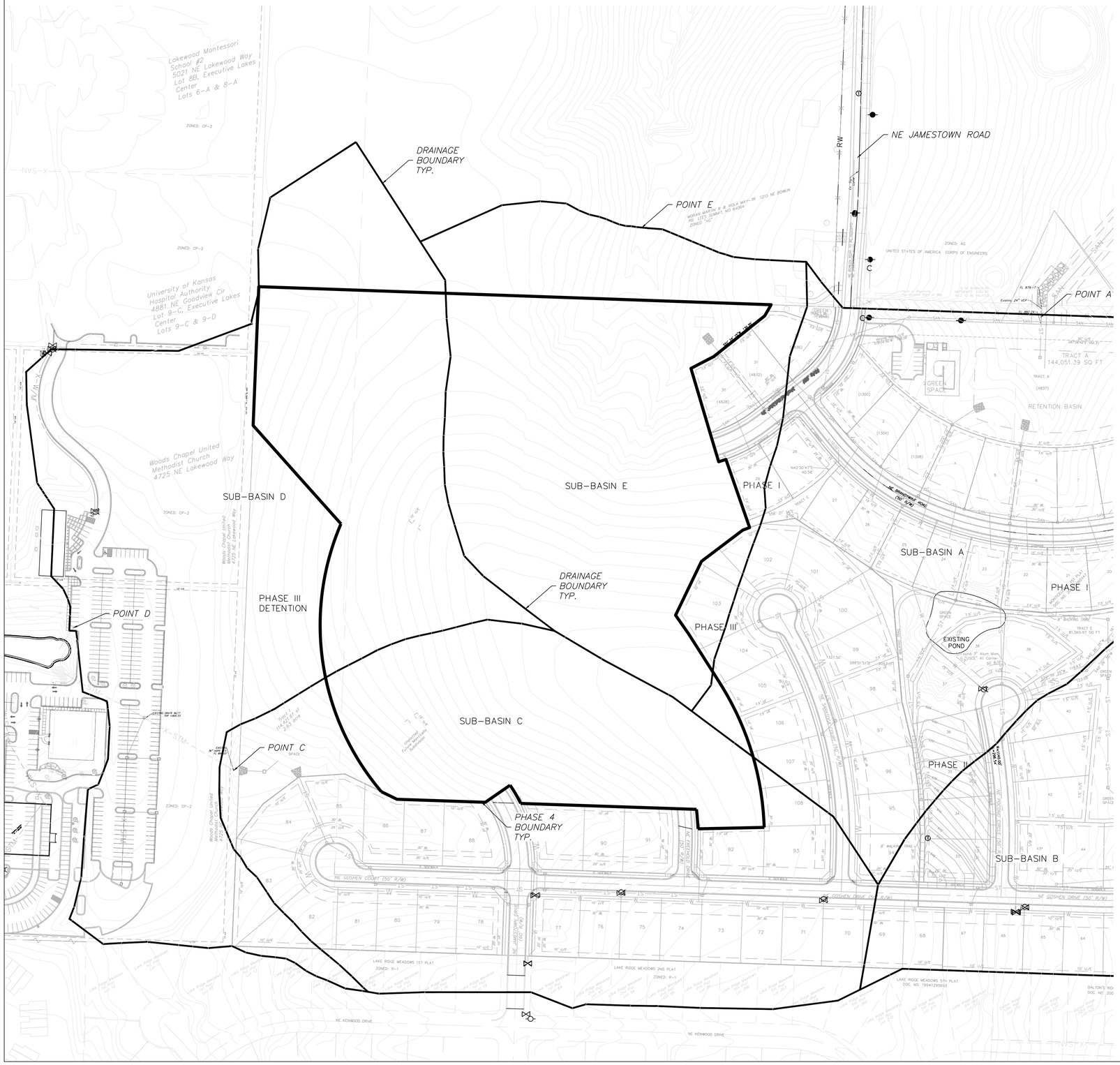
Pre-Development Drainage Map

PRE-DEVELOPMENT DRAINAGE AREA MAP

SCALE: 1" = 100'

North

0 50' 100' 200'



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Oklahoma
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Nebraska
Engineering CA2821

Monticello 4th Plat
Lee's Summit, Jackson County, Missouri

Project: Monticello

Issue Date: May, 2019

Pre-Development Drainage Area Map
Construction Plans for:
Monticello 4th Plat
Lee's Summit, Jackson County, Missouri

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

Exhibit

Exhibit E

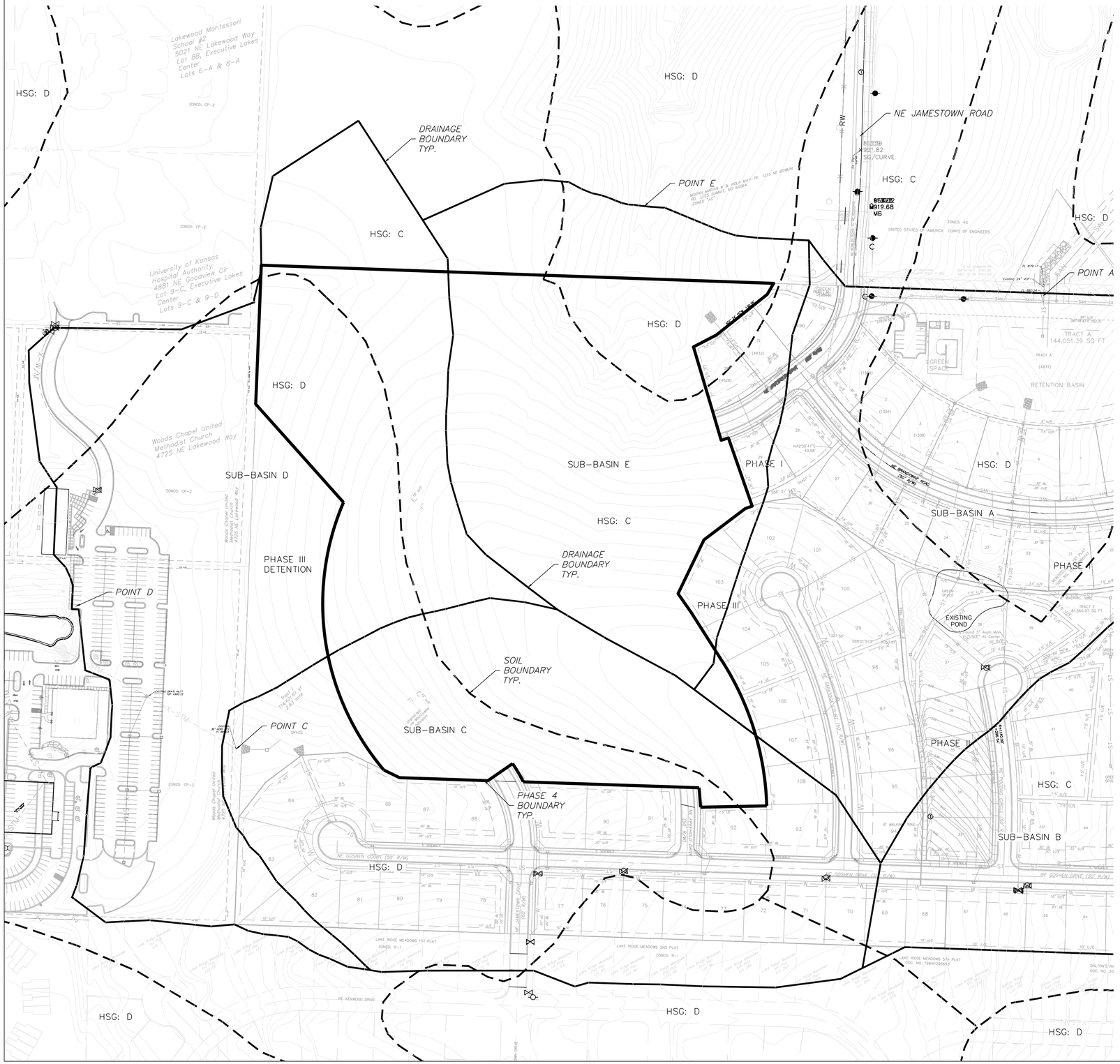
Pre-Development Land Usage Map

PRE-DEVELOPMENT LAND USAGE MAP

SCALE: 1" = 100'

North

0 50' 100' 200'



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Lee's Summit, Jackson County, Missouri

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REVISIONS

Exhibit

Exhibit F

Composite Curve Number Calculations

Existing Conditions

Sub-basin D	Area (ac.)	CN	Area x CN
Offsite Single Family 1/4 Acre D	0.17	87	15.02
Offsite Commercial C	1.26	94	118.51
Offsite Commercial D	8.31	95	789.79
Offsite Meadow C	1.67	71	118.49
Meadow C	2.50	71	177.33
Meadow D	5.11	78	398.51
Total Area	19.02		1617.65
Composite CN	85		

Sub-basin E	Area (ac.)	CN	Area x CN
Offsite Meadow D	1.38	78	107.71
Offsite Meadow C	1.01	71	71.90
Meadow C	8.34	71	592.35
Meadow D	1.69	78	131.50
Total Area	12.42		903.46
Composite CN	73		

Existing Conditions Onsite

Sub-basin D	Area (ac.)	CN	Area x CN
Offsite Single Family 1/4 Acre D			
Offsite Commercial C			
Offsite Commercial D			
Offsite Meadow C			
Meadow C	2.50	71	177.33
Meadow D	5.11	78	398.51
Total Area	7.61		575.84
Composite CN	76		

Sub-basin E	Area (ac.)	CN	Area x CN
Offsite Meadow D			
Offsite Meadow C			
Meadow C	8.34	71	592.35
Meadow D	1.69	78	131.50
Total Area	10.03		723.85
Composite CN	72		

Proposed Conditions

Sub-basin D	Area (ac.)	CN	Area x CN
Offsite Single Family 1/4 Acre D			
Offsite Commercial C	1.26	94	118.51
Offsite Commercial D	8.31	95	789.82
Offsite Meadow C	1.67	71	118.52
Green Space	0.48	82	39.36
Single Family 1/4 Acre C	0.12	83	9.73
Single Family 1/4 Acre D	1.54	87	133.98
Total Area	13.38		1209.93
Composite CN	90		

Sub-basin D (Green Space)	Area (ac.)	CN	Area x CN
Open Space C	0.01	74	0.50
Open Space D	0.42	80	33.60
Walking Path (Asphalt)	0.05	98	4.90
Total Area	0.48		39.00
Composite CN	82		

Sub-basin E	Area (ac.)	CN	Area x CN
Offsite Meadow D	1.38	78	107.71
Offsite Meadow C	1.01	71	71.92
Green Space	0.56	78	43.68
Single Family 1/4 Acre C	0.09	83	7.88
Single Family 1/4 Acre D	0.03	87	2.91
Total Area	3.08		234.10
Composite CN	76		

Sub-basin E (Green Space)	Area (ac.)	CN	Area x CN
Open Space C	0.19	74	13.81
Open Space D	0.36	80	29.12
Walking Path (Asphalt)	0.01	98	0.97
Total Area	0.56		43.90
Composite CN	78		

Sub-basin E1	Area (ac.)	CN	Area x CN
Single Family 1/4 Acre C	9.68	83	803.19
Single Family 1/4 Acre D	1.10	87	95.78
Open Space C	0.73	74	53.82
Open Space D	0.58	80	46.30
Walking Path (Asphalt)	0.26	98	25.48
Total Area	12.34		1024.57
Composite CN	83		

Exhibit G

Time of Concentration Calculations

Monticello 4th Phase
Time of Concentration Table
October 17, 2019

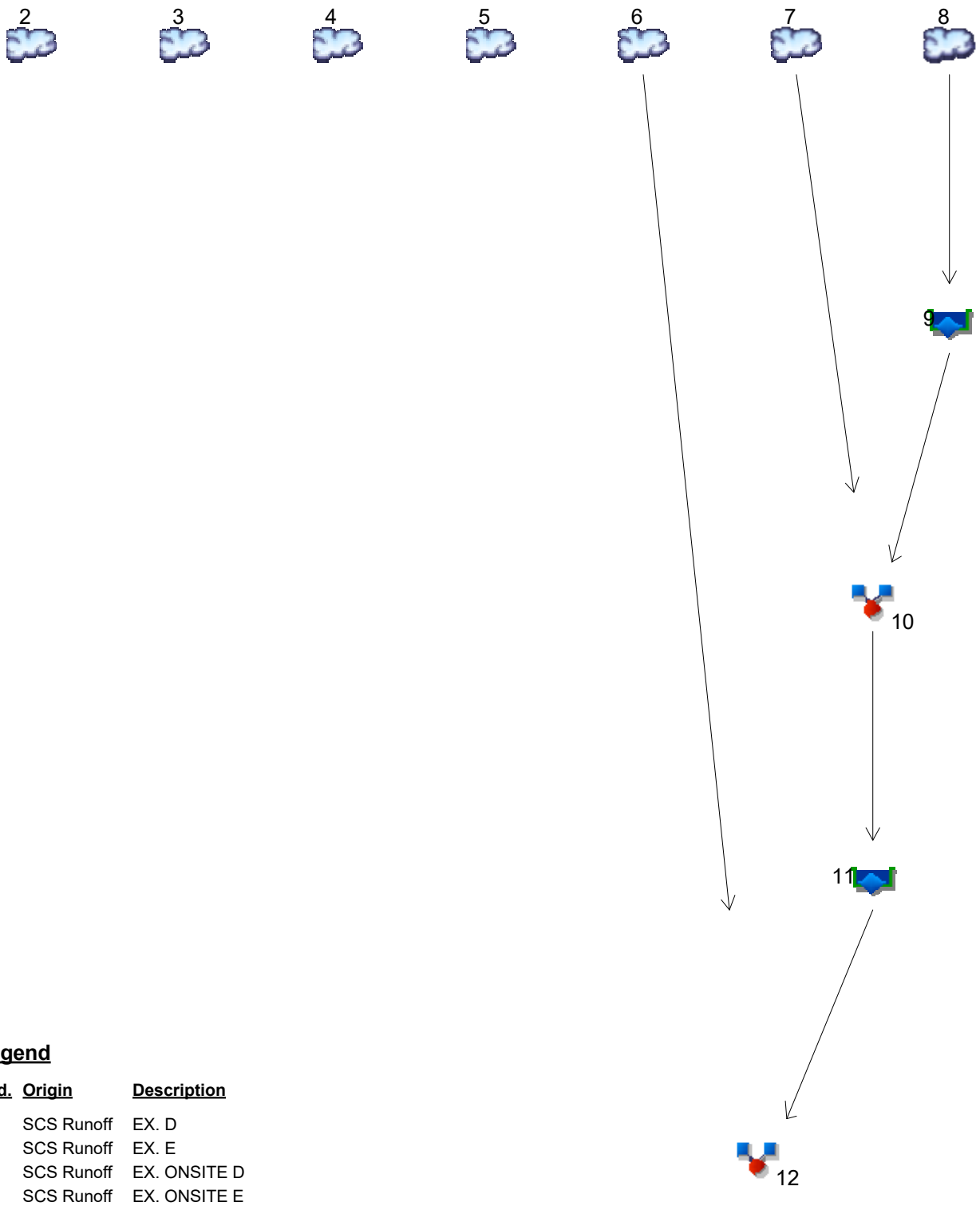
Point	Initial Sheet Flow					Shallow Concentrated Flow				Total Overland	Channel Flow					Unimproved Watersheds			**Total**
	"n" Value	L (ft.)	P(2-Yr)	S (%)	T_T (min.)	Paved (Y/N)	L (ft.)	S (%)	T_T (min.)	Flow (min.)	L (ft.)	Manning's n	R (ft.)	S (ft./ft.)	T_T (min.)	L (ft.)	S (%)	T_T (min.)	**T_C (min.)**
PRE-DEVELOPMENT																			
C	0.15	100	3.5	2.0	9.37	N	215	3.7	1.15	10.52		0.000	0.00	0.000	0	1038	4.8	1.73	12.25
D	0.15	100	3.5	2.0	9.37	N	478	2.1	3.41	12.78		0.000	0.00	0.000	0	616	2.5	1.03	13.81
A	0.15	100	3.5	2.0	9.37	N	656	7.0	2.56	11.93					0	522	5.4	0.58	12.51
E	0.15	100	3.5	2.0	9.37	N	668	6.7	2.66	12.03					0	290	11.0	0.32	12.35
POST-DEVELOPMENT																			
C										5.00									5.00
C1	0.15	100	3.5	2.0	9.37	Y	298	2.1	1.70	11.07	993	0.013	0.5	0.04	1.14				12.21
D	0.15	100	3.5	2.0	9.37	N	478	2.1	3.41	12.78						616	2.5	1.03	13.81
E	0.15	100	3.5	2.0	9.37	N	410	5.9	1.75	11.12									11.12
E1	0.15	100	3.5	2.0	9.37	Y	134	1.0	1.10	10.47	752	0.013	0.5	0.05	0.78	300	4.2	0.50	11.75
A1	0.15	100	3.5	2.0	9.37	Y	229	9.0	0.63	9.99	1536	0.013	0.75	0.03	1.68				11.67
A	0.15	100	3.5	2.0	9.37	N	75	6.0	0.32	9.68						539	5.4	0.60	10.28
E2	0.15	100	3.5	2.0	9.37	N	269	4.3	1.34	10.71									10.71

Exhibit H

Complete Hydraflow Report

Hydraflow Table of Contents

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX. D
2	SCS Runoff	EX. E
3	SCS Runoff	EX. ONSITE D
4	SCS Runoff	EX. ONSITE E
5	SCS Runoff	PROP. D
6	SCS Runoff	PROP. E
7	SCS Runoff	PROP. E1
8	SCS Runoff	PROP. E2
9	Reservoir	DETAINED PROP. E2
10	Combine	ROUTED E2 + E1
11	Reservoir	(ROUTED E2 + PROP. E1)
12	Combine	POI E

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	------	8.910	51.68	-------	-------	89.62	-------	-------	145.78	EX. D
2	SCS Runoff	------	0.504	20.20	-------	-------	42.80	-------	-------	79.46	EX. E
3	SCS Runoff	------	0.765	13.81	-------	-------	27.76	-------	-------	49.76	EX. ONSITE D
4	SCS Runoff	------	0.256	15.40	-------	-------	33.32	-------	-------	62.68	EX. ONSITE E
5	SCS Runoff	------	10.25	42.40	-------	-------	68.69	-------	-------	106.91	PROP. D
6	SCS Runoff	------	0.310	5.361	-------	-------	10.69	-------	-------	19.10	PROP. E
7	SCS Runoff	------	2.573	17.40	-------	-------	31.01	-------	-------	51.35	PROP. E1
8	SCS Runoff	------	2.745	18.39	-------	-------	32.75	-------	-------	54.21	PROP. E2
9	Reservoir	8	0.161	3.623	-------	-------	6.400	-------	-------	8.992	DETAINED PROP. E2
10	Combine	7, 9	2.601	19.63	-------	-------	36.04	-------	-------	58.82	ROUTED E2 + E1
11	Reservoir	10	0.157	5.170	-------	-------	12.20	-------	-------	19.22	(ROUTED E2 + PROP. E1)
12	Combine	6, 11	0.342	7.735	-------	-------	18.30	-------	-------	33.66	POI E

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

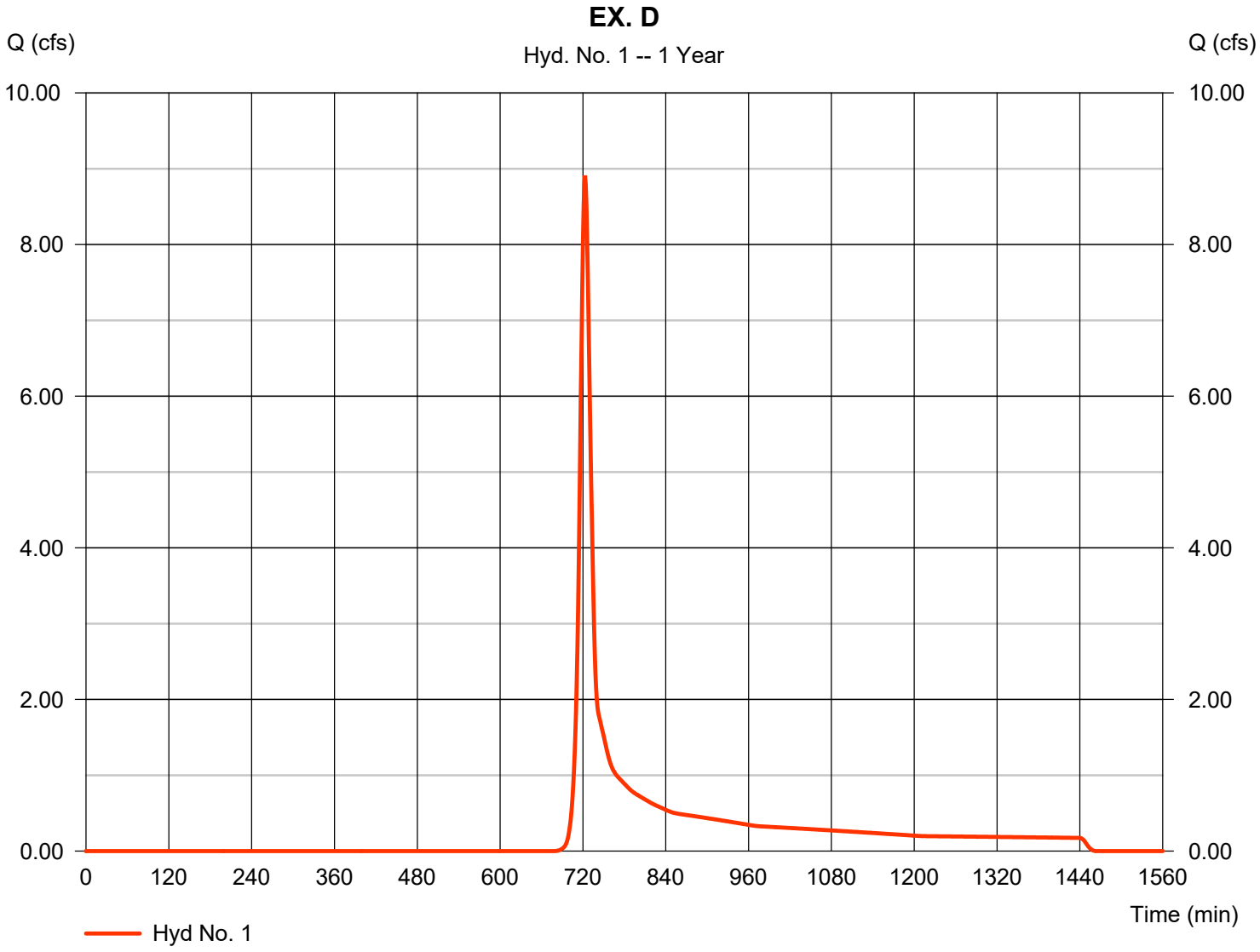
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.910	1	723	25,674	------	------	------	EX. D
2	SCS Runoff	0.504	1	726	4,073	------	------	------	EX. E
3	SCS Runoff	0.765	1	726	3,865	------	------	------	EX. ONSITE D
4	SCS Runoff	0.256	1	727	2,805	------	------	------	EX. ONSITE E
5	SCS Runoff	10.25	1	722	27,754	------	------	------	PROP. D
6	SCS Runoff	0.310	1	723	1,339	------	------	------	PROP. E
7	SCS Runoff	2.573	1	722	7,252	------	------	------	PROP. E1
8	SCS Runoff	2.745	1	721	7,340	------	------	------	PROP. E2
9	Reservoir	0.161	1	841	6,829	8	914.68	3,386	DETAINED PROP. E2
10	Combine	2.601	1	722	14,080	7, 9	------	------	ROUTED E2 + E1
11	Reservoir	0.157	1	844	5,703	10	907.66	3,275	(ROUTED E2 + PROP. E1)
12	Combine	0.342	1	724	7,042	6, 11	------	------	POI E

Hydrograph Report

Hyd. No. 1

EX. D

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.910 cfs
Storm frequency	=	1 yrs	Time to peak	=	723 min
Time interval	=	1 min	Hyd. volume	=	25,674 cuft
Drainage area	=	19.020 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.81 min
Total precip.	=	1.37 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

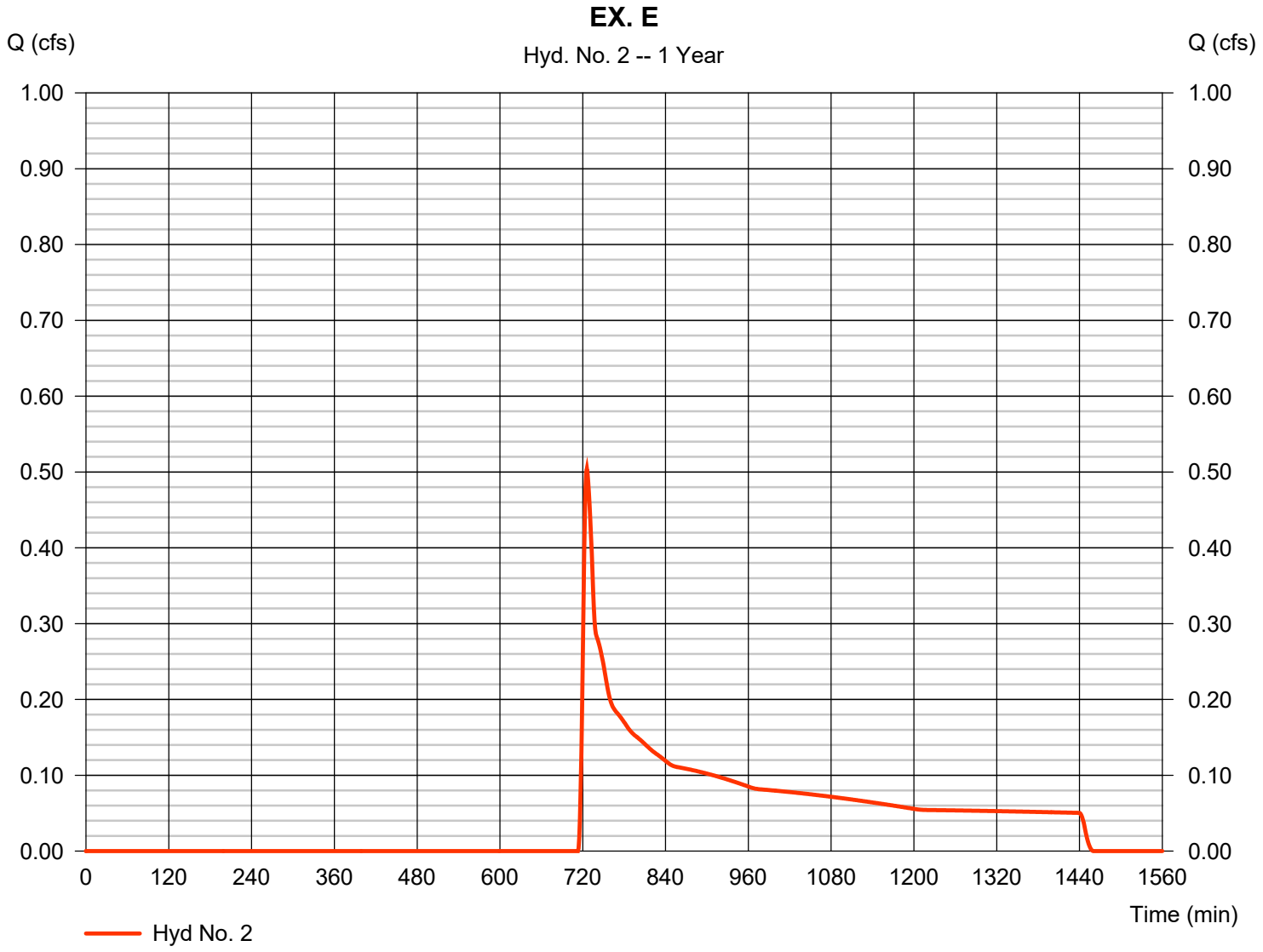


Hydrograph Report

Hyd. No. 2

EX. E

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.504 cfs
Storm frequency	=	1 yrs	Time to peak	=	726 min
Time interval	=	1 min	Hyd. volume	=	4,073 cuft
Drainage area	=	12.420 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	12.40 min
Total precip.	=	1.37 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

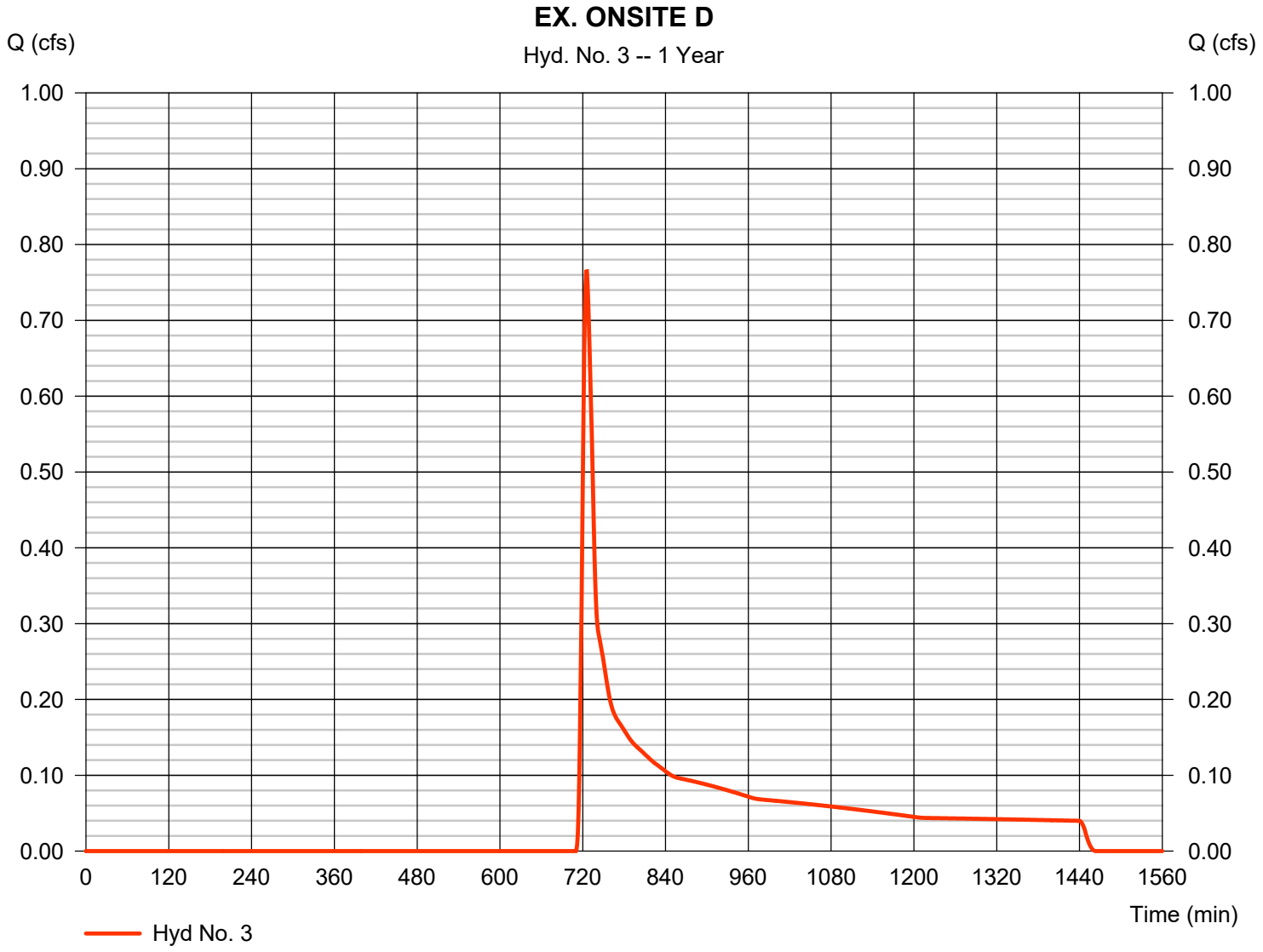


Hydrograph Report

Hyd. No. 3

EX. ONSITE D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.765 cfs
Storm frequency	= 1 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 3,865 cuft
Drainage area	= 7.610 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.81 min
Total precip.	= 1.37 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

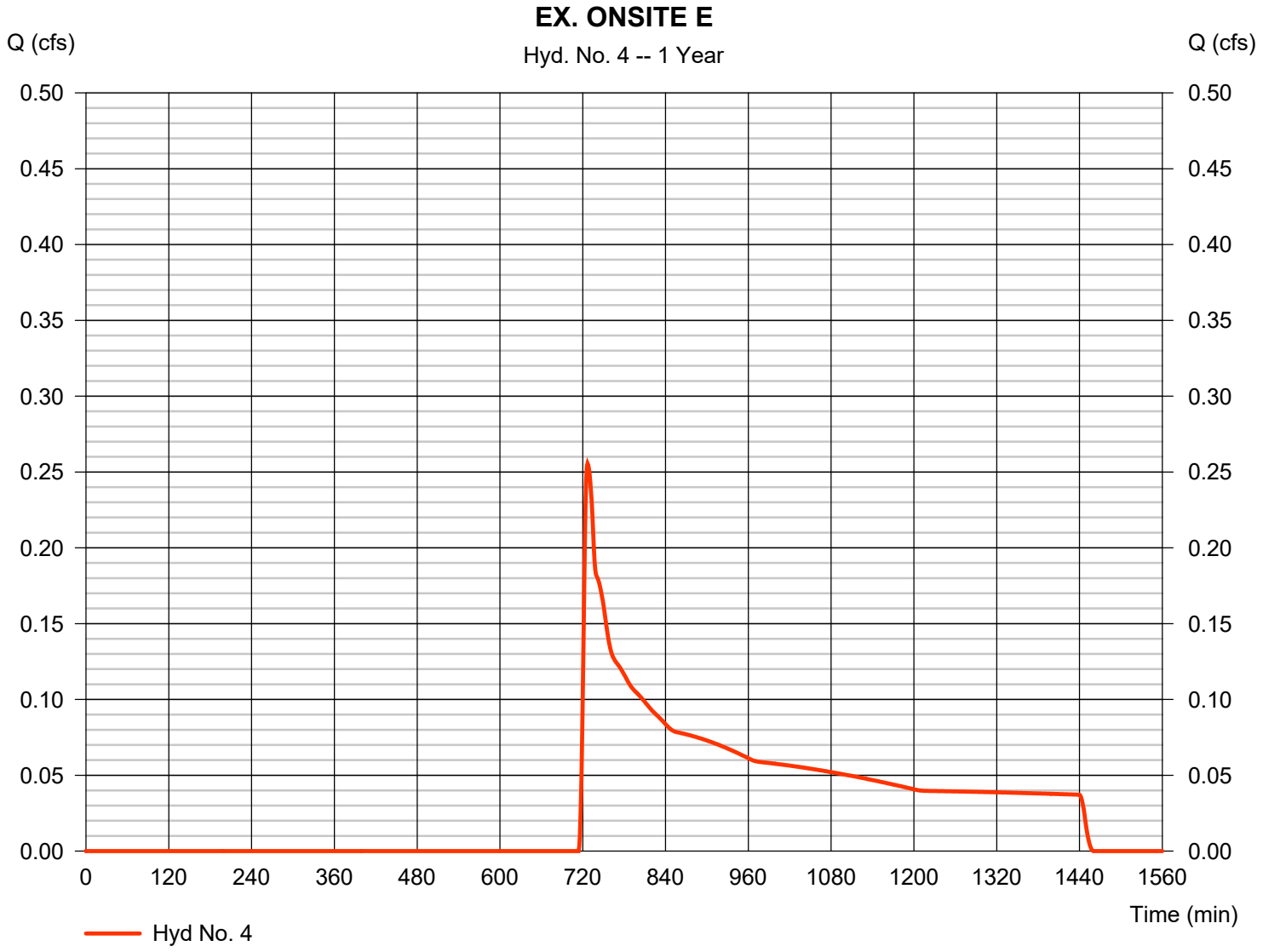


Hydrograph Report

Hyd. No. 4

EX. ONSITE E

Hydrograph type	= SCS Runoff	Peak discharge	= 0.256 cfs
Storm frequency	= 1 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 2,805 cuft
Drainage area	= 10.030 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.35 min
Total precip.	= 1.37 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

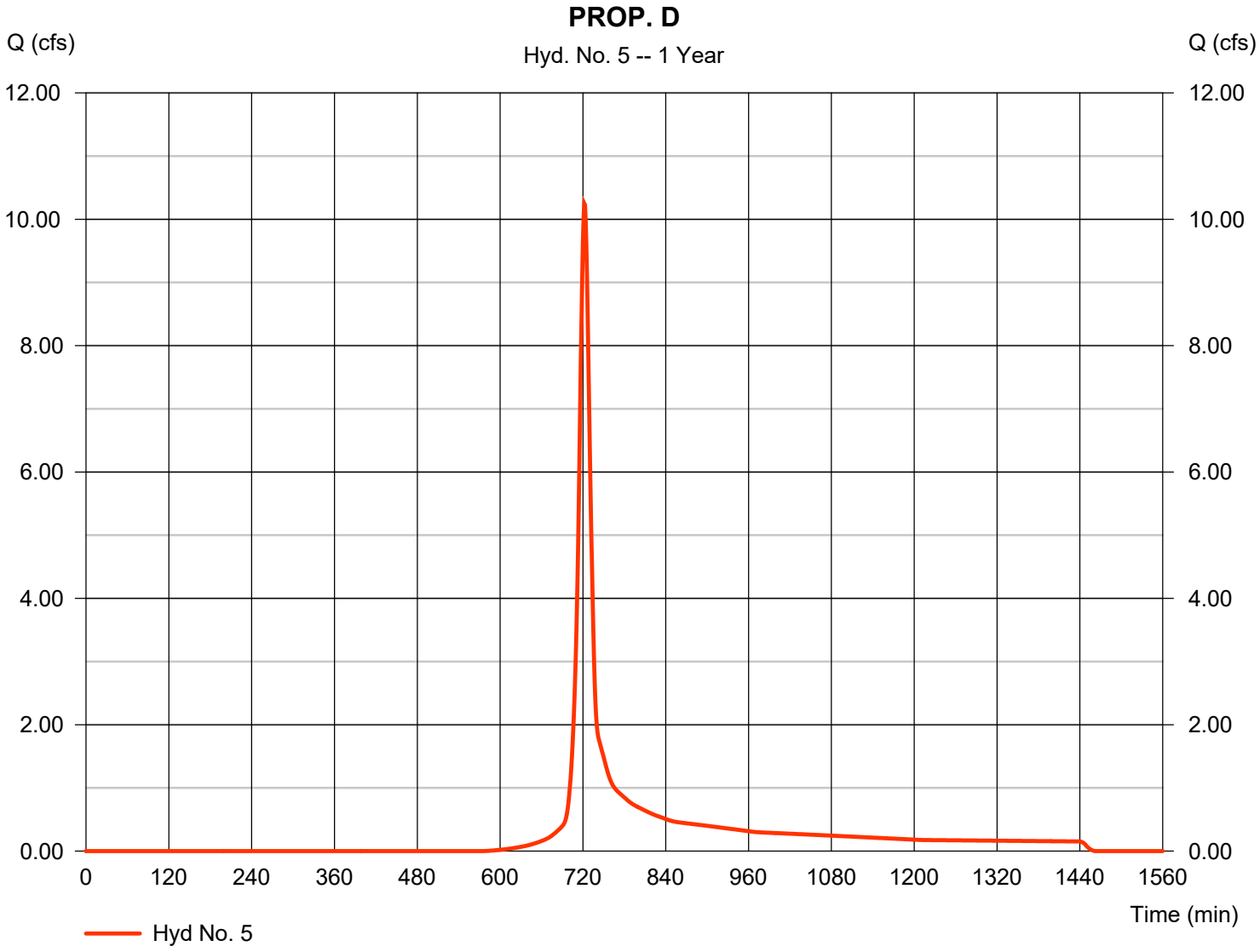


Hydrograph Report

Hyd. No. 5

PROP. D

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.25 cfs
Storm frequency	=	1 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	27,754 cuft
Drainage area	=	13.110 ac	Curve number	=	90
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.80 min
Total precip.	=	1.37 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

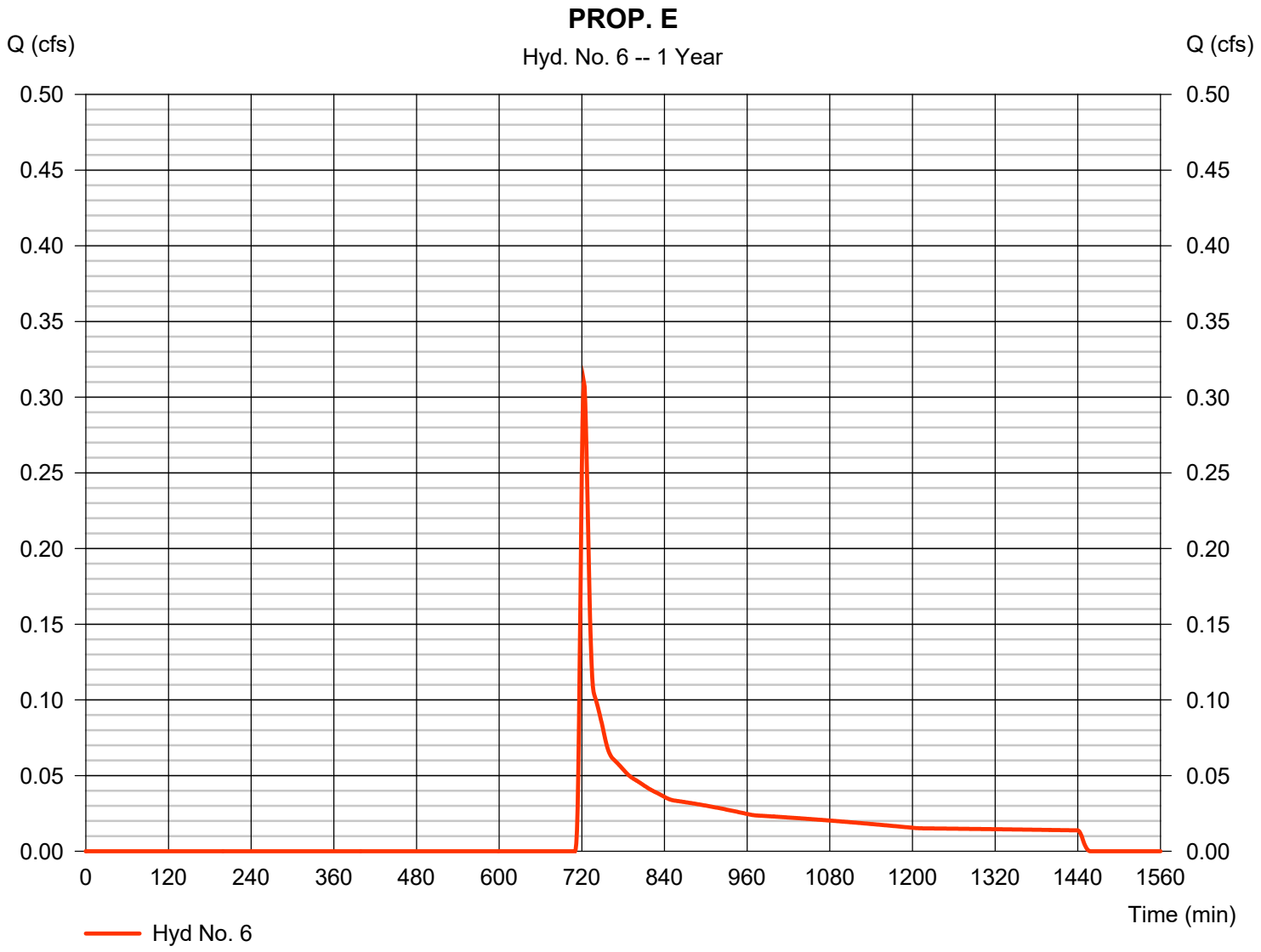


Hydrograph Report

Hyd. No. 6

PROP. E

Hydrograph type	= SCS Runoff	Peak discharge	= 0.310 cfs
Storm frequency	= 1 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 1,339 cuft
Drainage area	= 2.590 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.10 min
Total precip.	= 1.37 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

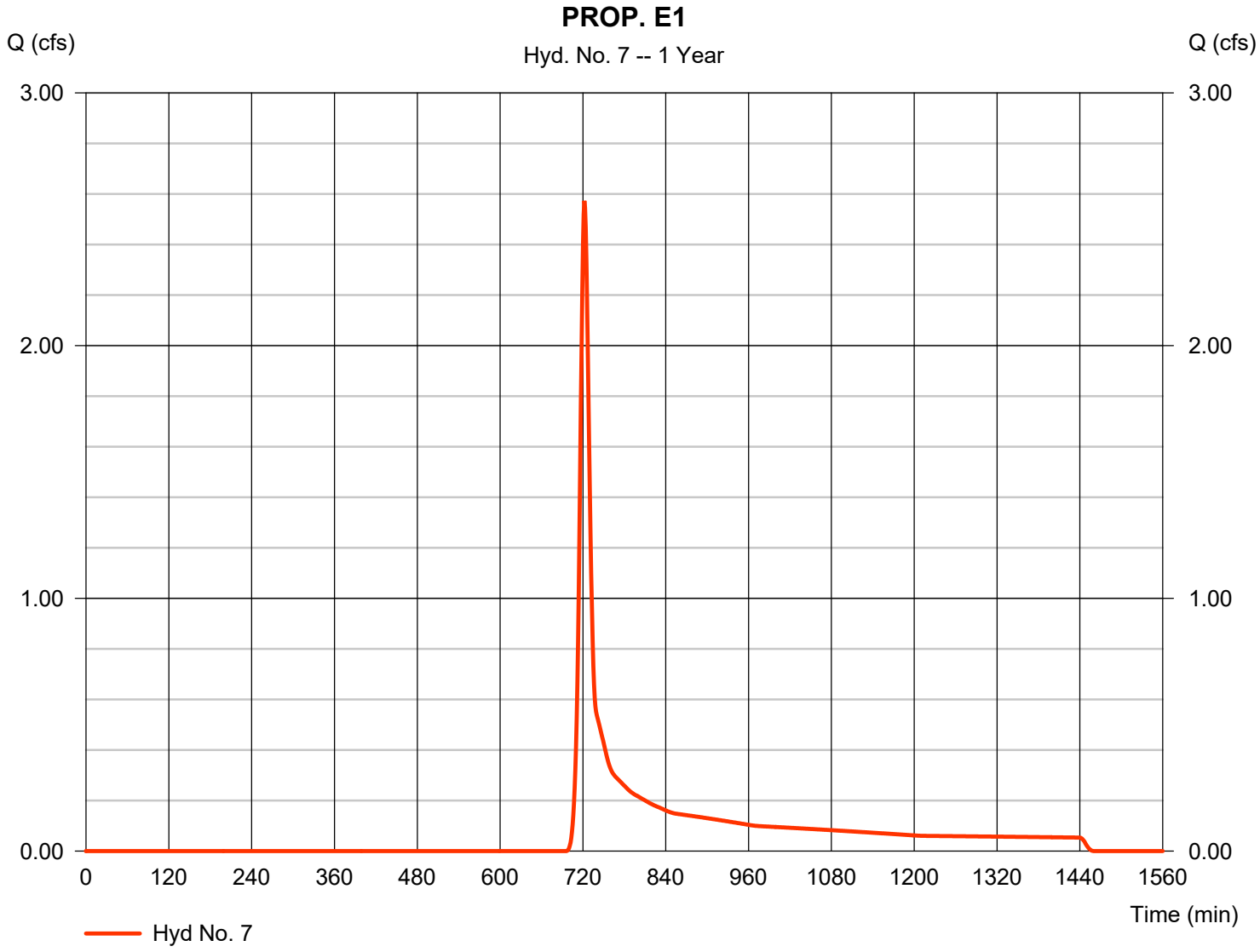


Hydrograph Report

Hyd. No. 7

PROP. E1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.573 cfs
Storm frequency	=	1 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	7,252 cuft
Drainage area	=	6.620 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.80 min
Total precip.	=	1.37 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

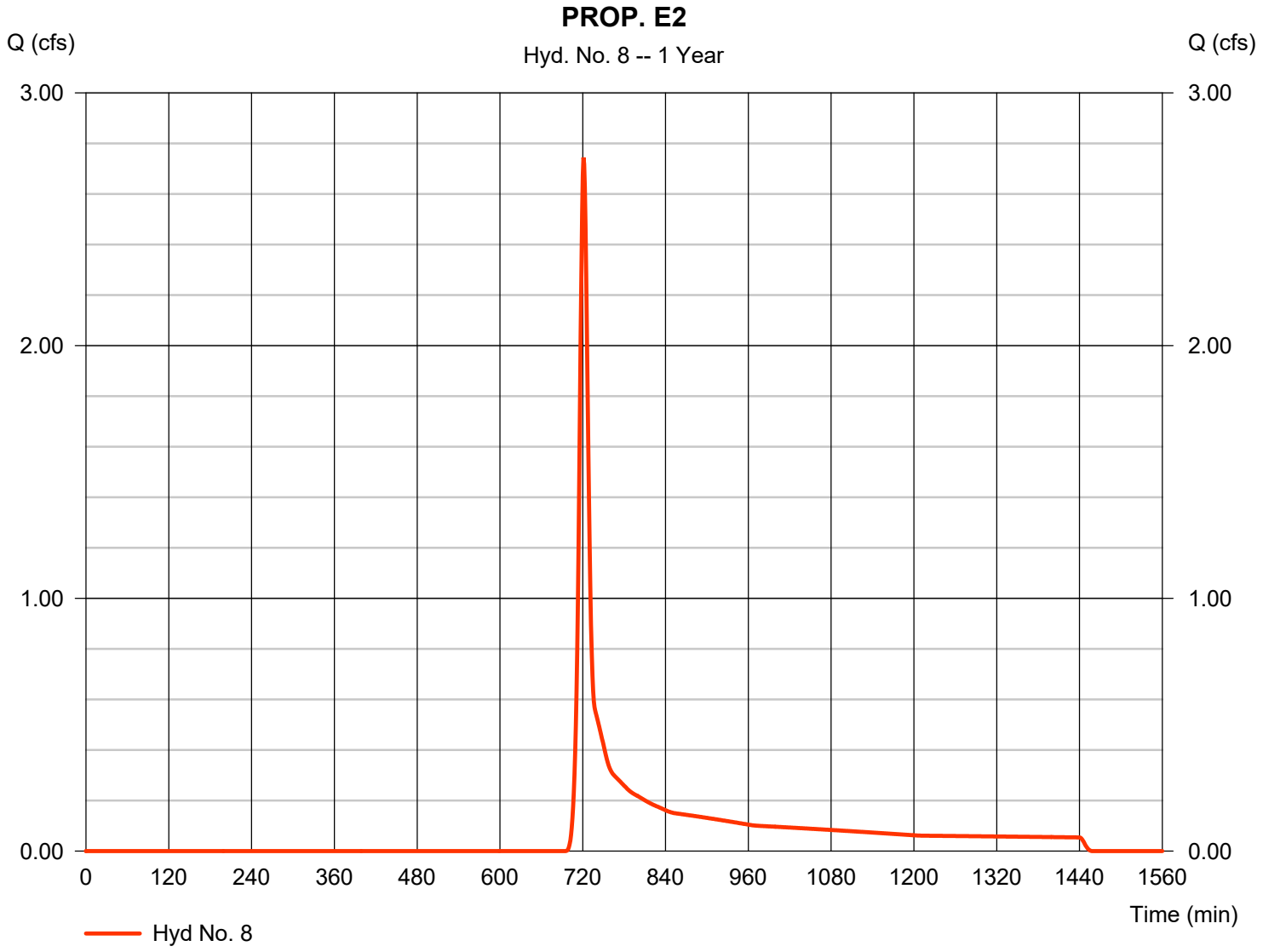


Hydrograph Report

Hyd. No. 8

PROP. E2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.745 cfs
Storm frequency	=	1 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	7,340 cuft
Drainage area	=	6.480 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.70 min
Total precip.	=	1.37 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



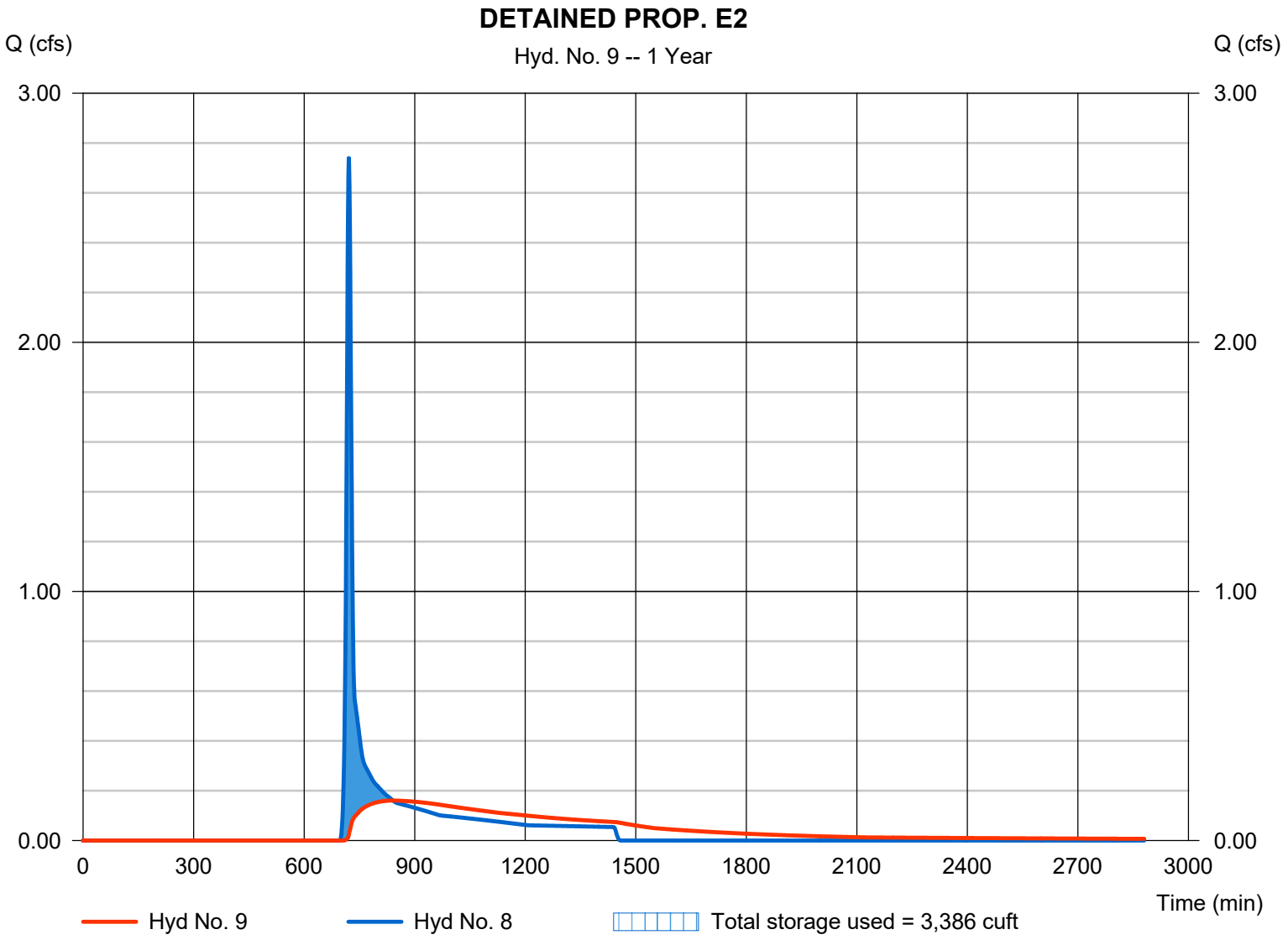
Hydrograph Report

Hyd. No. 9

DETAINED PROP. E2

Hydrograph type	=	Reservoir	Peak discharge	=	0.161 cfs
Storm frequency	=	1 yrs	Time to peak	=	841 min
Time interval	=	1 min	Hyd. volume	=	6,829 cuft
Inflow hyd. No.	=	8 - PROP. E2	Max. Elevation	=	914.68 ft
Reservoir name	=	BASIN E2 (CELL 1)	Max. Storage	=	3,386 cuft

Storage Indication method used.



Pond Report

Pond No. 5 - BASIN E2 (CELL 1)

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 914.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	914.50	18,346	0	0
0.50	915.00	19,204	9,388	9,388
1.50	916.00	20,981	20,093	29,480
2.50	917.00	22,814	21,898	51,378
3.50	918.00	24,704	23,759	75,137
4.50	919.00	26,650	25,677	100,814
5.50	920.00	27,638	27,144	127,958

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	0.00	0.00	0.00
Span (in)	= 15.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 914.50	0.00	0.00	0.00
Length (ft)	= 52.66	0.00	0.00	0.00
Slope (%)	= 12.34	0.00	0.00	n/a
N-Value	= .010	.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)	= 70.00	0.00	0.00	0.00
Crest El. (ft)	= 918.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

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

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

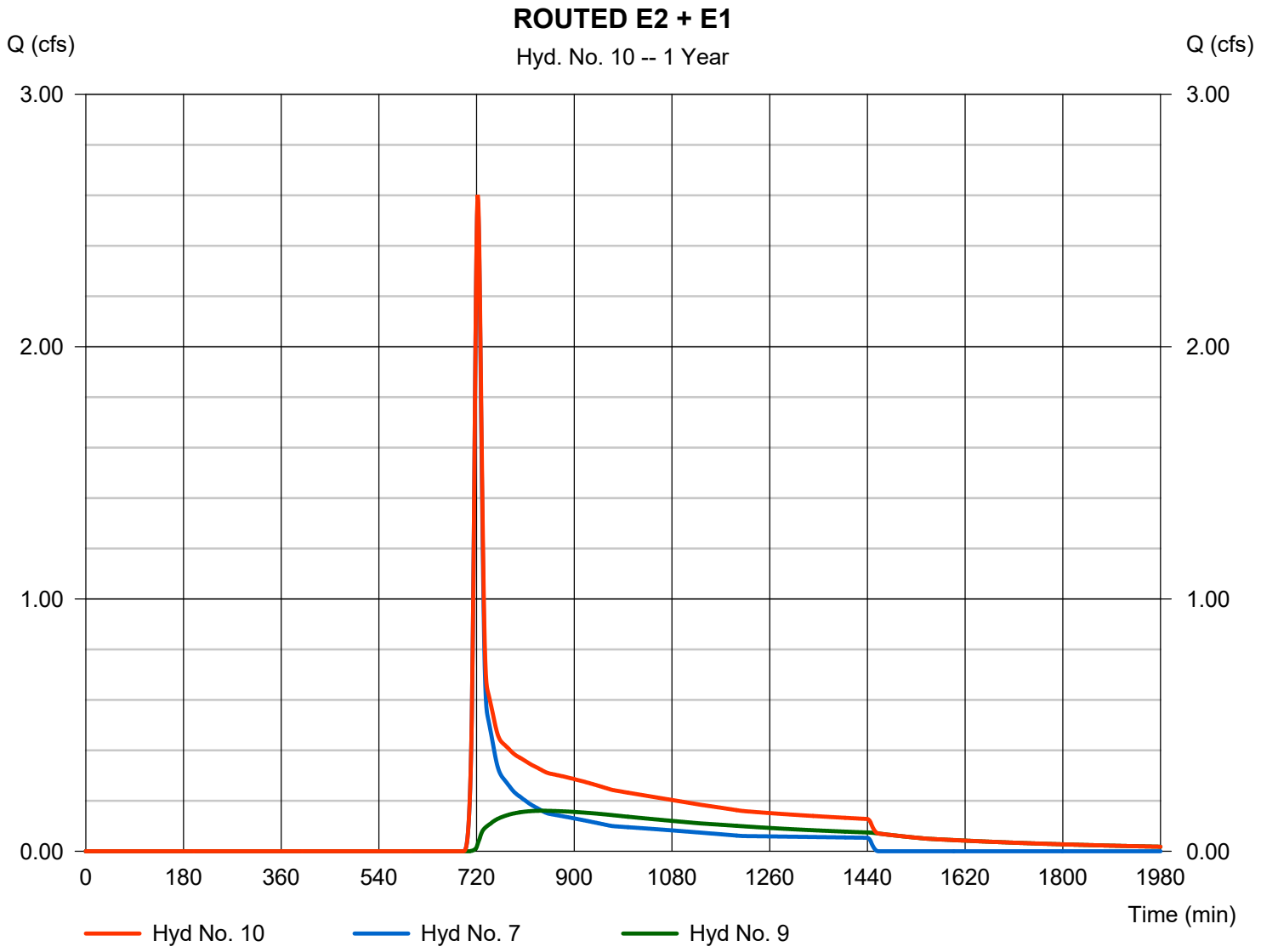
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	914.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.50	9,388	915.00	1.10 ic	---	---	---	0.00	---	---	---	---	---	1.104
1.50	29,480	916.00	5.53 ic	---	---	---	0.00	---	---	---	---	---	5.527
2.50	51,378	917.00	8.09 ic	---	---	---	0.00	---	---	---	---	---	8.090
3.50	75,137	918.00	10.02 ic	---	---	---	0.00	---	---	---	---	---	10.02
4.50	100,814	919.00	11.63 ic	---	---	---	64.35	---	---	---	---	---	75.98
5.50	127,958	920.00	13.04 ic	---	---	---	334.36	---	---	---	---	---	347.40

Hydrograph Report

Hyd. No. 10

ROUTED E2 + E1

Hydrograph type	= Combine	Peak discharge	= 2.601 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 14,080 cuft
Inflow hyds.	= 7, 9	Contrib. drain. area	= 6.620 ac



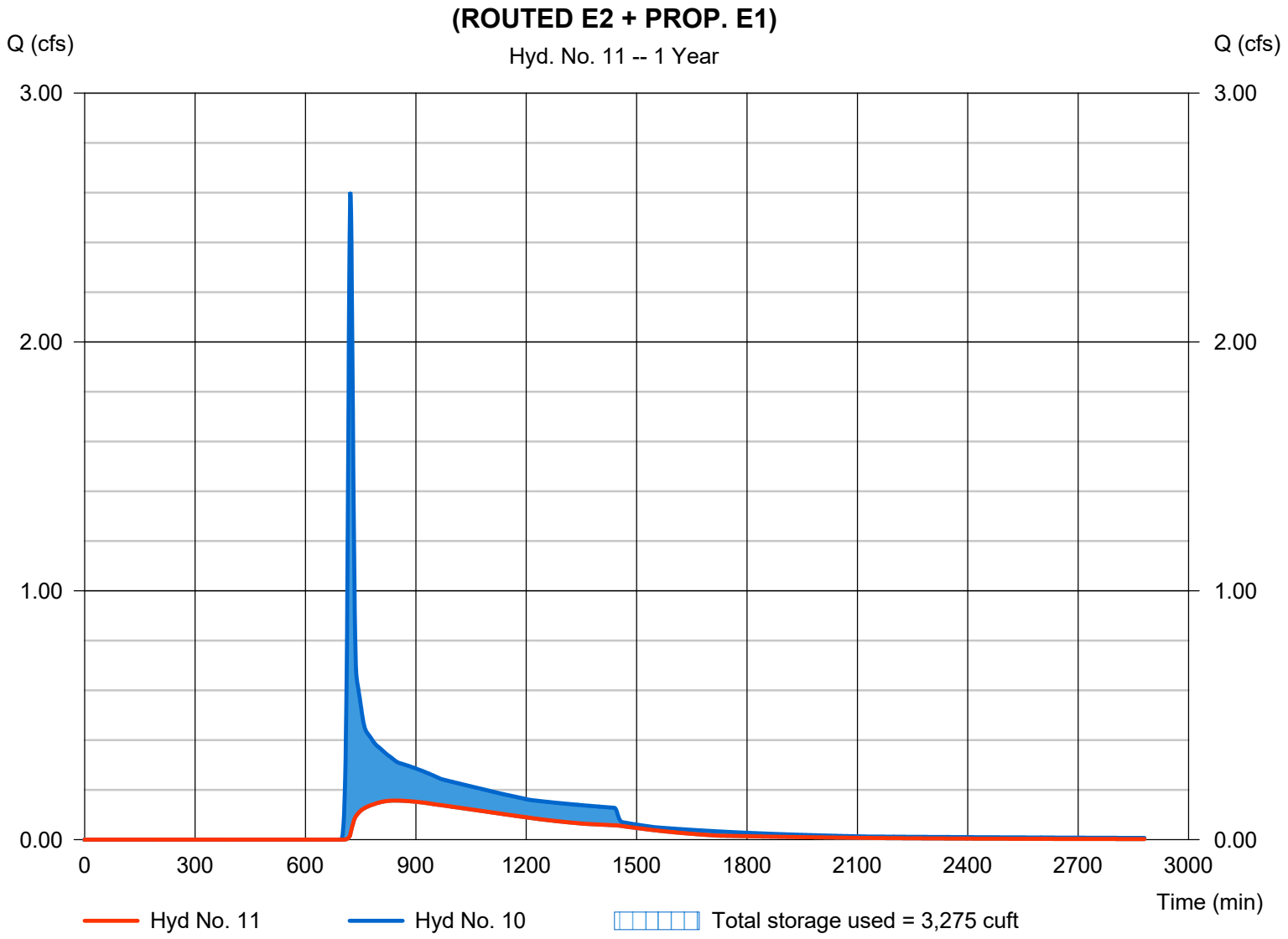
Hydrograph Report

Hyd. No. 11

(ROUTED E2 + PROP. E1)

Hydrograph type	=	Reservoir	Peak discharge	=	0.157 cfs
Storm frequency	=	1 yrs	Time to peak	=	844 min
Time interval	=	1 min	Hyd. volume	=	5,703 cuft
Inflow hyd. No.	=	10 - ROUTED E2 + E1	Max. Elevation	=	907.66 ft
Reservoir name	=	BASIN E1 (CELL 2)	Max. Storage	=	3,275 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 4 - BASIN E1 (CELL 2)

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 907.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	907.50	19,703	0	0
0.50	908.00	22,040	10,429	10,429
1.50	909.00	24,440	23,227	33,657
2.50	910.00	26,898	25,657	59,313
3.50	911.00	29,411	28,142	87,456
4.50	912.00	31,982	30,684	118,140

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 907.50	0.00	0.00	0.00
Length (ft)	= 24.50	0.00	0.00	0.00
Slope (%)	= 20.40	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)	= 210.00	0.00	0.00	0.00
Crest El. (ft)	= 910.70	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 1.000 (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).

Stage / Storage / Discharge Table

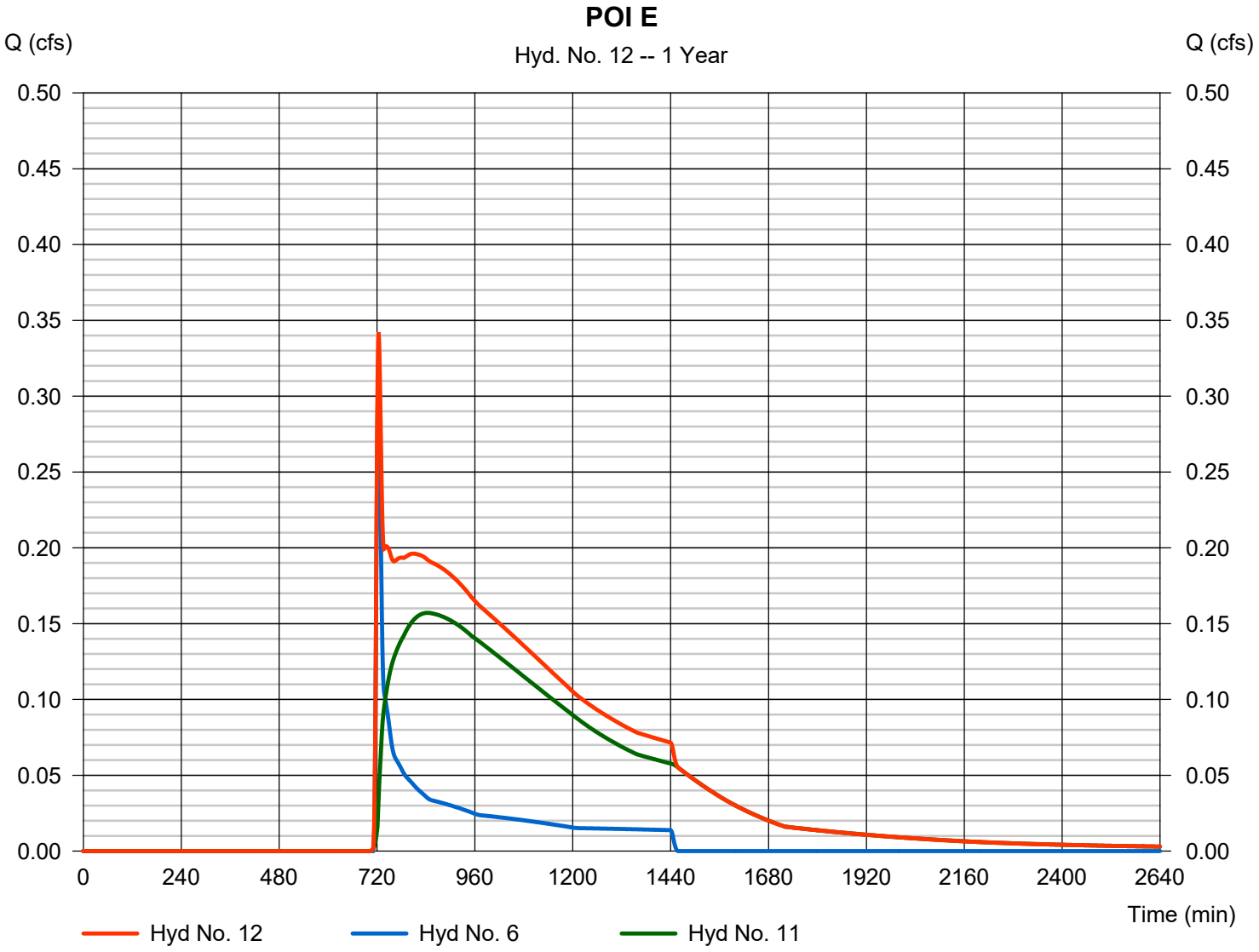
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	907.50	0.00	---	---	---	0.00	---	---	---	0.000	---	0.000
0.50	10,429	908.00	1.48 ic	---	---	---	0.00	---	---	---	0.510	---	1.991
1.50	33,657	909.00	10.55 ic	---	---	---	0.00	---	---	---	0.566	---	11.11
2.50	59,313	910.00	18.52 ic	---	---	---	0.00	---	---	---	0.623	---	19.15
3.50	87,456	911.00	23.91 ic	---	---	---	89.71	---	---	---	0.681	---	114.31
4.50	118,140	912.00	28.30 ic	---	---	---	809.29	---	---	---	0.740	---	838.32

Hydrograph Report

Hyd. No. 12

POI E

Hydrograph type	= Combine	Peak discharge	= 0.342 cfs
Storm frequency	= 1 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 7,042 cuft
Inflow hyds.	= 6, 11	Contrib. drain. area	= 2.590 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

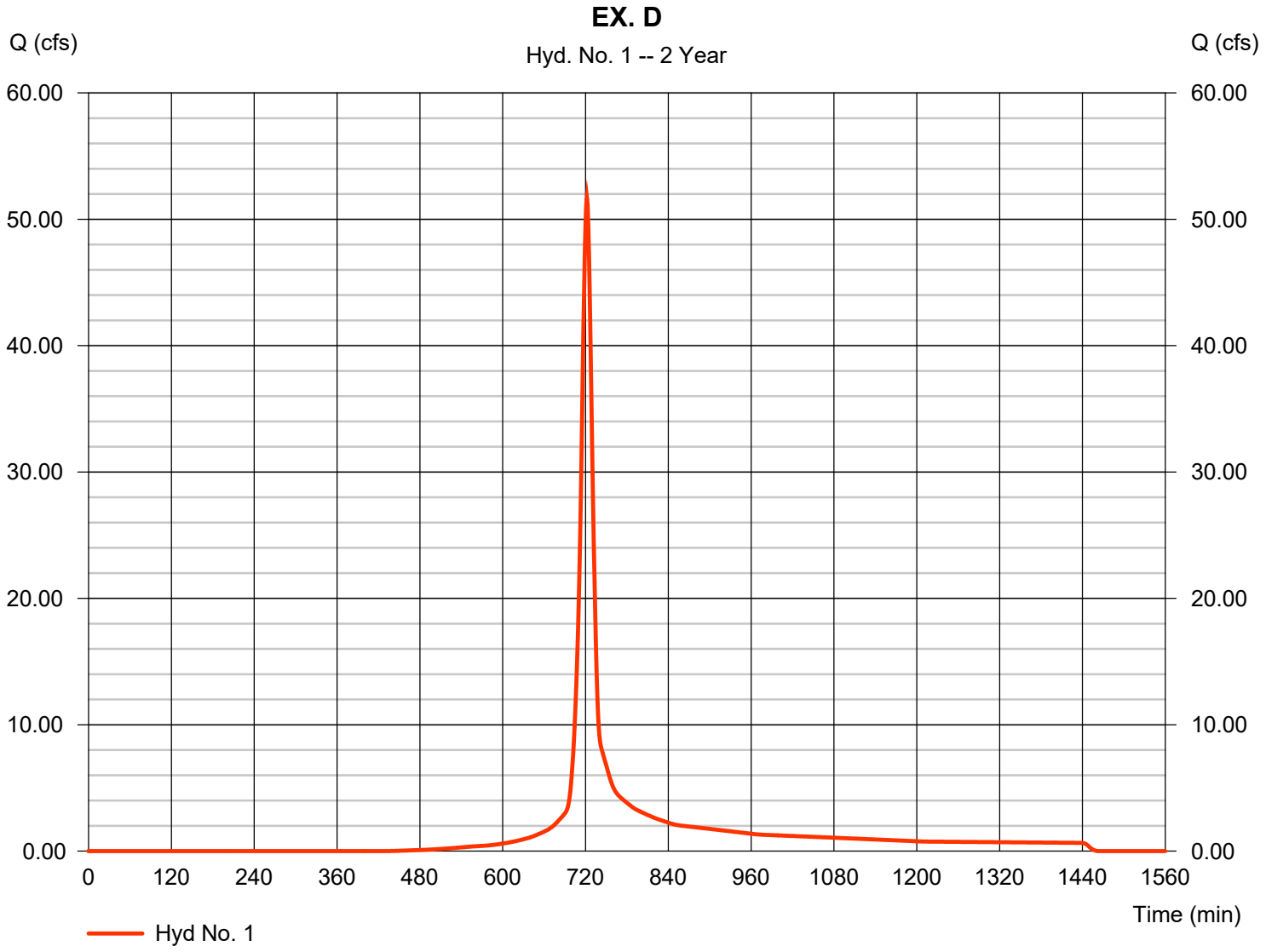
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	51.68	1	722	139,216	------	------	------	EX. D
2	SCS Runoff	20.20	1	722	52,352	------	------	------	EX. E
3	SCS Runoff	13.81	1	723	37,716	------	------	------	EX. ONSITE D
4	SCS Runoff	15.40	1	722	40,174	------	------	------	EX. ONSITE E
5	SCS Runoff	42.40	1	722	116,497	------	------	------	PROP. D
6	SCS Runoff	5.361	1	721	13,066	------	------	------	PROP. E
7	SCS Runoff	17.40	1	721	43,965	------	------	------	PROP. E1
8	SCS Runoff	18.39	1	720	44,499	------	------	------	PROP. E2
9	Reservoir	3.623	1	734	43,873	8	915.51	19,591	DETAINED PROP. E2
10	Combine	19.63	1	722	87,838	7, 9	------	------	ROUTED E2 + E1
11	Reservoir	5.170	1	748	65,711	10	908.48	21,590	(ROUTED E2 + PROP. E1)
12	Combine	7.735	1	723	78,776	6, 11	------	------	POI E

Hydrograph Report

Hyd. No. 1

EX. D

Hydrograph type	=	SCS Runoff	Peak discharge	=	51.68 cfs
Storm frequency	=	2 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	139,216 cuft
Drainage area	=	19.020 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.81 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

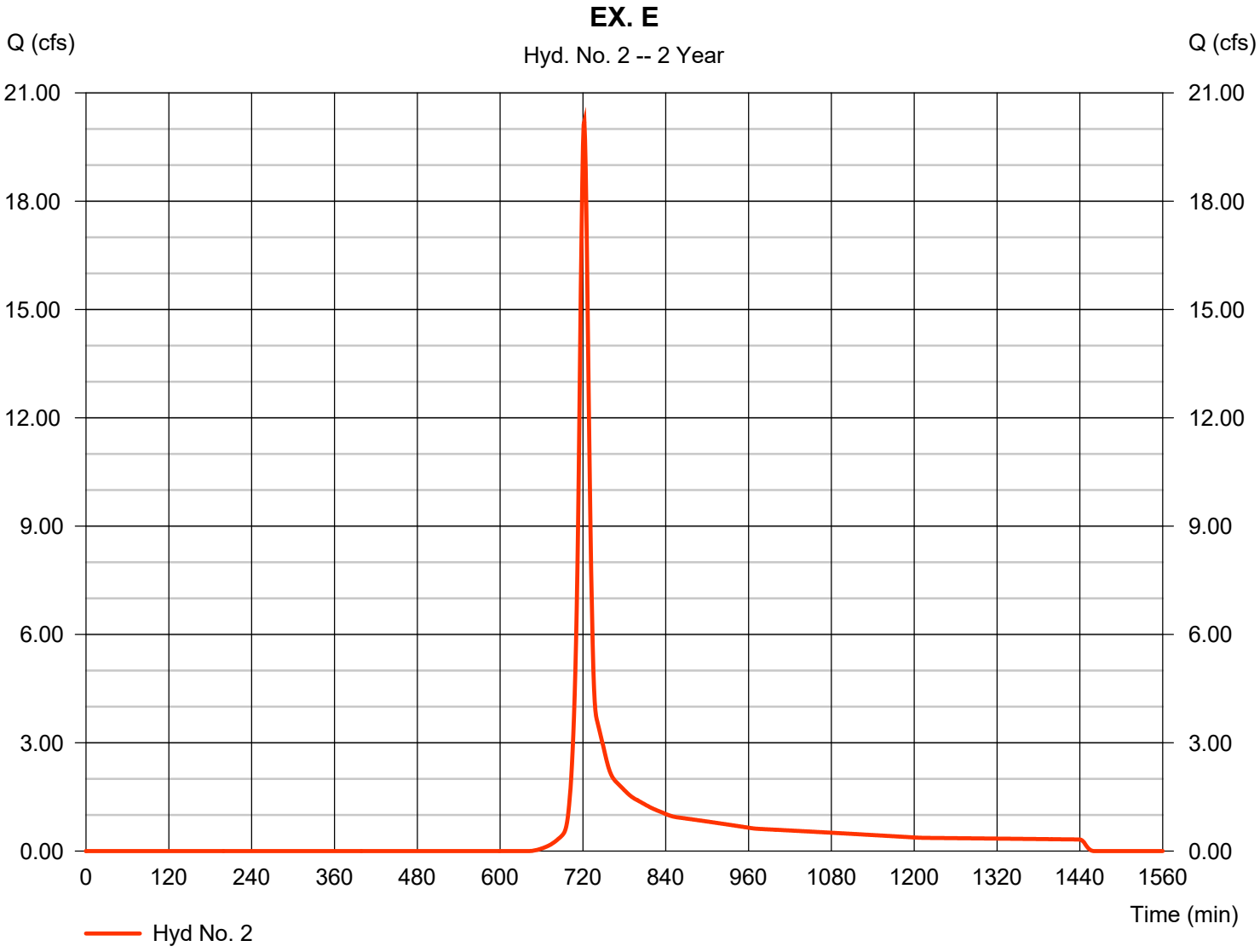


Hydrograph Report

Hyd. No. 2

EX. E

Hydrograph type	= SCS Runoff	Peak discharge	= 20.20 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 52,352 cuft
Drainage area	= 12.420 ac	Curve number	= 73
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.40 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

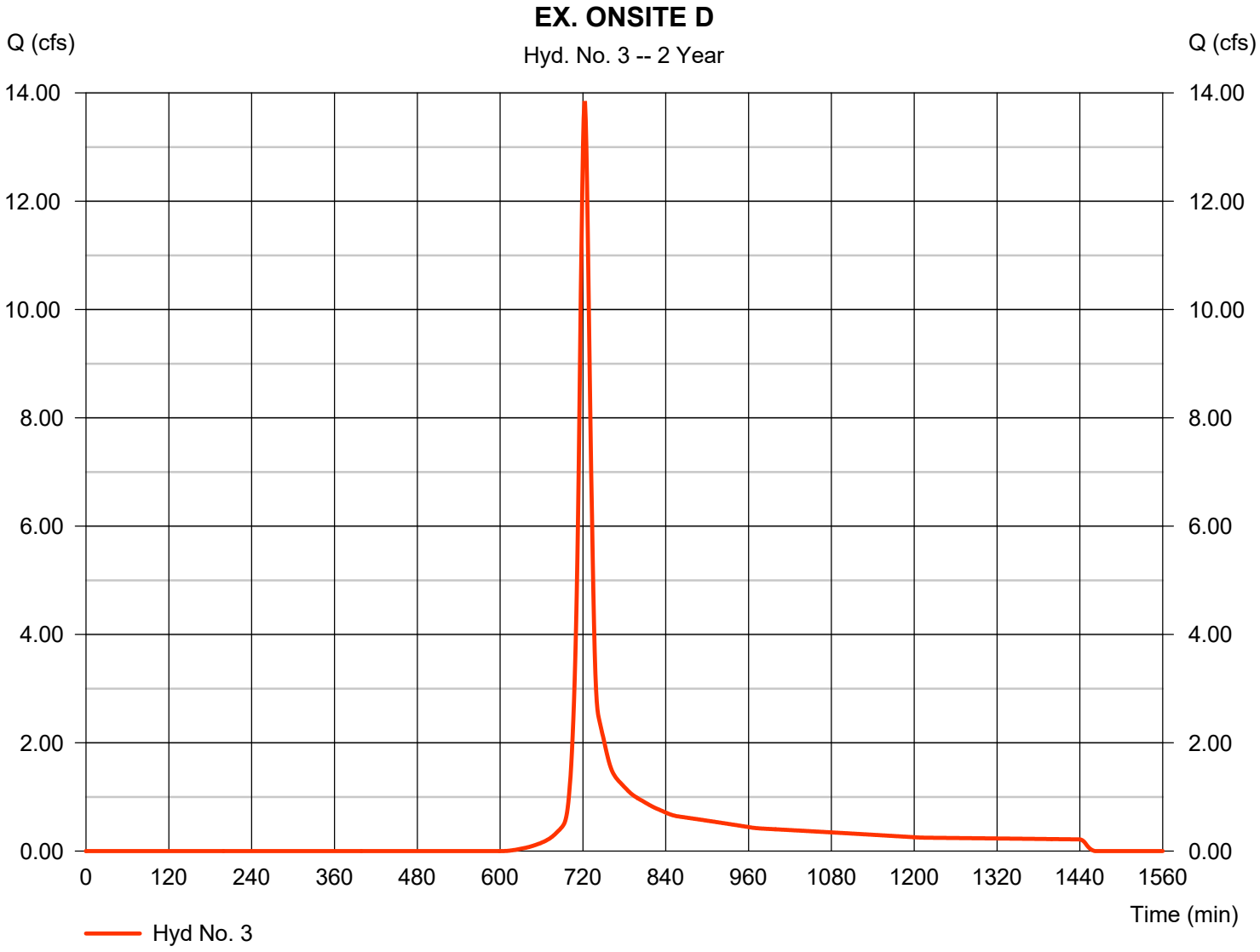


Hydrograph Report

Hyd. No. 3

EX. ONSITE D

Hydrograph type	= SCS Runoff	Peak discharge	= 13.81 cfs
Storm frequency	= 2 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 37,716 cuft
Drainage area	= 7.610 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.81 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

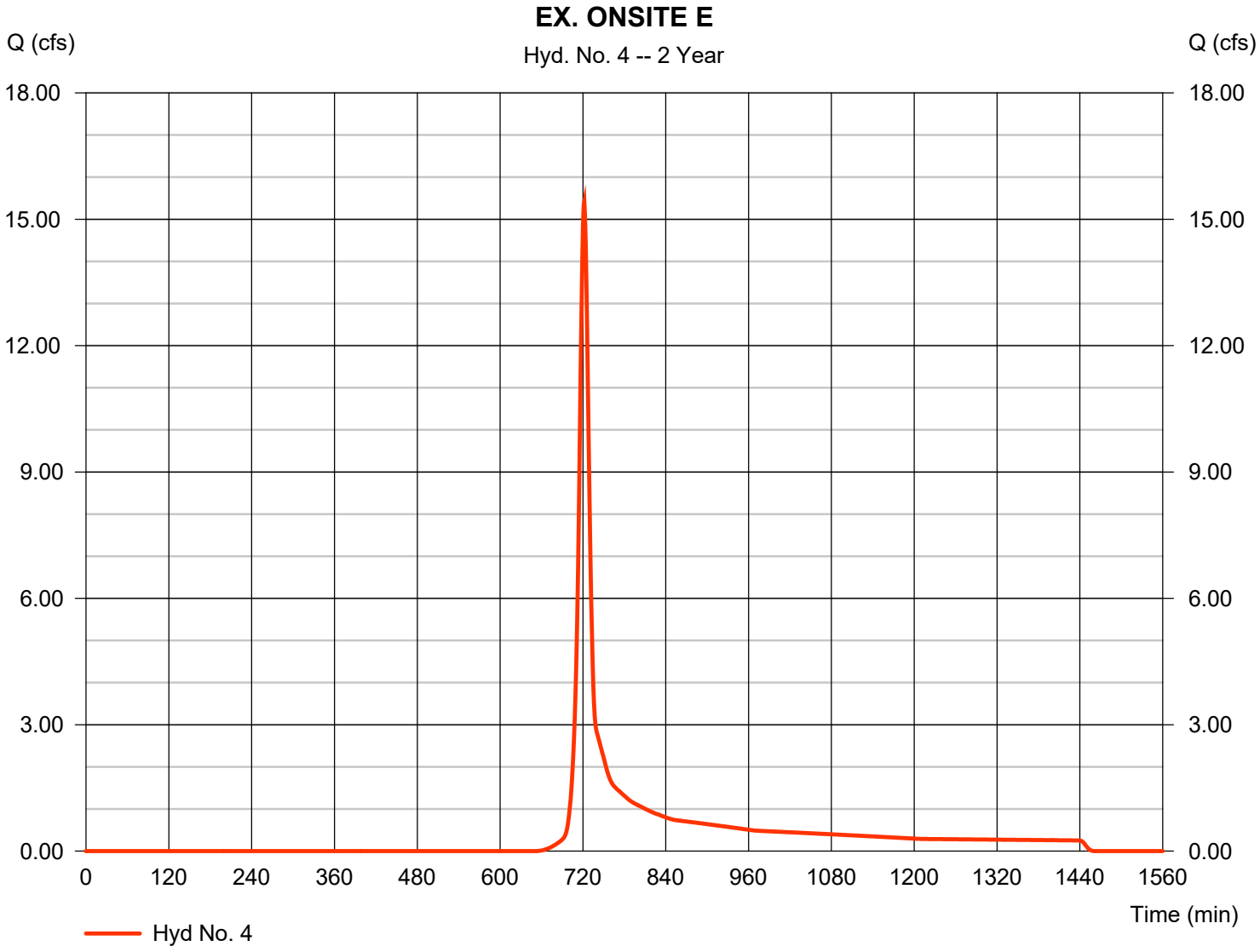


Hydrograph Report

Hyd. No. 4

EX. ONSITE E

Hydrograph type	= SCS Runoff	Peak discharge	= 15.40 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 40,174 cuft
Drainage area	= 10.030 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.35 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

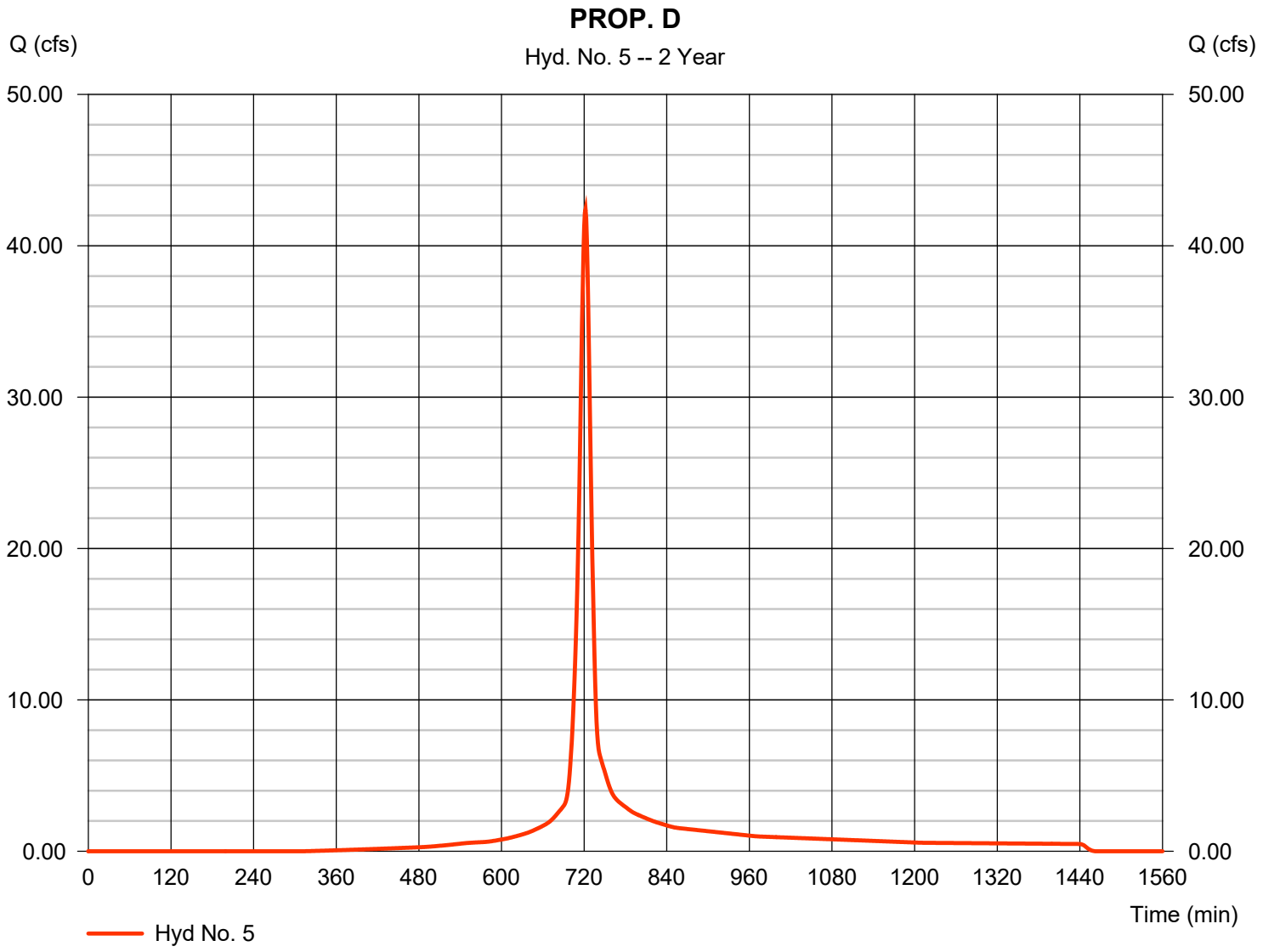


Hydrograph Report

Hyd. No. 5

PROP. D

Hydrograph type	= SCS Runoff	Peak discharge	= 42.40 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 116,497 cuft
Drainage area	= 13.110 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.80 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

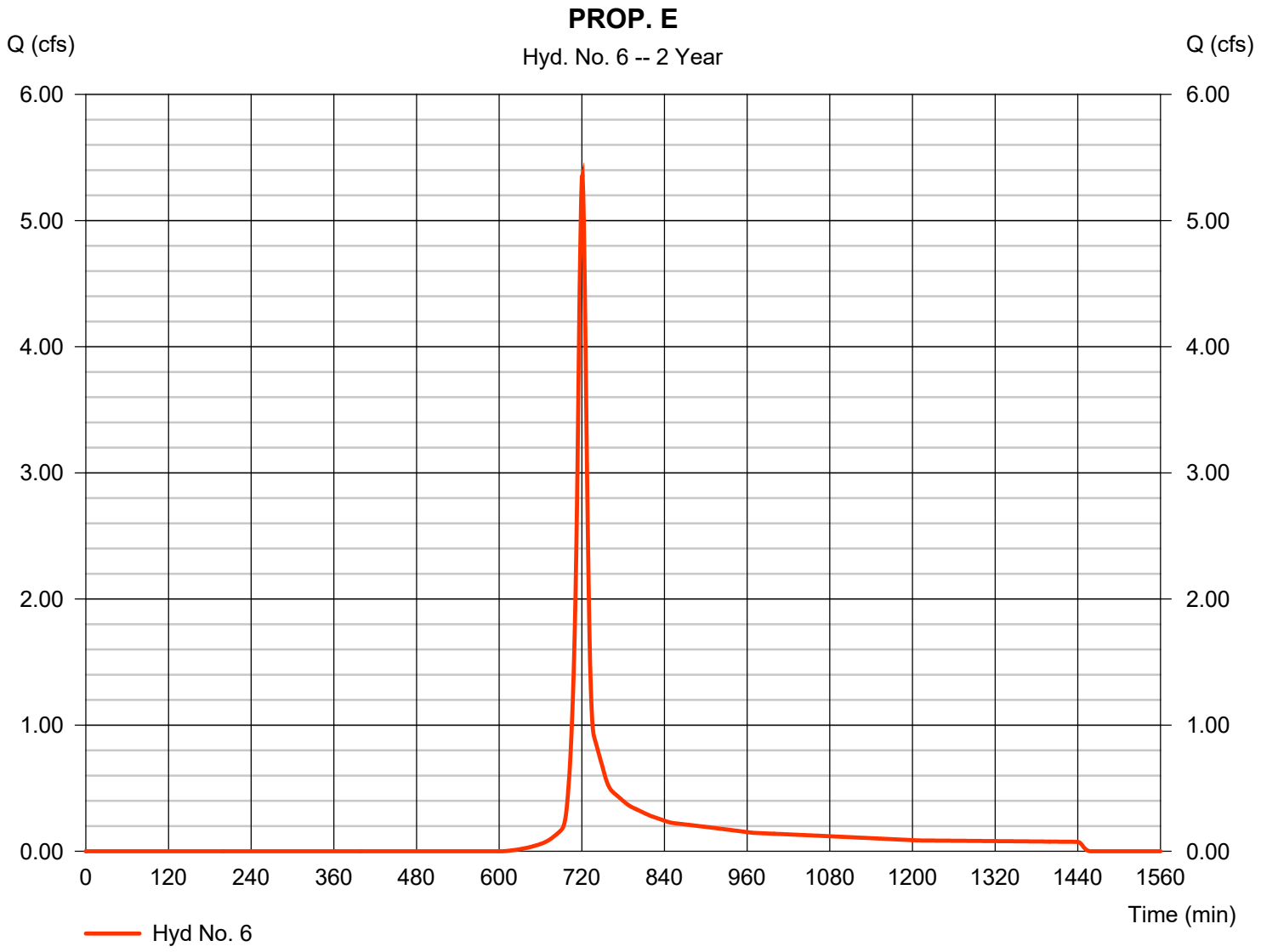


Hydrograph Report

Hyd. No. 6

PROP. E

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.361 cfs
Storm frequency	=	2 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	13,066 cuft
Drainage area	=	2.590 ac	Curve number	=	76
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.10 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

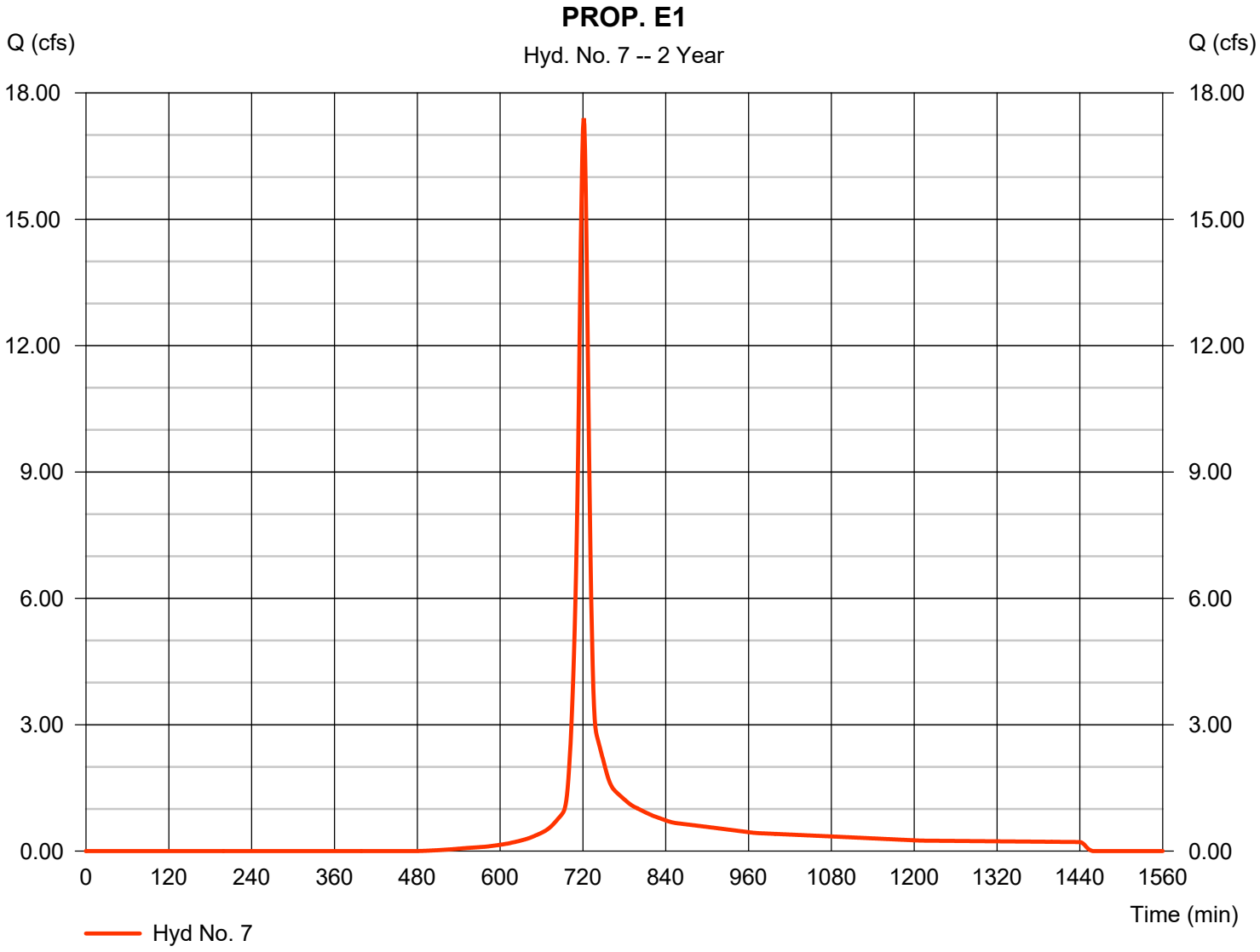


Hydrograph Report

Hyd. No. 7

PROP. E1

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.40 cfs
Storm frequency	=	2 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	43,965 cuft
Drainage area	=	6.620 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.80 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

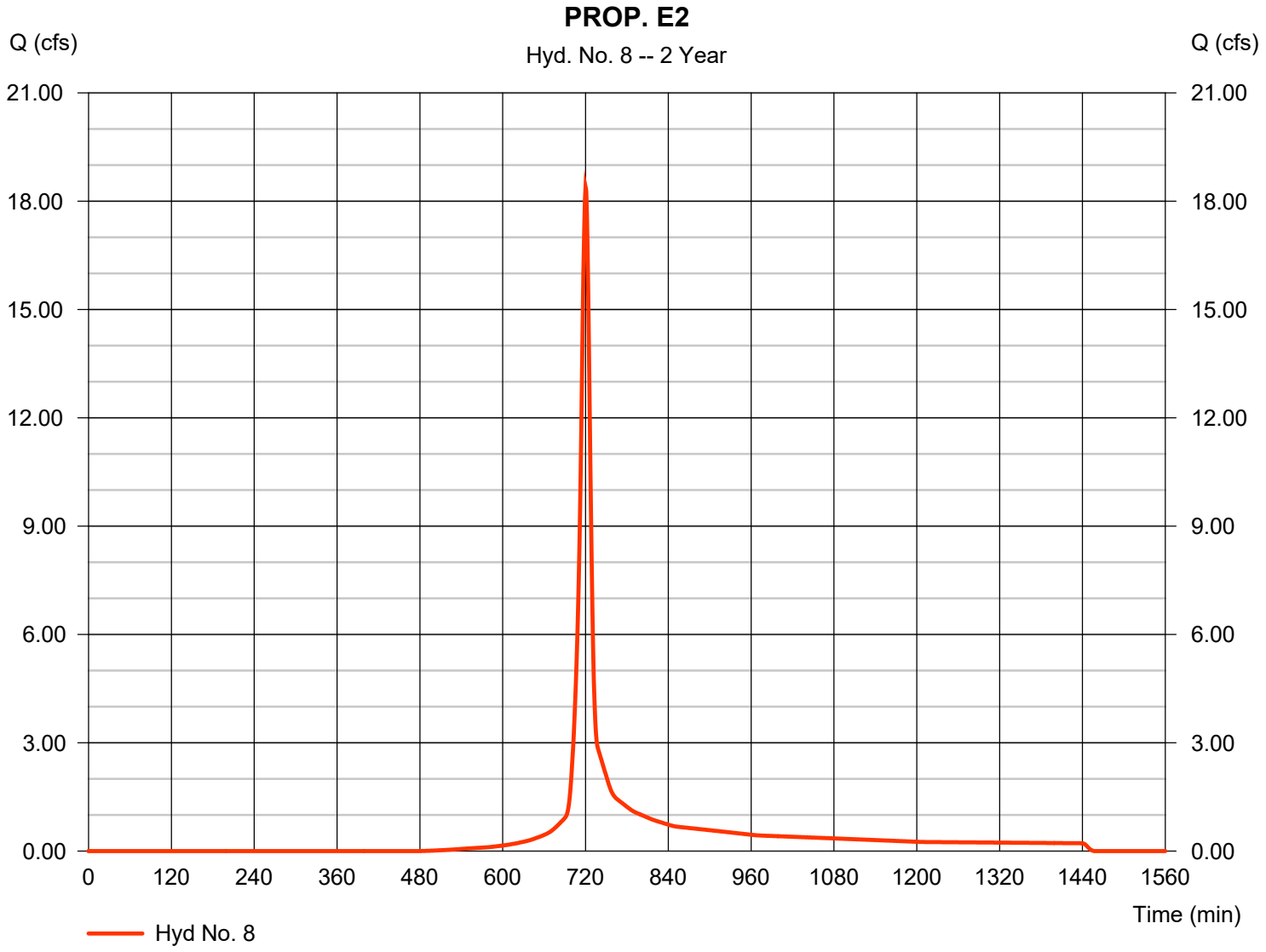


Hydrograph Report

Hyd. No. 8

PROP. E2

Hydrograph type	= SCS Runoff	Peak discharge	= 18.39 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 44,499 cuft
Drainage area	= 6.480 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.70 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



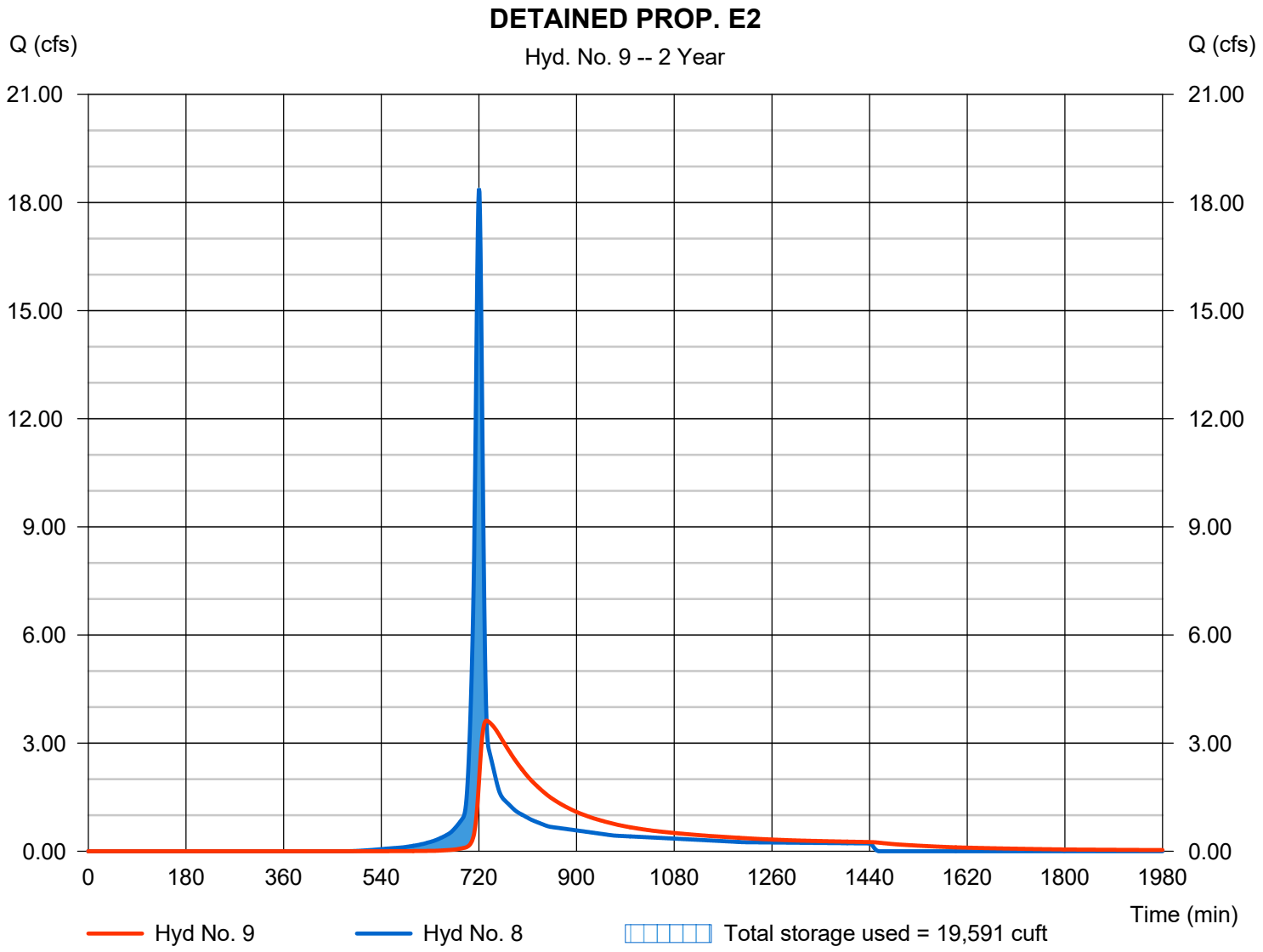
Hydrograph Report

Hyd. No. 9

DETAINED PROP. E2

Hydrograph type	=	Reservoir	Peak discharge	=	3.623 cfs
Storm frequency	=	2 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	43,873 cuft
Inflow hyd. No.	=	8 - PROP. E2	Max. Elevation	=	915.51 ft
Reservoir name	=	BASIN E2 (CELL 1)	Max. Storage	=	19,591 cuft

Storage Indication method used.

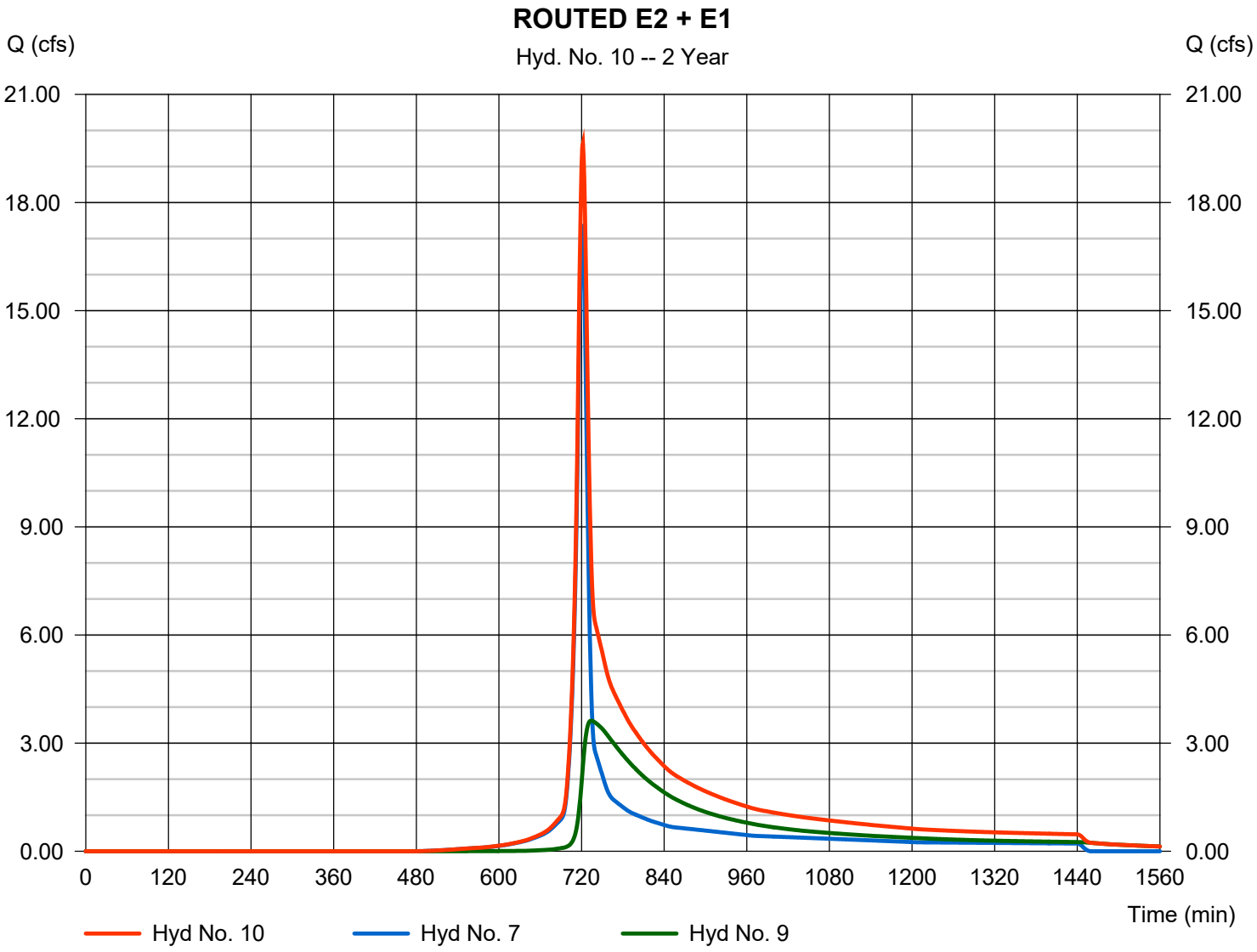


Hydrograph Report

Hyd. No. 10

ROUTED E2 + E1

Hydrograph type	= Combine	Peak discharge	= 19.63 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 87,838 cuft
Inflow hyds.	= 7, 9	Contrib. drain. area	= 6.620 ac



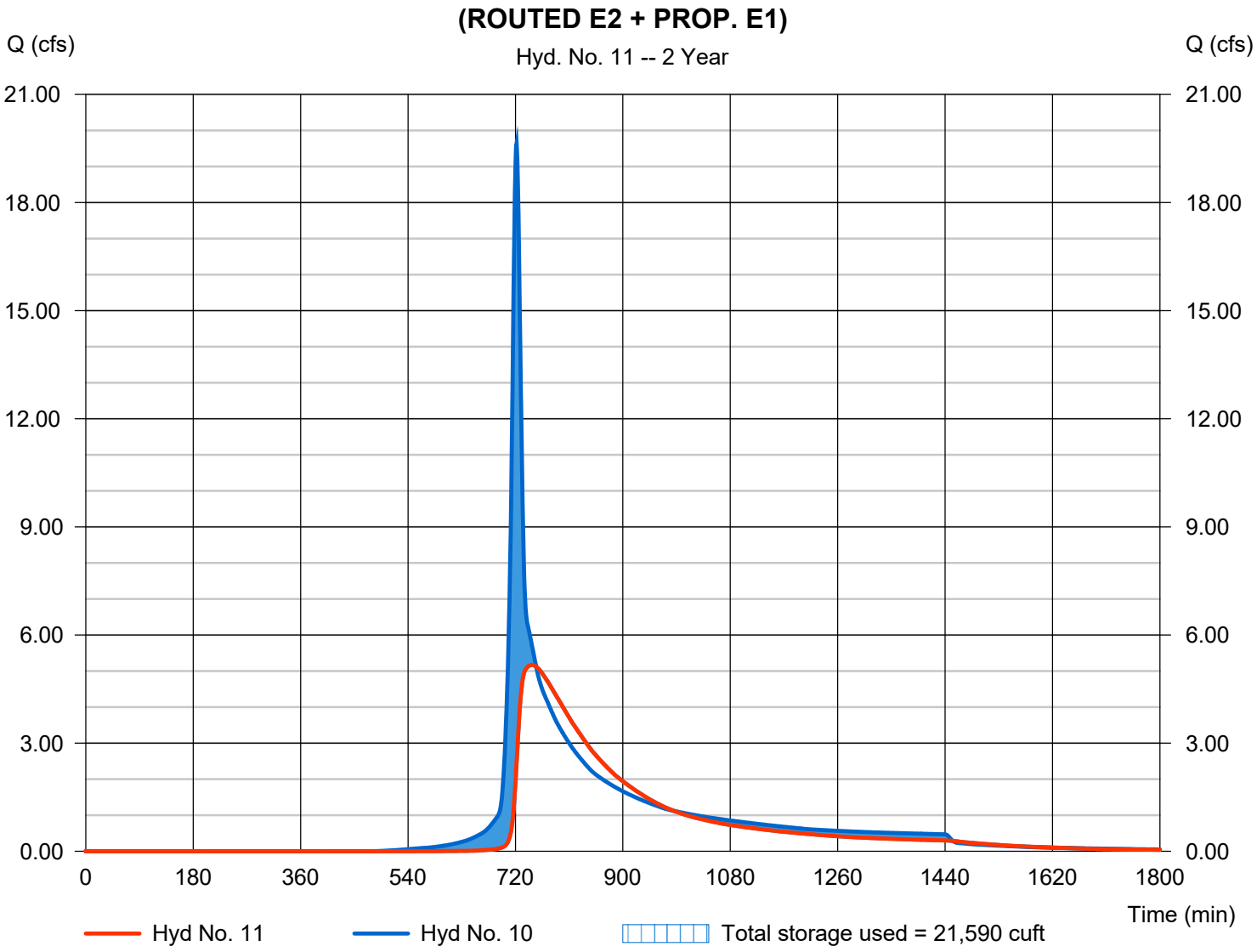
Hydrograph Report

Hyd. No. 11

(ROUTED E2 + PROP. E1)

Hydrograph type	=	Reservoir	Peak discharge	=	5.170 cfs
Storm frequency	=	2 yrs	Time to peak	=	748 min
Time interval	=	1 min	Hyd. volume	=	65,711 cuft
Inflow hyd. No.	=	10 - ROUTED E2 + E1	Max. Elevation	=	908.48 ft
Reservoir name	=	BASIN E1 (CELL 2)	Max. Storage	=	21,590 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

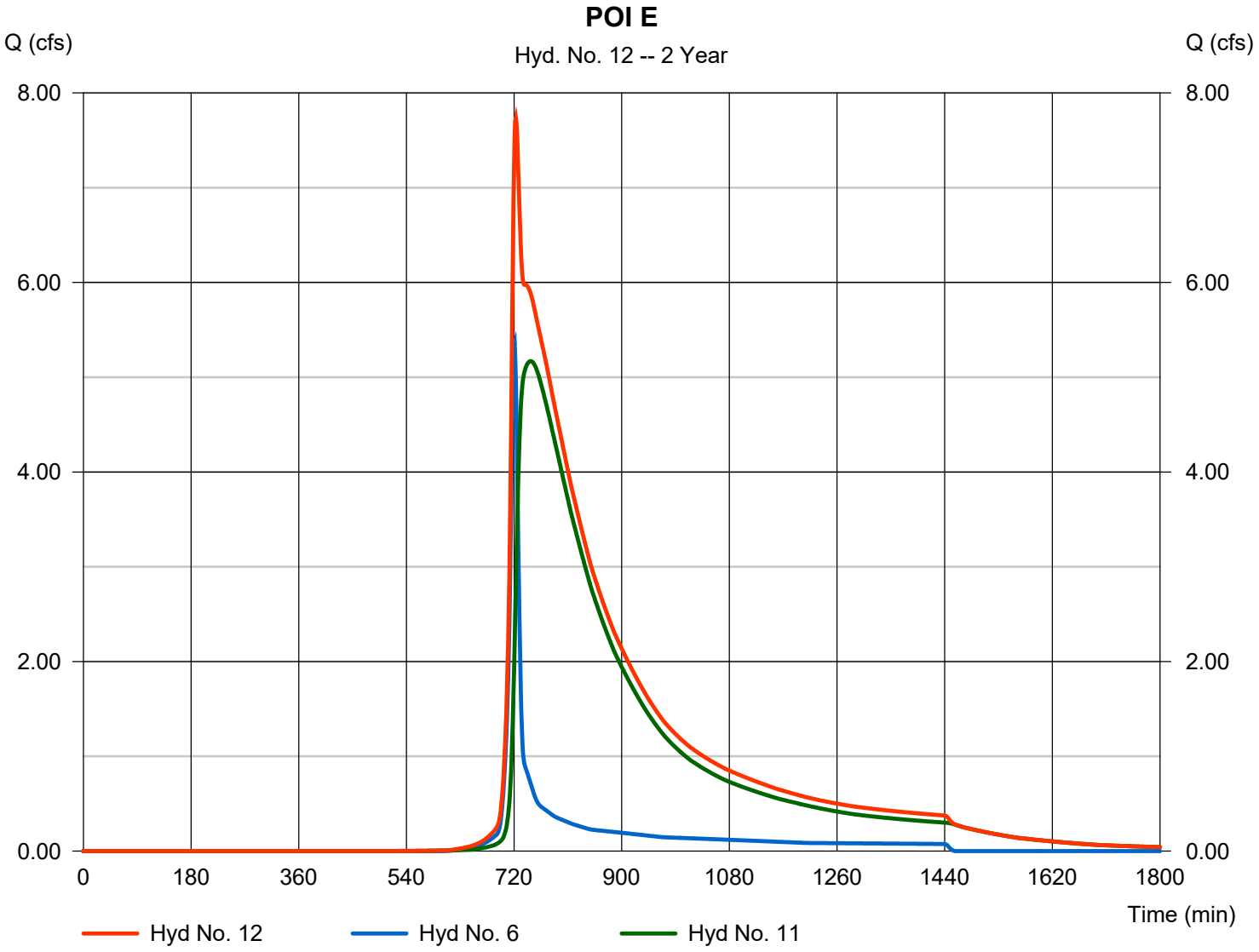


Hydrograph Report

Hyd. No. 12

POI E

Hydrograph type	= Combine	Peak discharge	= 7.735 cfs
Storm frequency	= 2 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 78,776 cuft
Inflow hyds.	= 6, 11	Contrib. drain. area	= 2.590 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

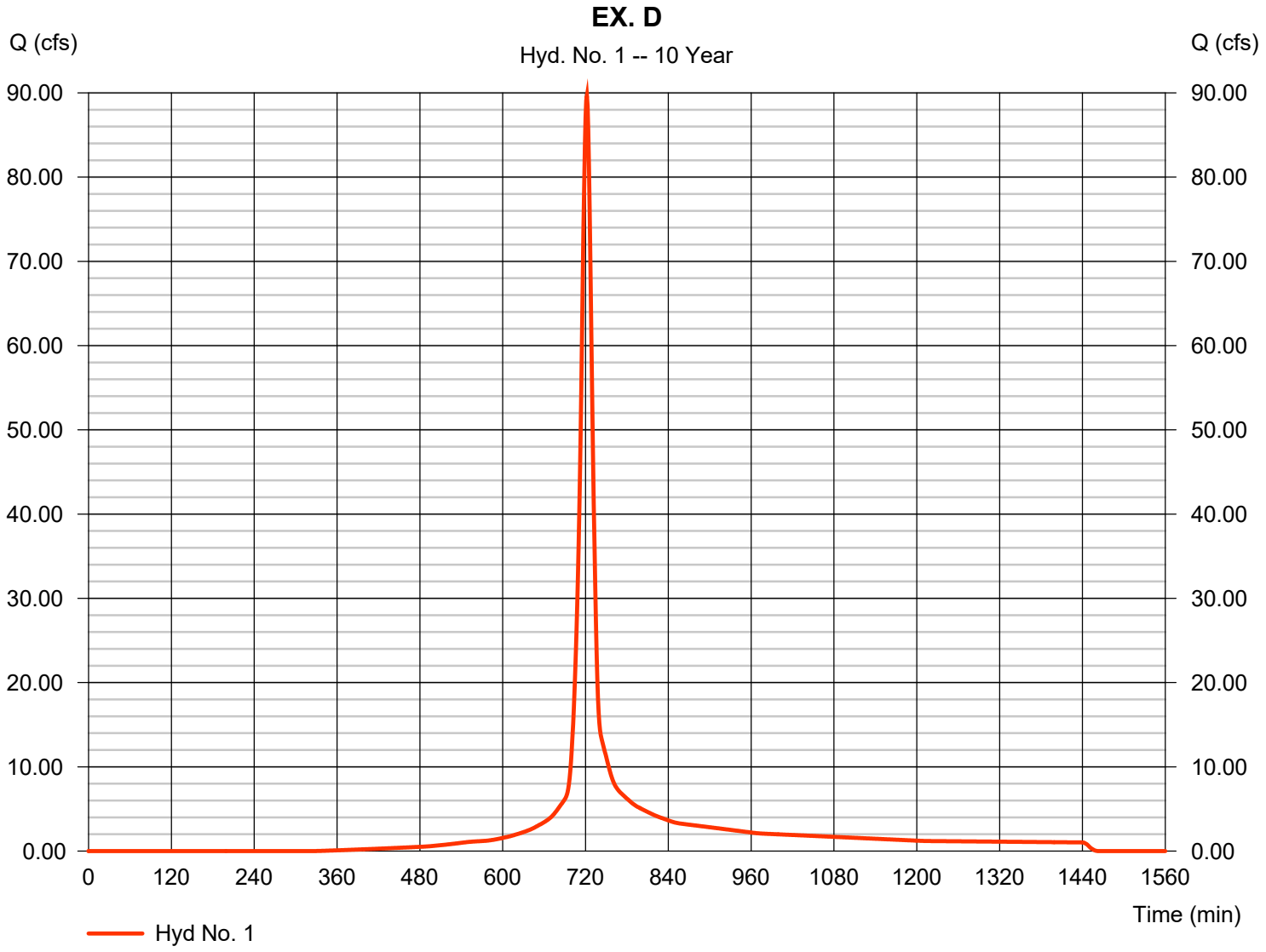
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	89.62	1	722	245,333	------	------	------	EX. D
2	SCS Runoff	42.80	1	721	108,213	------	------	------	EX. E
3	SCS Runoff	27.76	1	722	74,619	------	------	------	EX. ONSITE D
4	SCS Runoff	33.32	1	721	84,332	------	------	------	EX. ONSITE E
5	SCS Runoff	68.69	1	722	193,661	------	------	------	PROP. D
6	SCS Runoff	10.69	1	720	25,850	------	------	------	PROP. E
7	SCS Runoff	31.01	1	721	79,378	------	------	------	PROP. E1
8	SCS Runoff	32.75	1	720	80,342	------	------	------	PROP. E2
9	Reservoir	6.400	1	734	79,686	8	916.30	36,020	DETAINED PROP. E2
10	Combine	36.04	1	721	159,064	7, 9	------	------	ROUTED E2 + E1
11	Reservoir	12.20	1	735	131,756	10	909.16	37,704	(ROUTED E2 + PROP. E1)
12	Combine	18.30	1	723	157,605	6, 11	------	------	POI E

Hydrograph Report

Hyd. No. 1

EX. D

Hydrograph type	=	SCS Runoff	Peak discharge	=	89.62 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	245,333 cuft
Drainage area	=	19.020 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.81 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

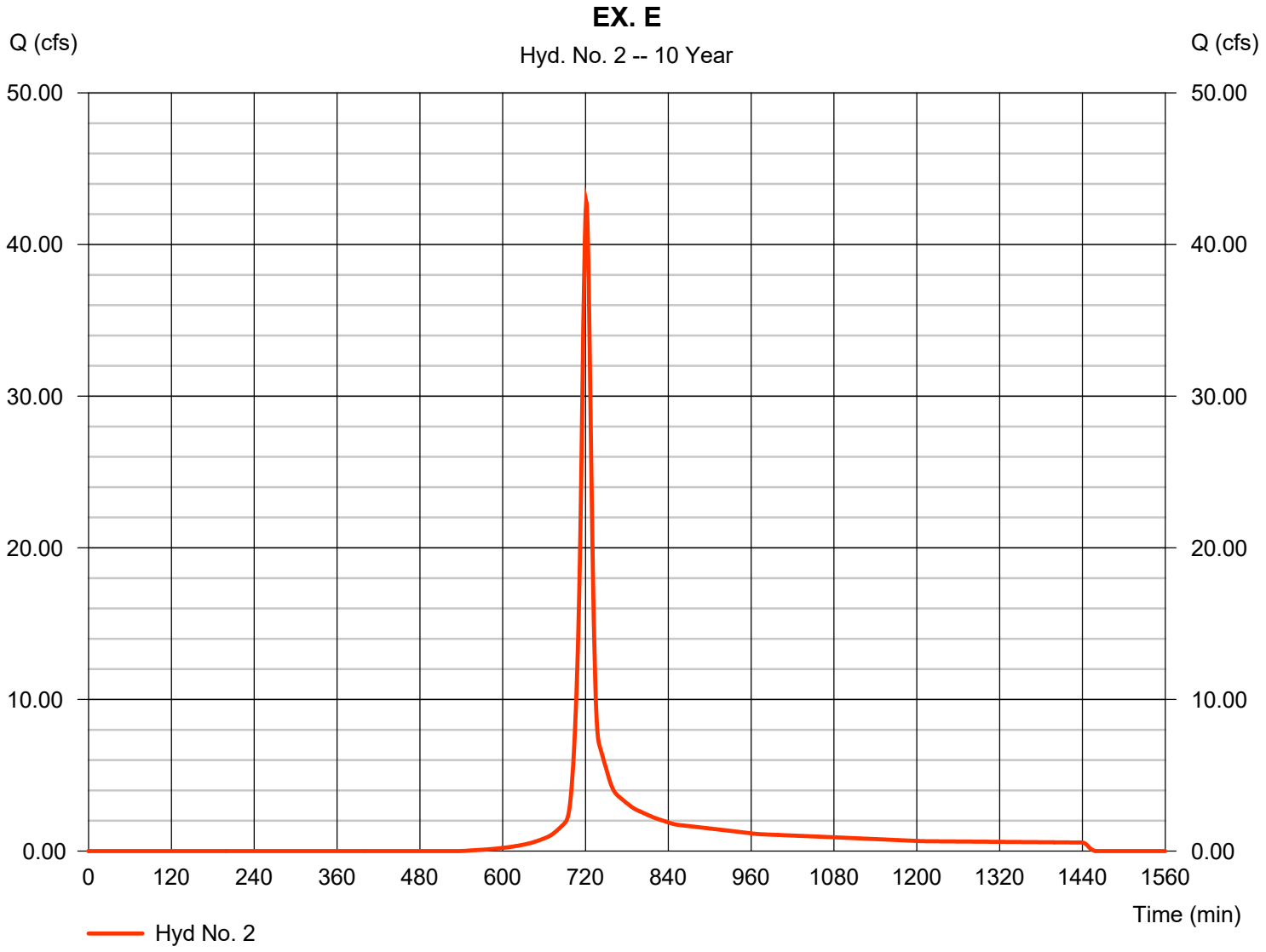


Hydrograph Report

Hyd. No. 2

EX. E

Hydrograph type	=	SCS Runoff	Peak discharge	=	42.80 cfs
Storm frequency	=	10 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	108,213 cuft
Drainage area	=	12.420 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	12.40 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

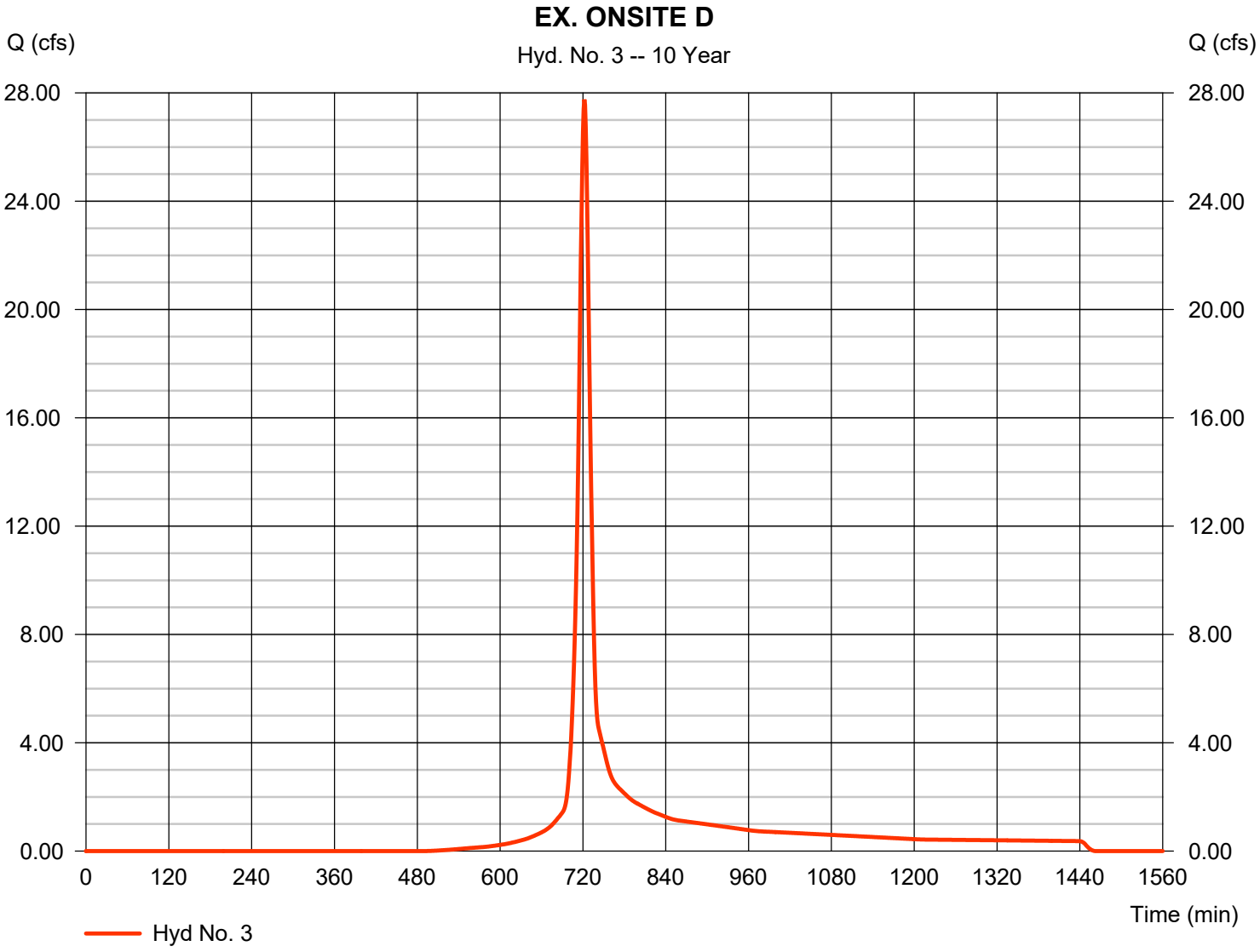


Hydrograph Report

Hyd. No. 3

EX. ONSITE D

Hydrograph type	= SCS Runoff	Peak discharge	= 27.76 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 74,619 cuft
Drainage area	= 7.610 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.81 min
Total precip.	= 5.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

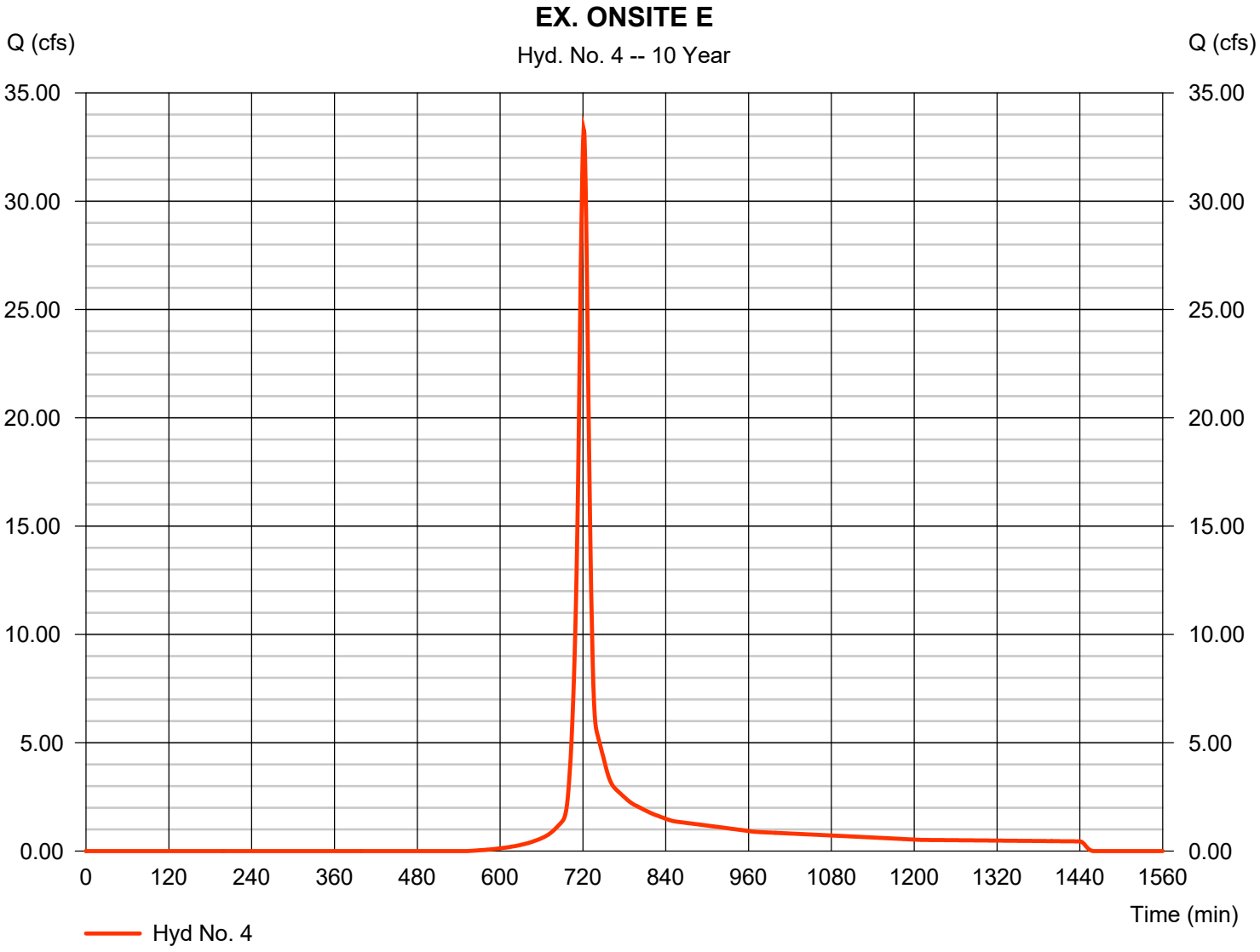


Hydrograph Report

Hyd. No. 4

EX. ONSITE E

Hydrograph type	= SCS Runoff	Peak discharge	= 33.32 cfs
Storm frequency	= 10 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 84,332 cuft
Drainage area	= 10.030 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.35 min
Total precip.	= 5.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

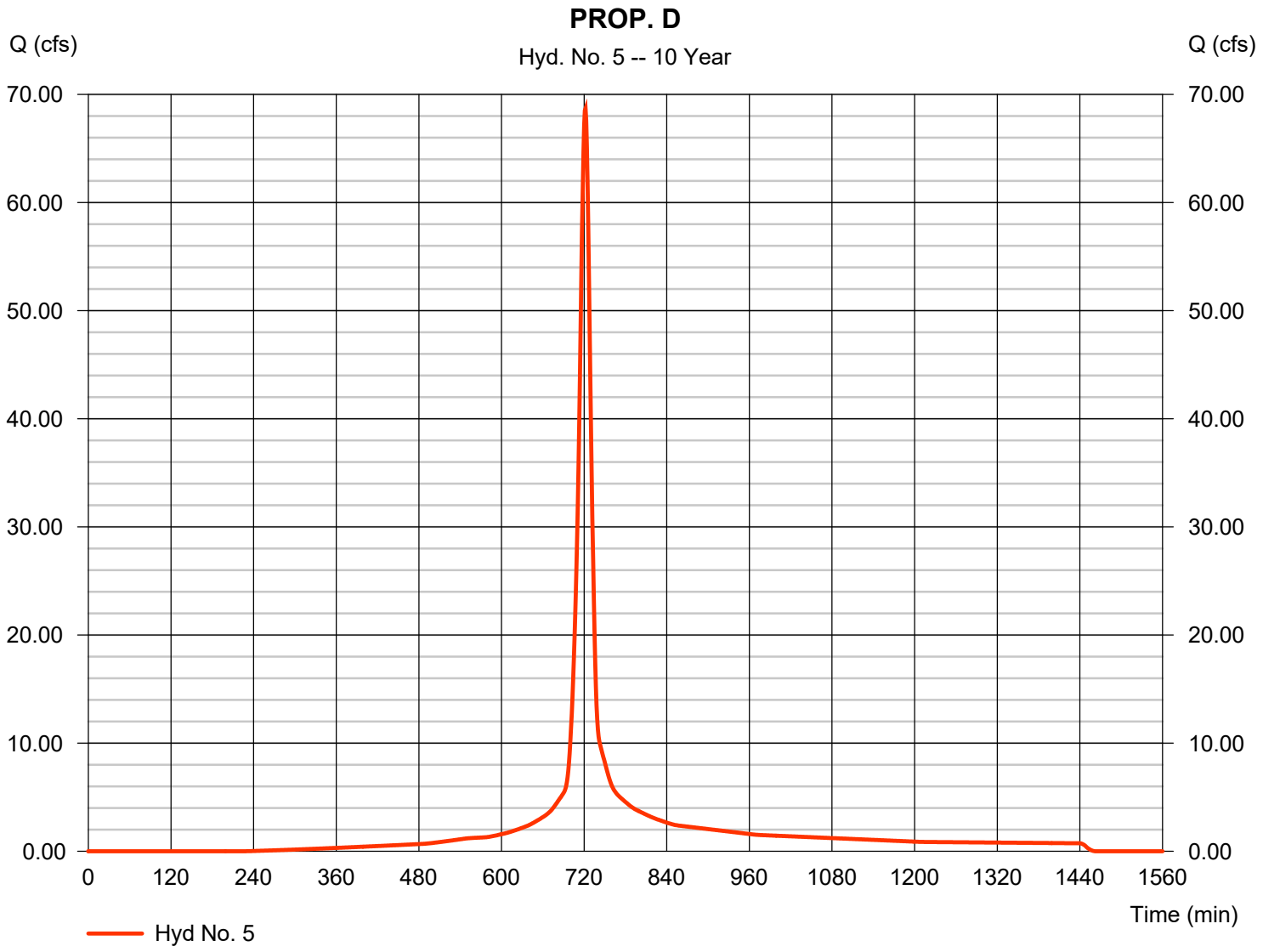


Hydrograph Report

Hyd. No. 5

PROP. D

Hydrograph type	=	SCS Runoff	Peak discharge	=	68.69 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	193,661 cuft
Drainage area	=	13.110 ac	Curve number	=	90
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.80 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

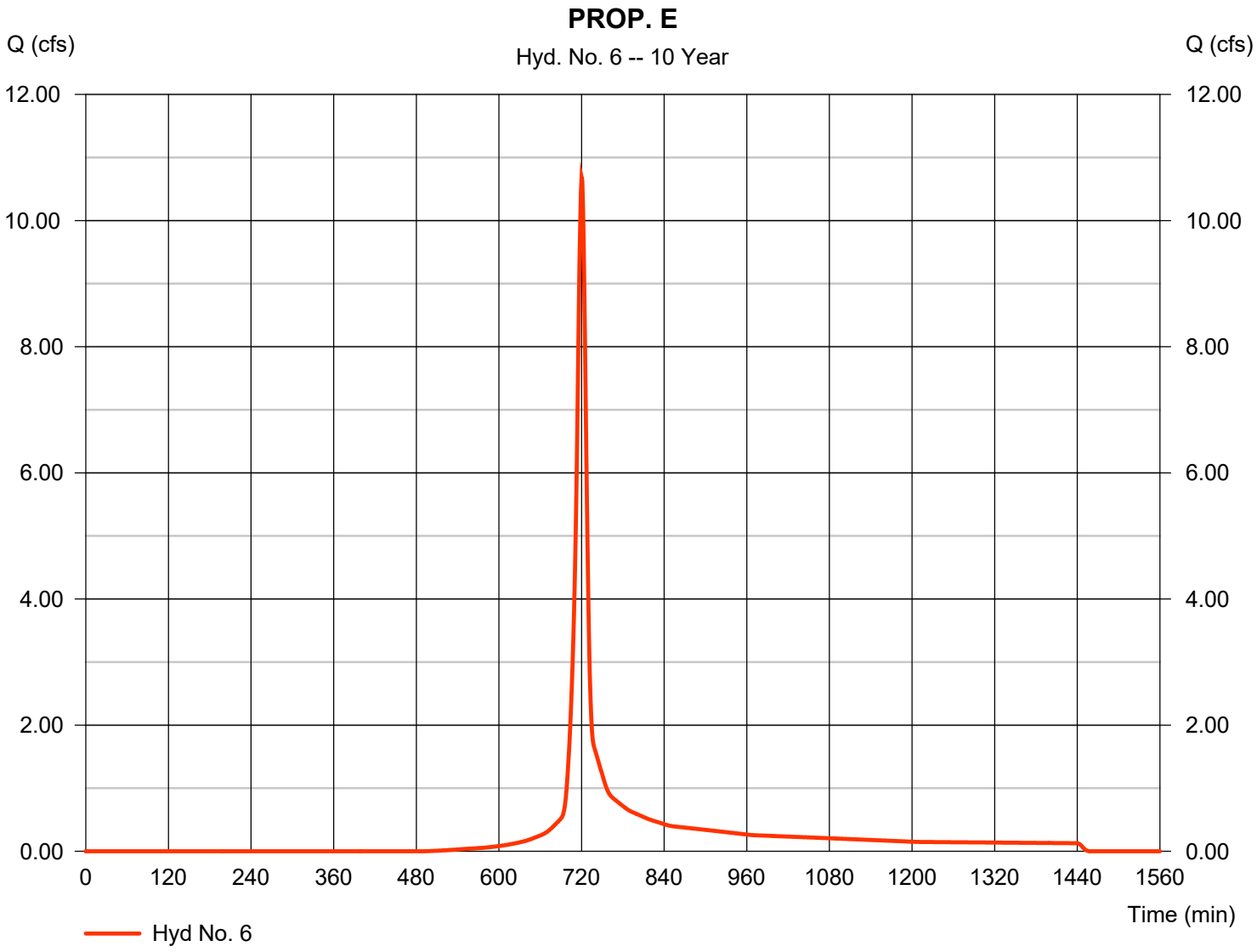


Hydrograph Report

Hyd. No. 6

PROP. E

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.69 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	25,850 cuft
Drainage area	=	2.590 ac	Curve number	=	76
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.10 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

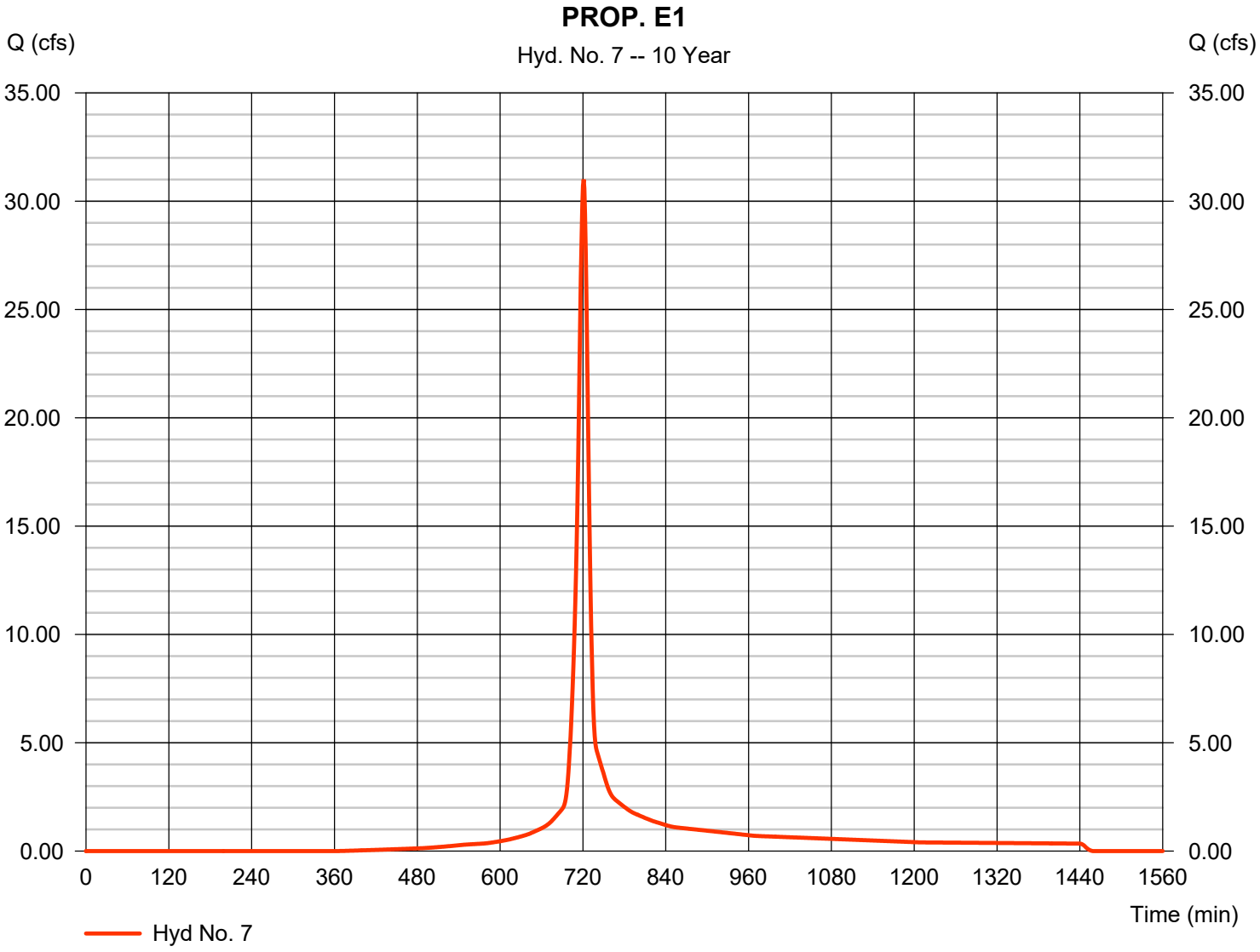


Hydrograph Report

Hyd. No. 7

PROP. E1

Hydrograph type	=	SCS Runoff	Peak discharge	=	31.01 cfs
Storm frequency	=	10 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	79,378 cuft
Drainage area	=	6.620 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.80 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

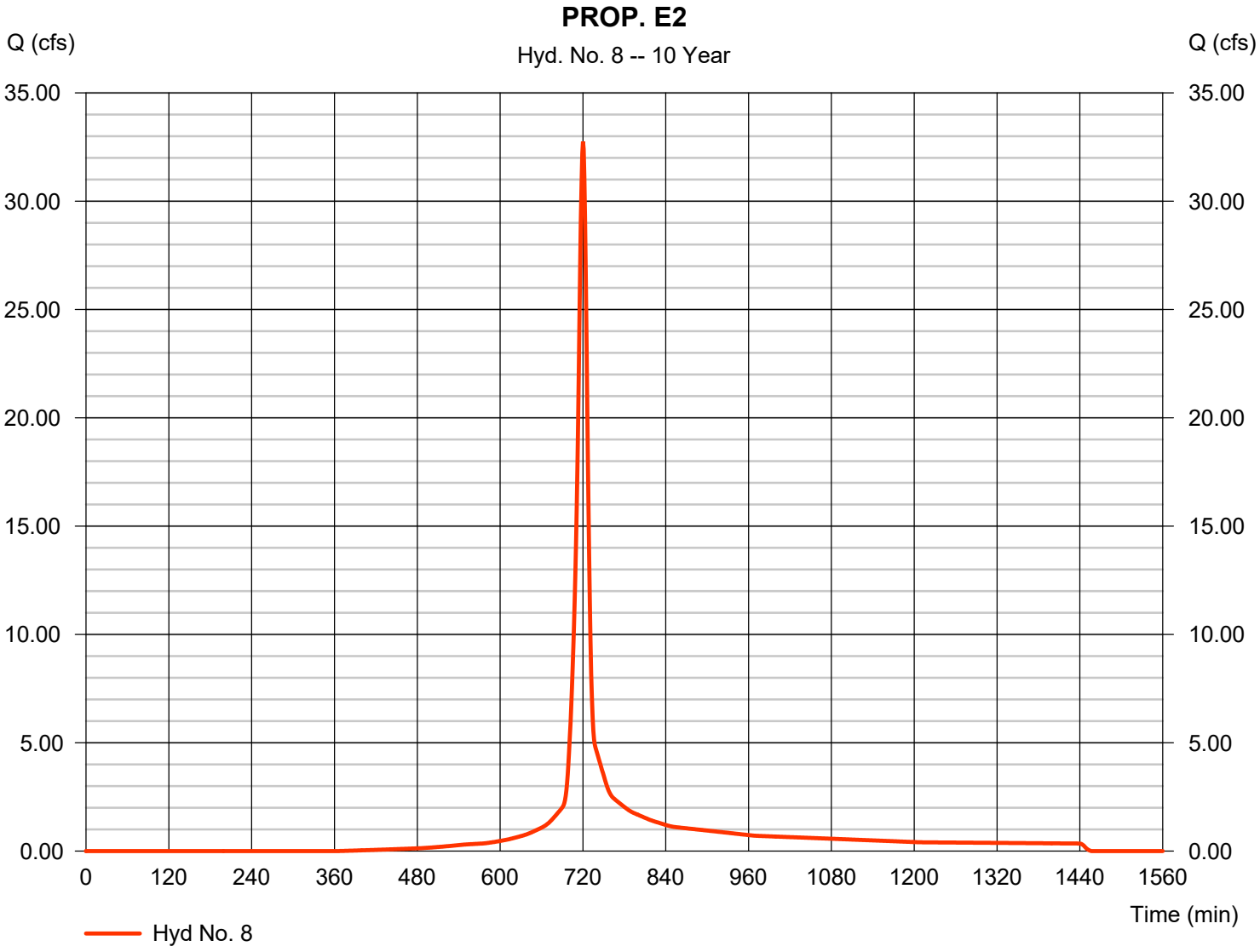


Hydrograph Report

Hyd. No. 8

PROP. E2

Hydrograph type	=	SCS Runoff	Peak discharge	=	32.75 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	80,342 cuft
Drainage area	=	6.480 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.70 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



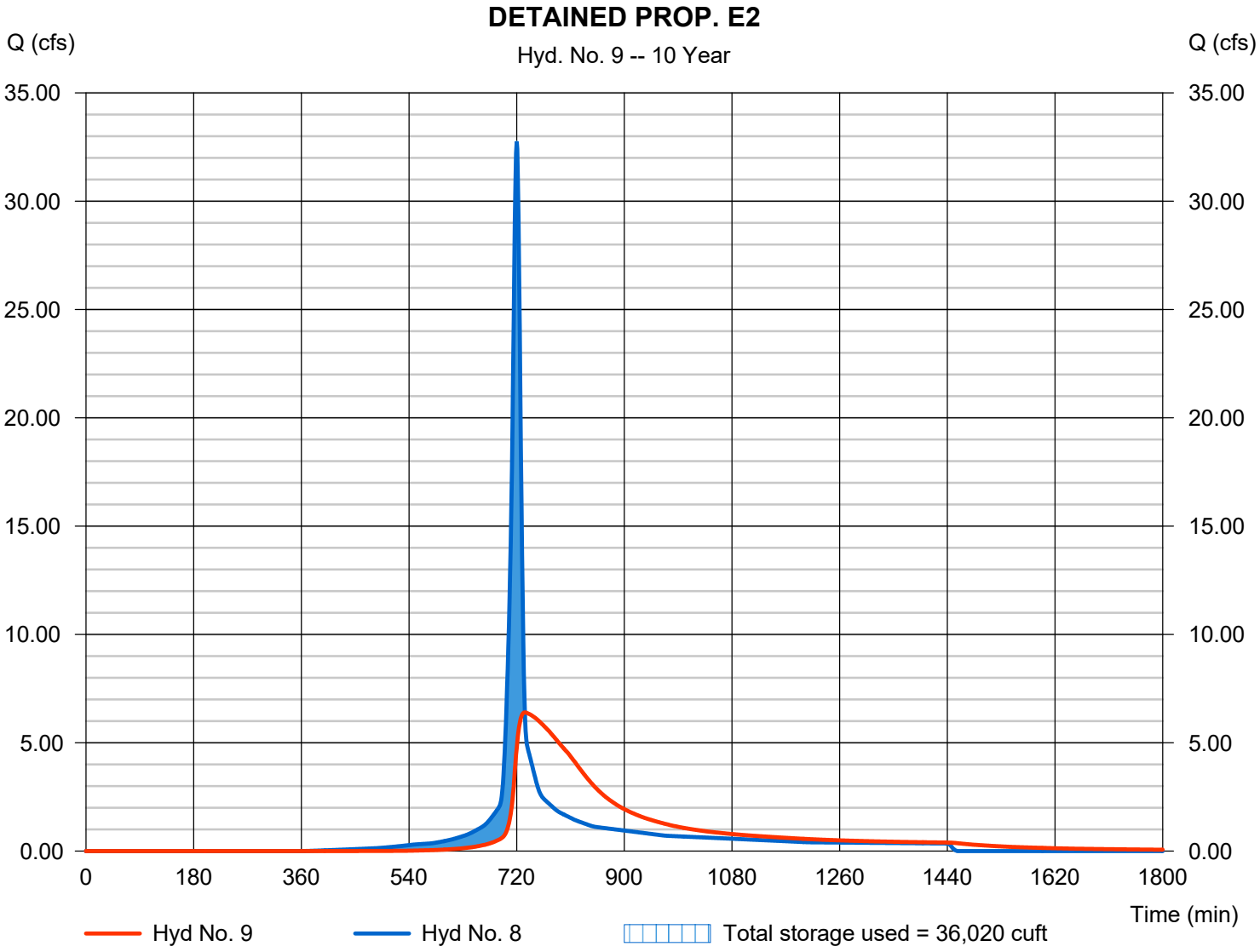
Hydrograph Report

Hyd. No. 9

DETAINED PROP. E2

Hydrograph type	=	Reservoir	Peak discharge	=	6.400 cfs
Storm frequency	=	10 yrs	Time to peak	=	734 min
Time interval	=	1 min	Hyd. volume	=	79,686 cuft
Inflow hyd. No.	=	8 - PROP. E2	Max. Elevation	=	916.30 ft
Reservoir name	=	BASIN E2 (CELL 1)	Max. Storage	=	36,020 cuft

Storage Indication method used.

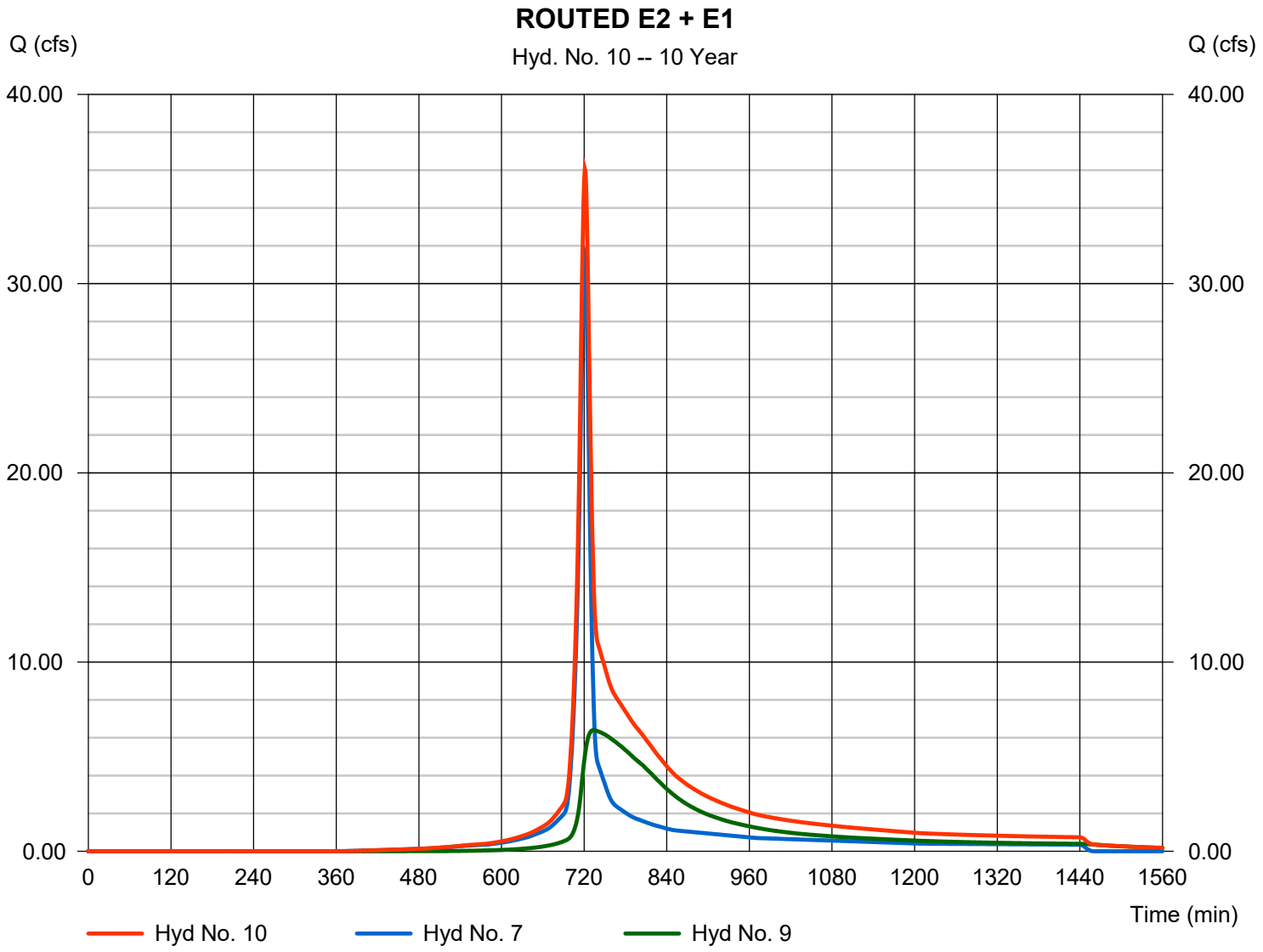


Hydrograph Report

Hyd. No. 10

ROUTED E2 + E1

Hydrograph type	= Combine	Peak discharge	= 36.04 cfs
Storm frequency	= 10 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 159,064 cuft
Inflow hyds.	= 7, 9	Contrib. drain. area	= 6.620 ac



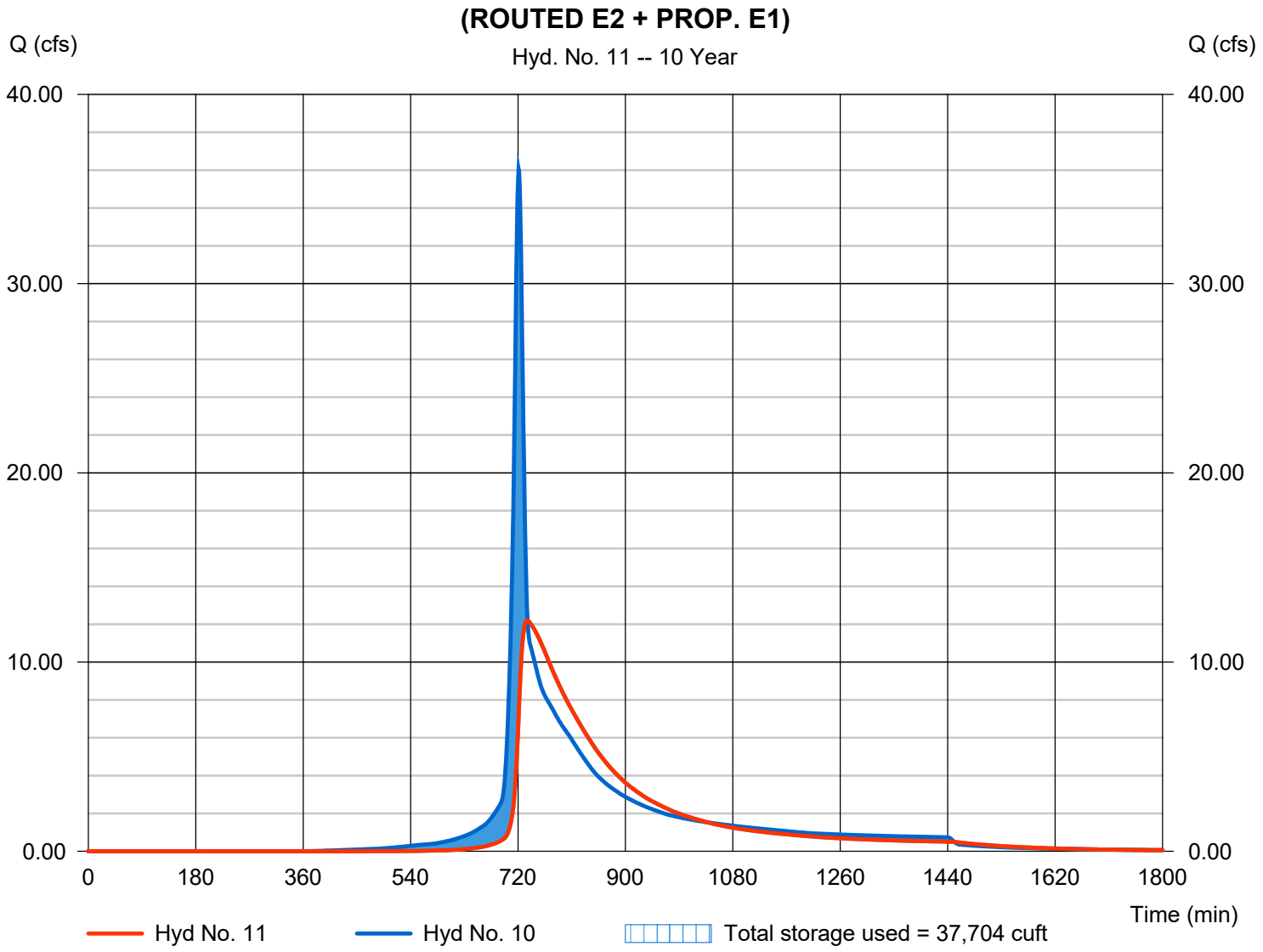
Hydrograph Report

Hyd. No. 11

(ROUTED E2 + PROP. E1)

Hydrograph type	=	Reservoir	Peak discharge	=	12.20 cfs
Storm frequency	=	10 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	131,756 cuft
Inflow hyd. No.	=	10 - ROUTED E2 + E1	Max. Elevation	=	909.16 ft
Reservoir name	=	BASIN E1 (CELL 2)	Max. Storage	=	37,704 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

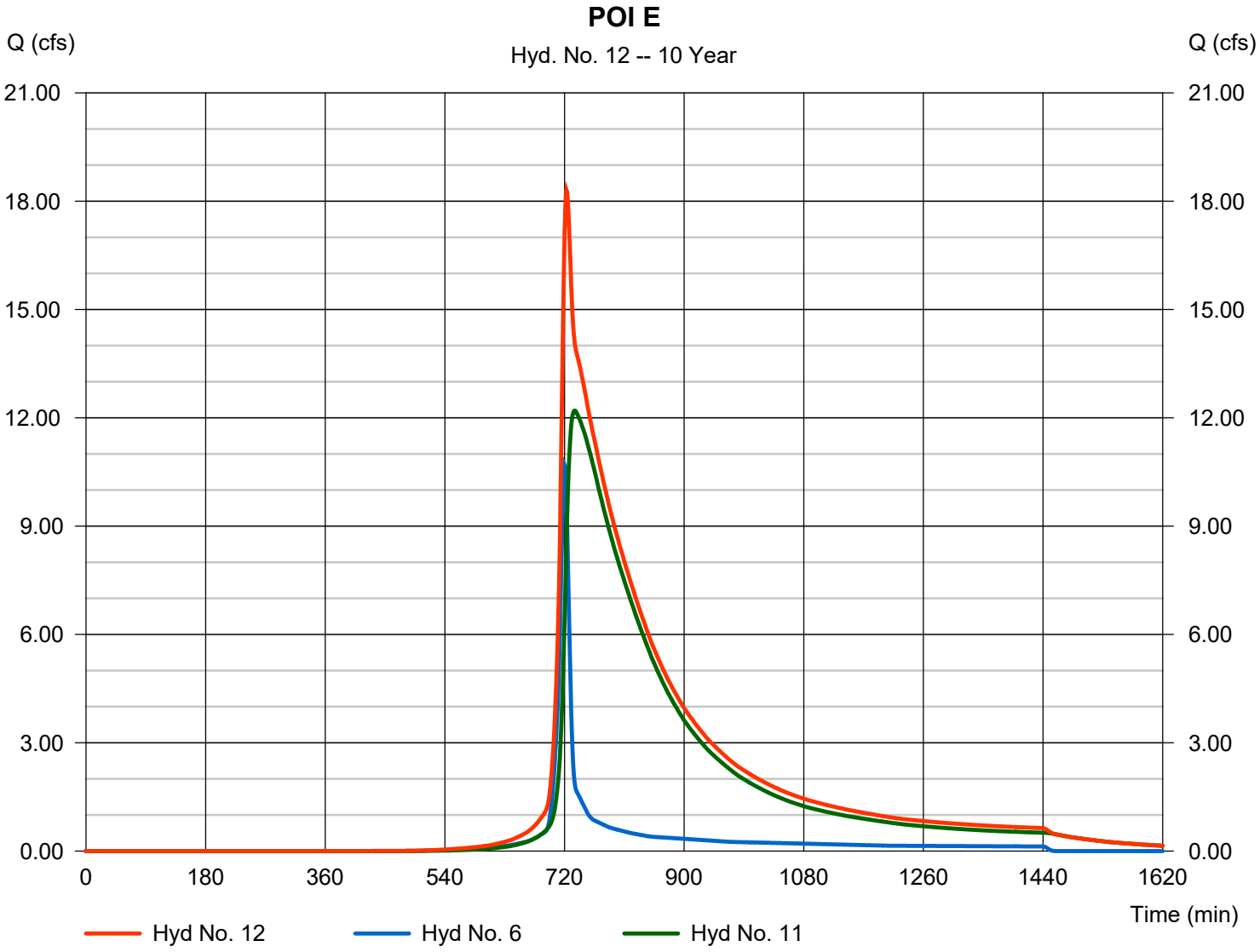


Hydrograph Report

Hyd. No. 12

POI E

Hydrograph type	= Combine	Peak discharge	= 18.30 cfs
Storm frequency	= 10 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 157,605 cuft
Inflow hyds.	= 6, 11	Contrib. drain. area	= 2.590 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

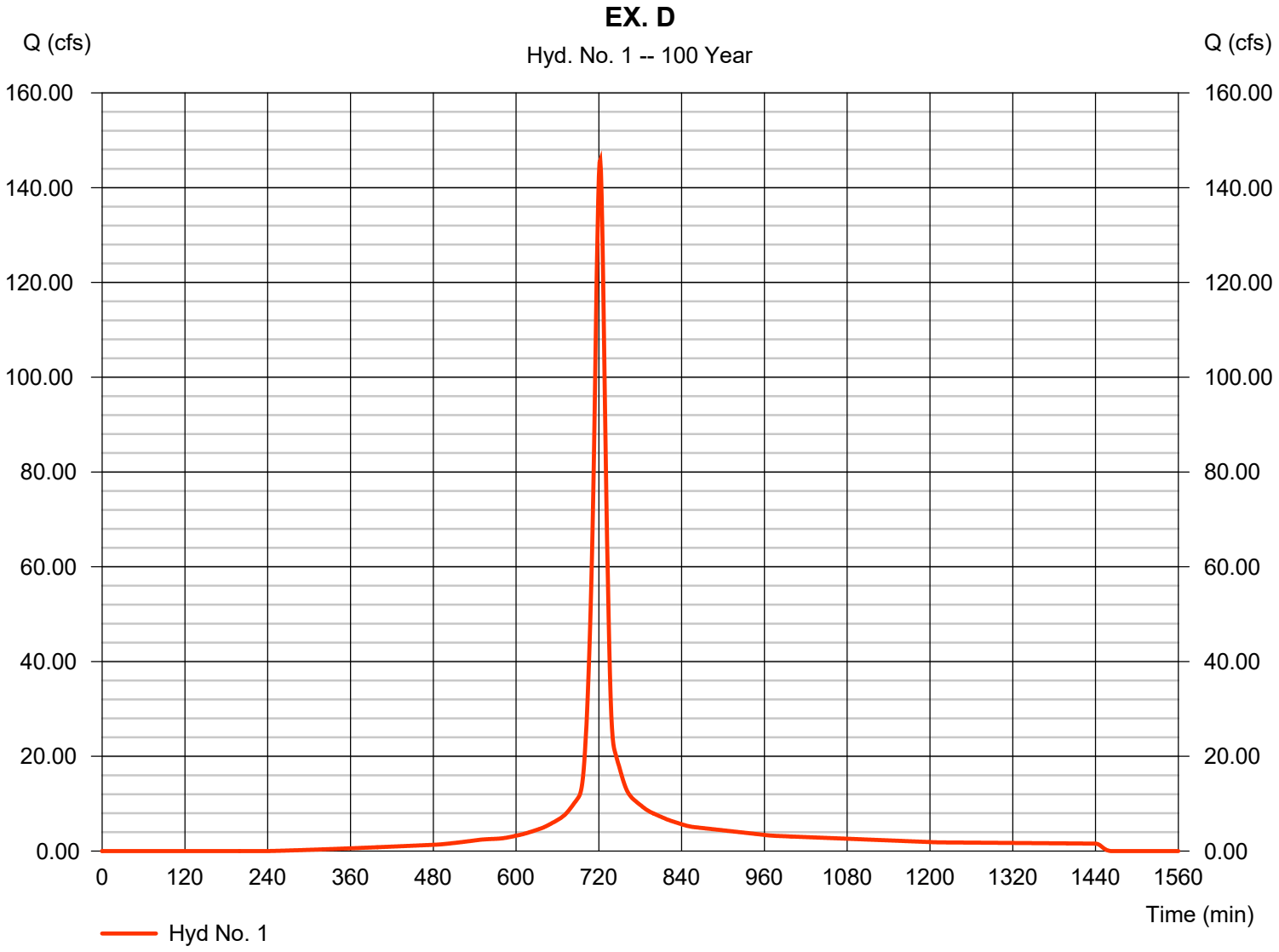
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	145.78	1	722	409,017	------	------	------	EX. D
2	SCS Runoff	79.46	1	721	201,711	------	------	------	EX. E
3	SCS Runoff	49.76	1	722	134,964	------	------	------	EX. ONSITE D
4	SCS Runoff	62.68	1	721	158,850	------	------	------	EX. ONSITE E
5	SCS Runoff	106.91	1	722	309,826	------	------	------	PROP. D
6	SCS Runoff	19.10	1	720	46,754	------	------	------	PROP. E
7	SCS Runoff	51.35	1	721	134,631	------	------	------	PROP. E1
8	SCS Runoff	54.21	1	720	136,266	------	------	------	PROP. E2
9	Reservoir	8.992	1	735	135,586	8	917.44	61,875	DETAINED PROP. E2
10	Combine	58.82	1	721	270,217	7, 9	------	------	ROUTED E2 + E1
11	Reservoir	19.22	1	735	236,743	10	910.12	62,554	(ROUTED E2 + PROP. E1)
12	Combine	33.66	1	721	283,497	6, 11	------	------	POI E

Hydrograph Report

Hyd. No. 1

EX. D

Hydrograph type	=	SCS Runoff	Peak discharge	=	145.78 cfs
Storm frequency	=	100 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	409,017 cuft
Drainage area	=	19.020 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.81 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

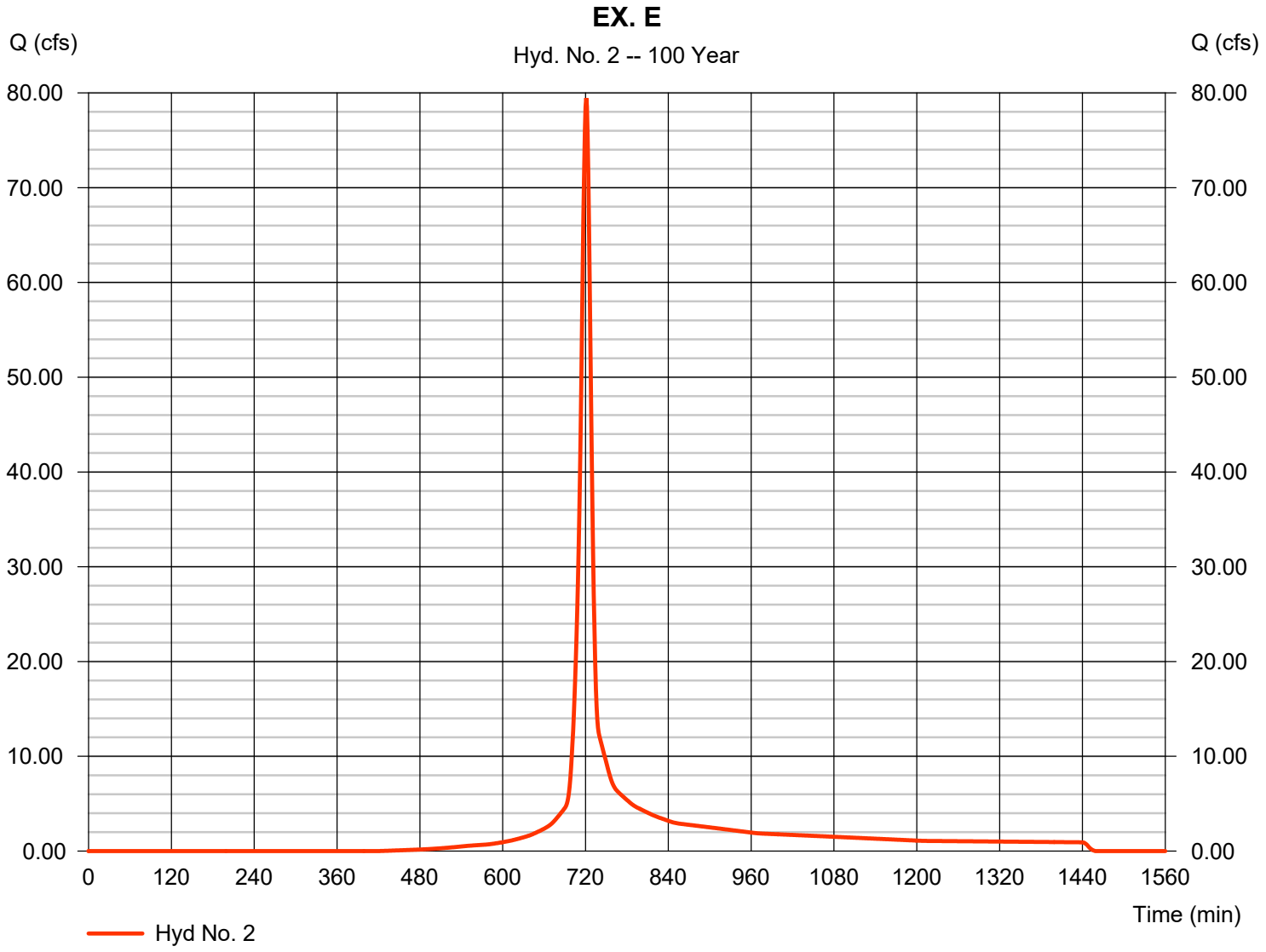


Hydrograph Report

Hyd. No. 2

EX. E

Hydrograph type	=	SCS Runoff	Peak discharge	=	79.46 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	201,711 cuft
Drainage area	=	12.420 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	12.40 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

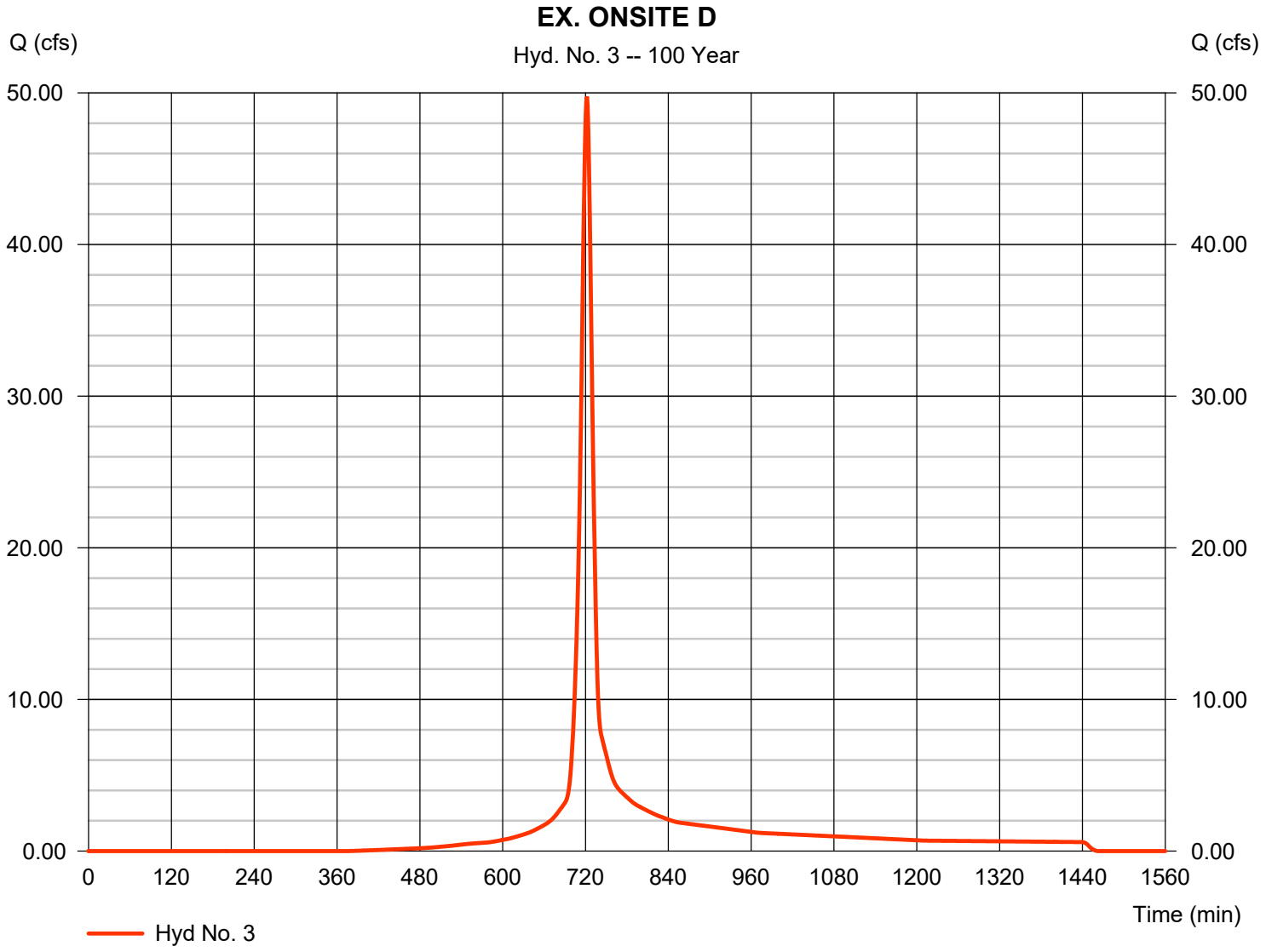


Hydrograph Report

Hyd. No. 3

EX. ONSITE D

Hydrograph type	= SCS Runoff	Peak discharge	= 49.76 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 134,964 cuft
Drainage area	= 7.610 ac	Curve number	= 76
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.81 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

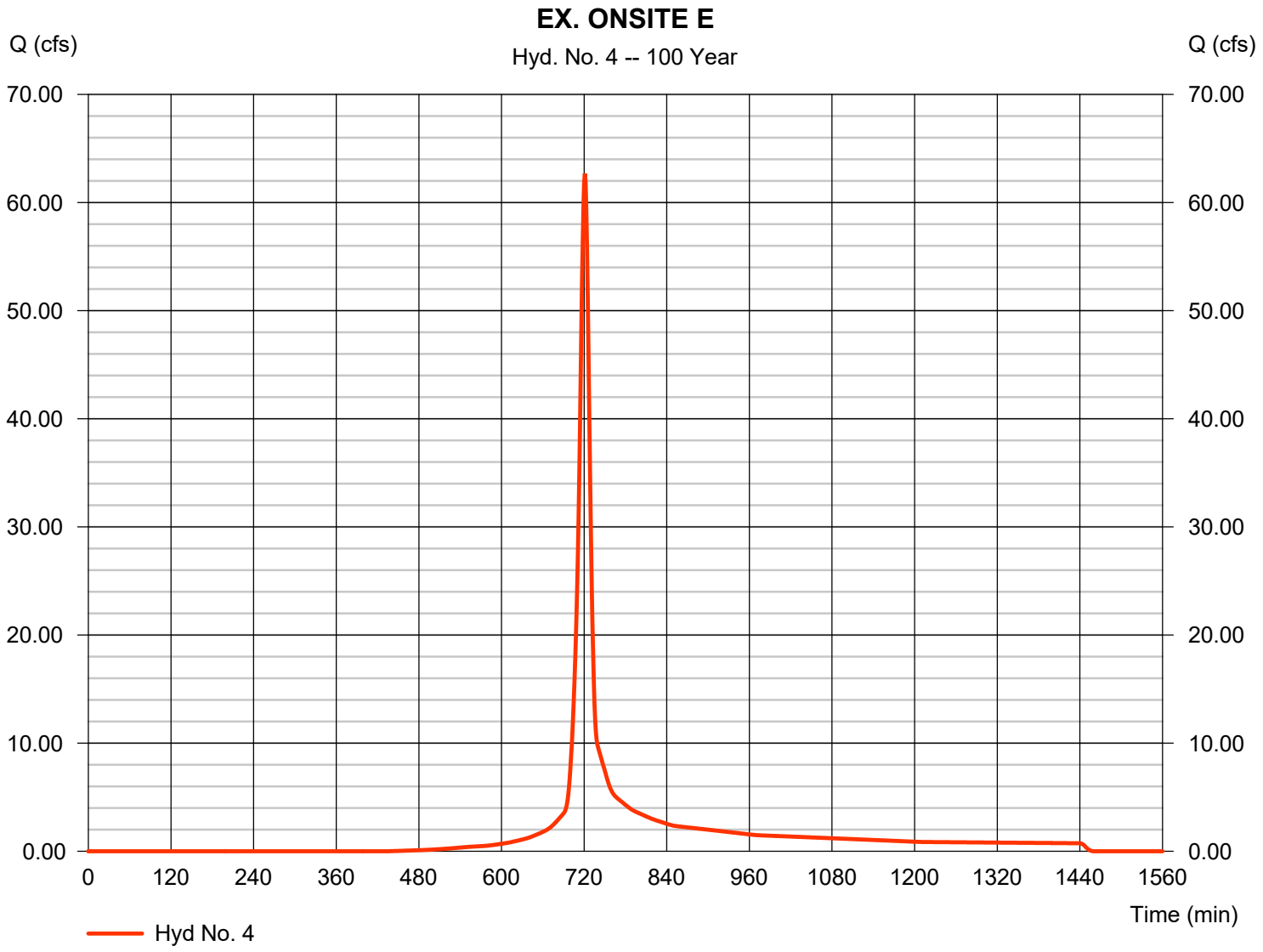


Hydrograph Report

Hyd. No. 4

EX. ONSITE E

Hydrograph type	=	SCS Runoff	Peak discharge	=	62.68 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	158,850 cuft
Drainage area	=	10.030 ac	Curve number	=	72
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	12.35 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

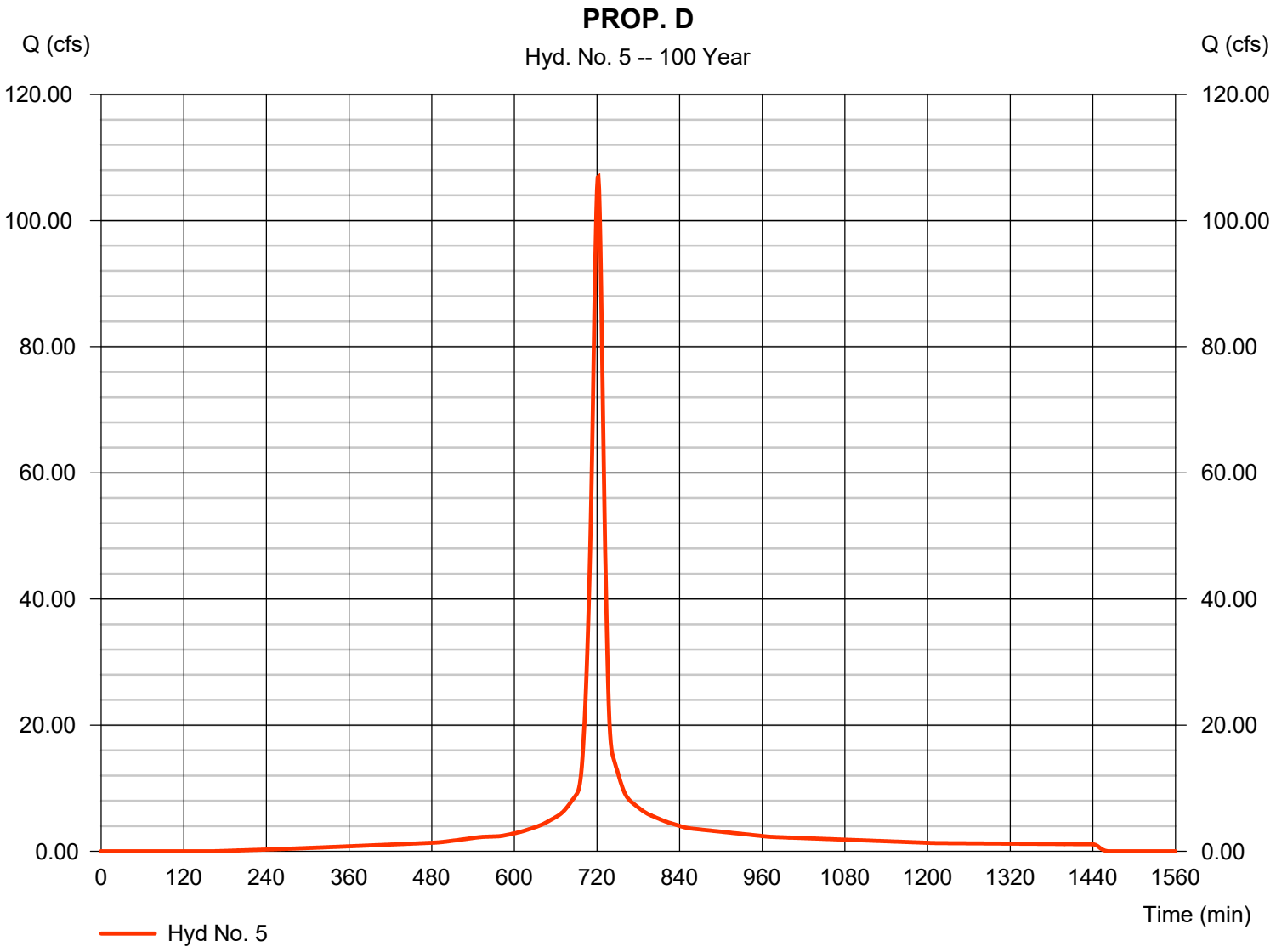


Hydrograph Report

Hyd. No. 5

PROP. D

Hydrograph type	=	SCS Runoff	Peak discharge	=	106.91 cfs
Storm frequency	=	100 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	309,826 cuft
Drainage area	=	13.110 ac	Curve number	=	90
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.80 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

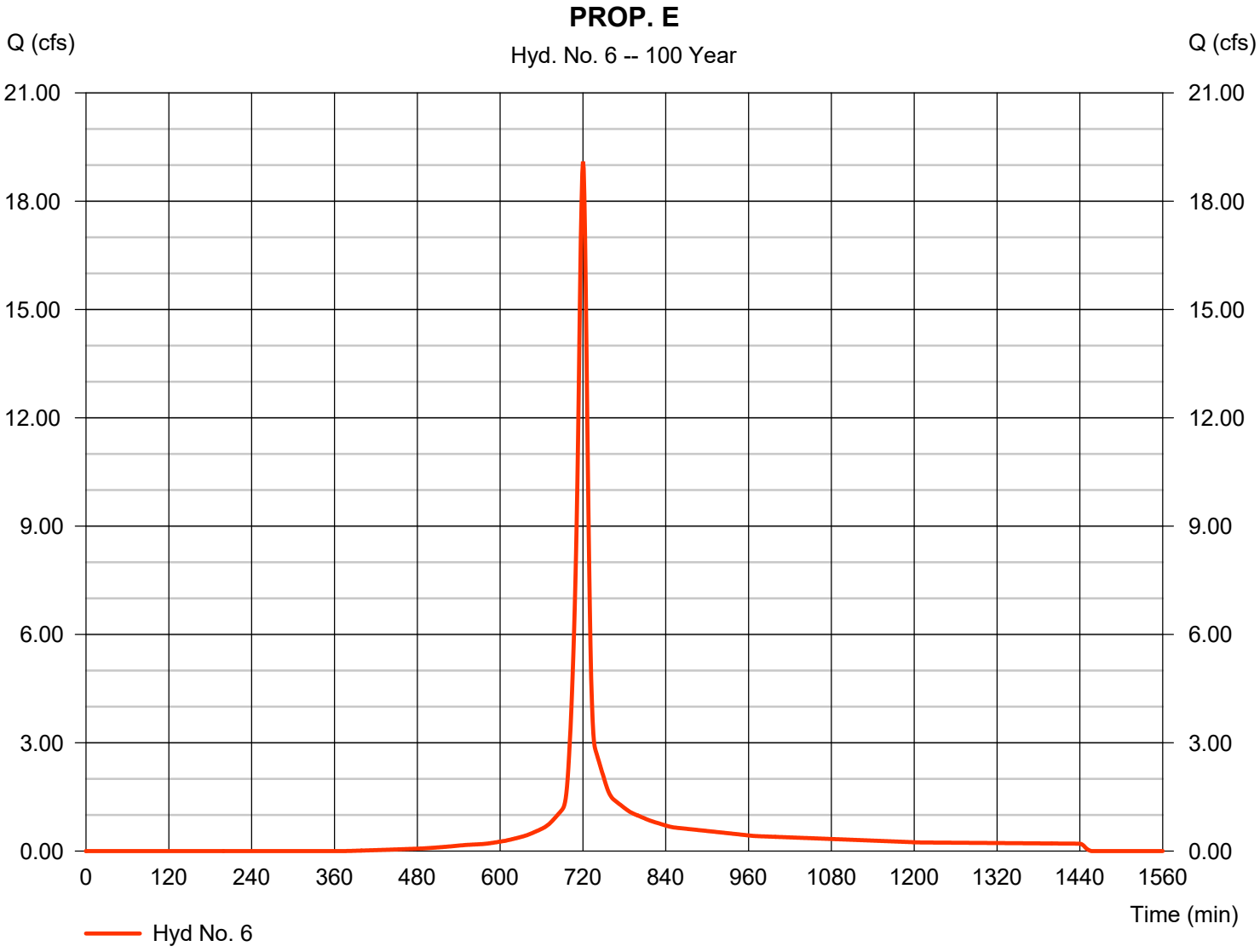


Hydrograph Report

Hyd. No. 6

PROP. E

Hydrograph type	=	SCS Runoff	Peak discharge	=	19.10 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	46,754 cuft
Drainage area	=	2.590 ac	Curve number	=	76
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.10 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

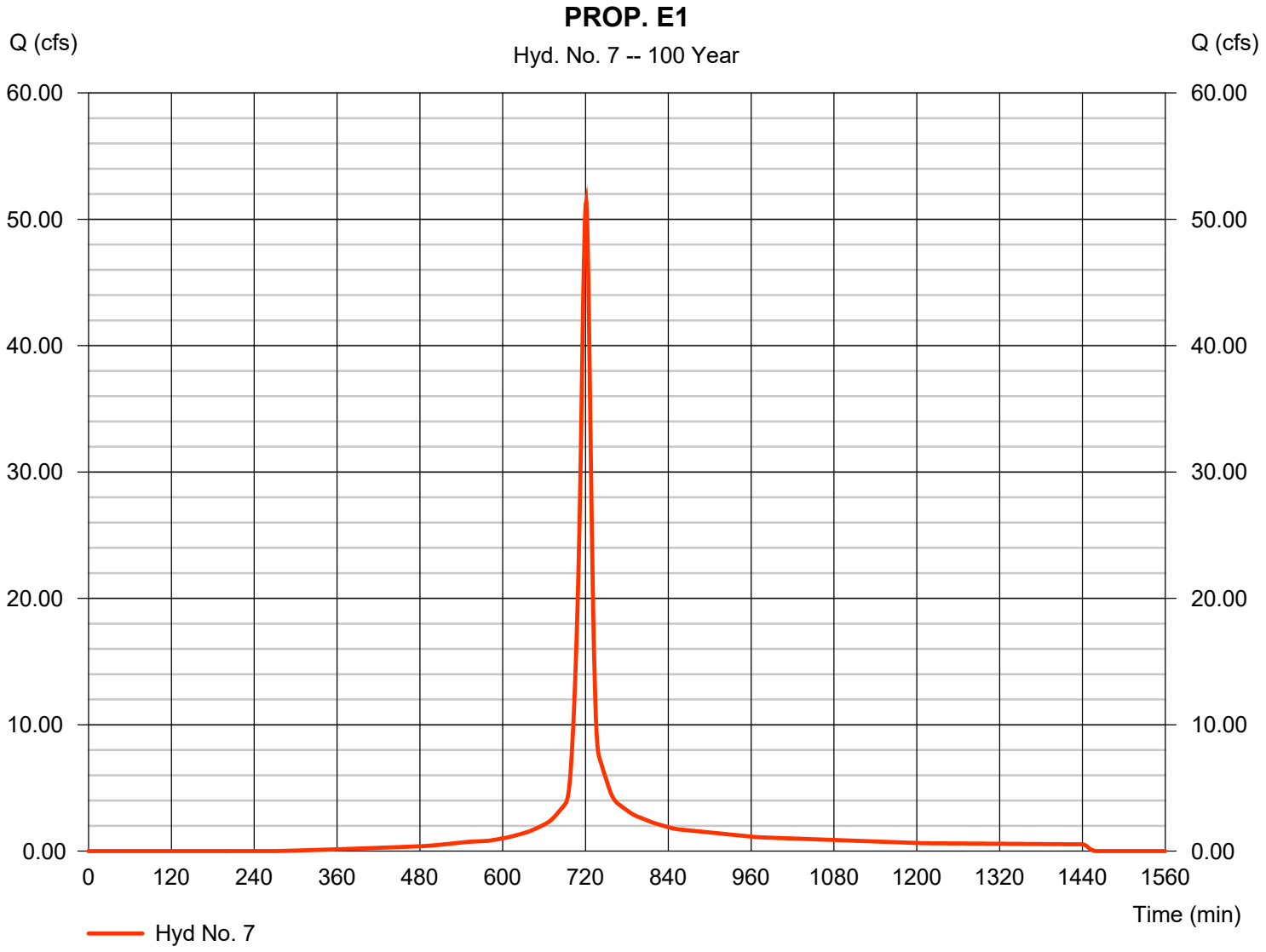


Hydrograph Report

Hyd. No. 7

PROP. E1

Hydrograph type	=	SCS Runoff	Peak discharge	=	51.35 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	134,631 cuft
Drainage area	=	6.620 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.80 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

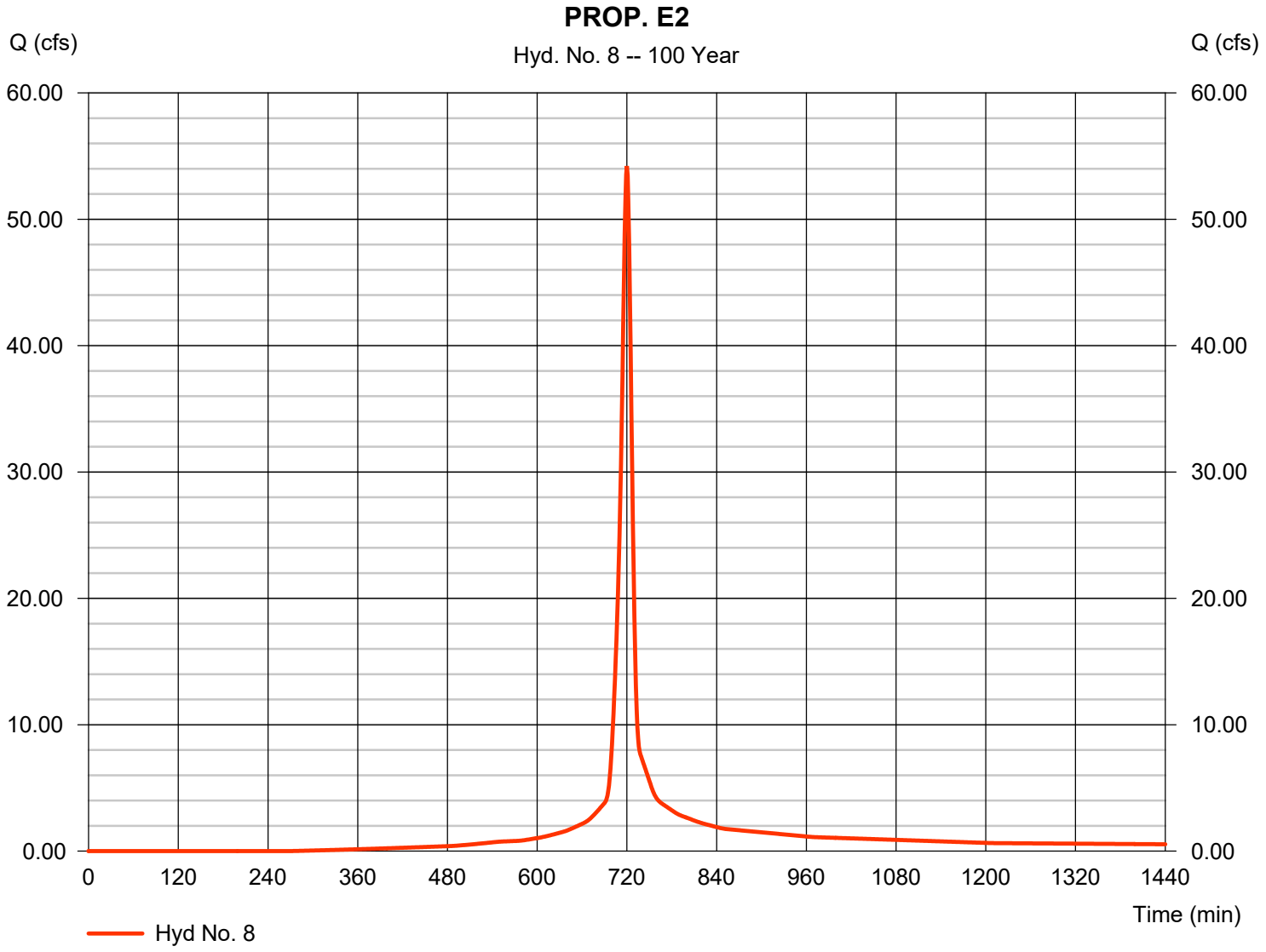


Hydrograph Report

Hyd. No. 8

PROP. E2

Hydrograph type	=	SCS Runoff	Peak discharge	=	54.21 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	136,266 cuft
Drainage area	=	6.480 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.70 min
Total precip.	=	7.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



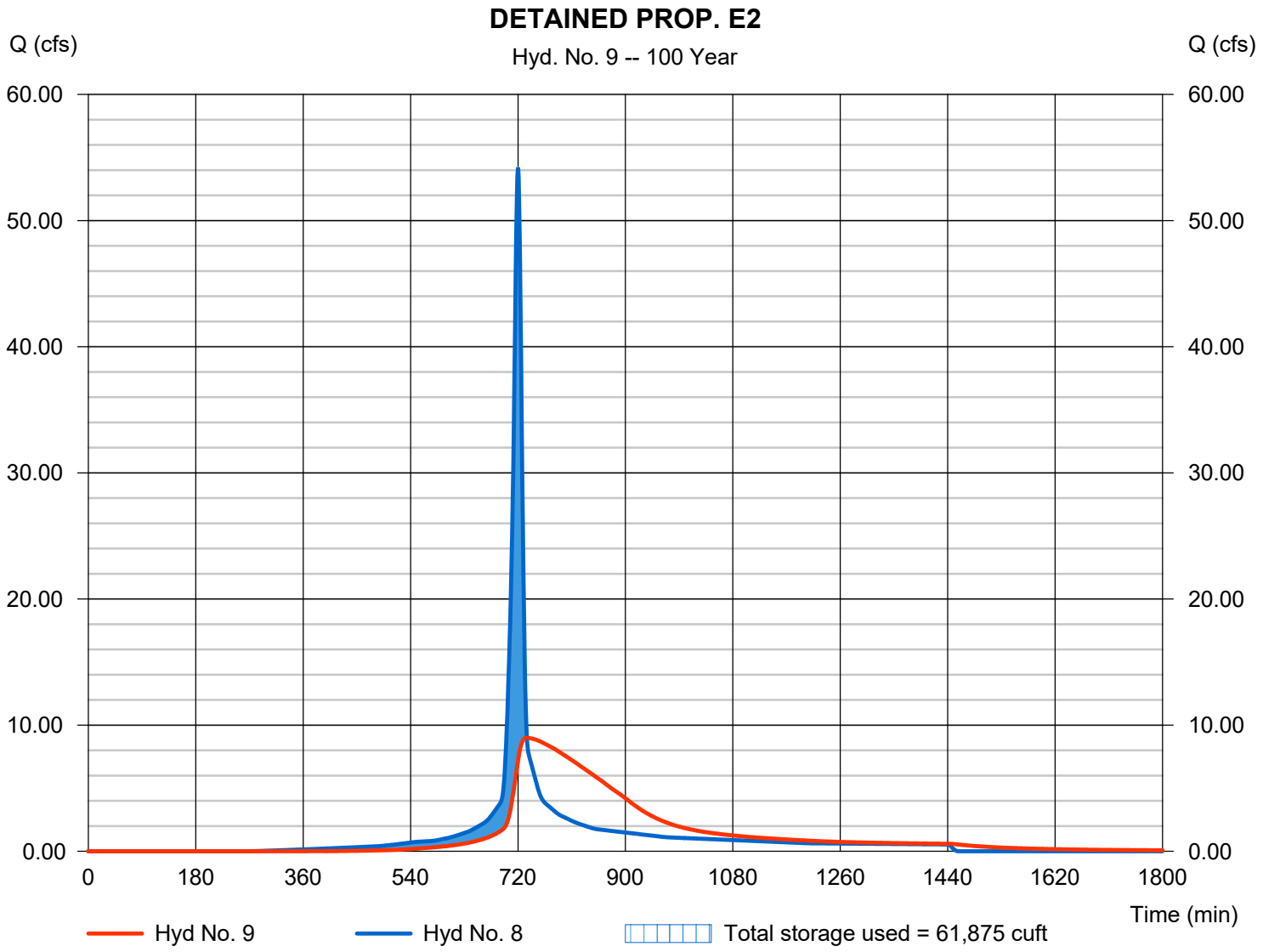
Hydrograph Report

Hyd. No. 9

DETAINED PROP. E2

Hydrograph type	=	Reservoir	Peak discharge	=	8.992 cfs
Storm frequency	=	100 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	135,586 cuft
Inflow hyd. No.	=	8 - PROP. E2	Max. Elevation	=	917.44 ft
Reservoir name	=	BASIN E2 (CELL 1)	Max. Storage	=	61,875 cuft

Storage Indication method used.

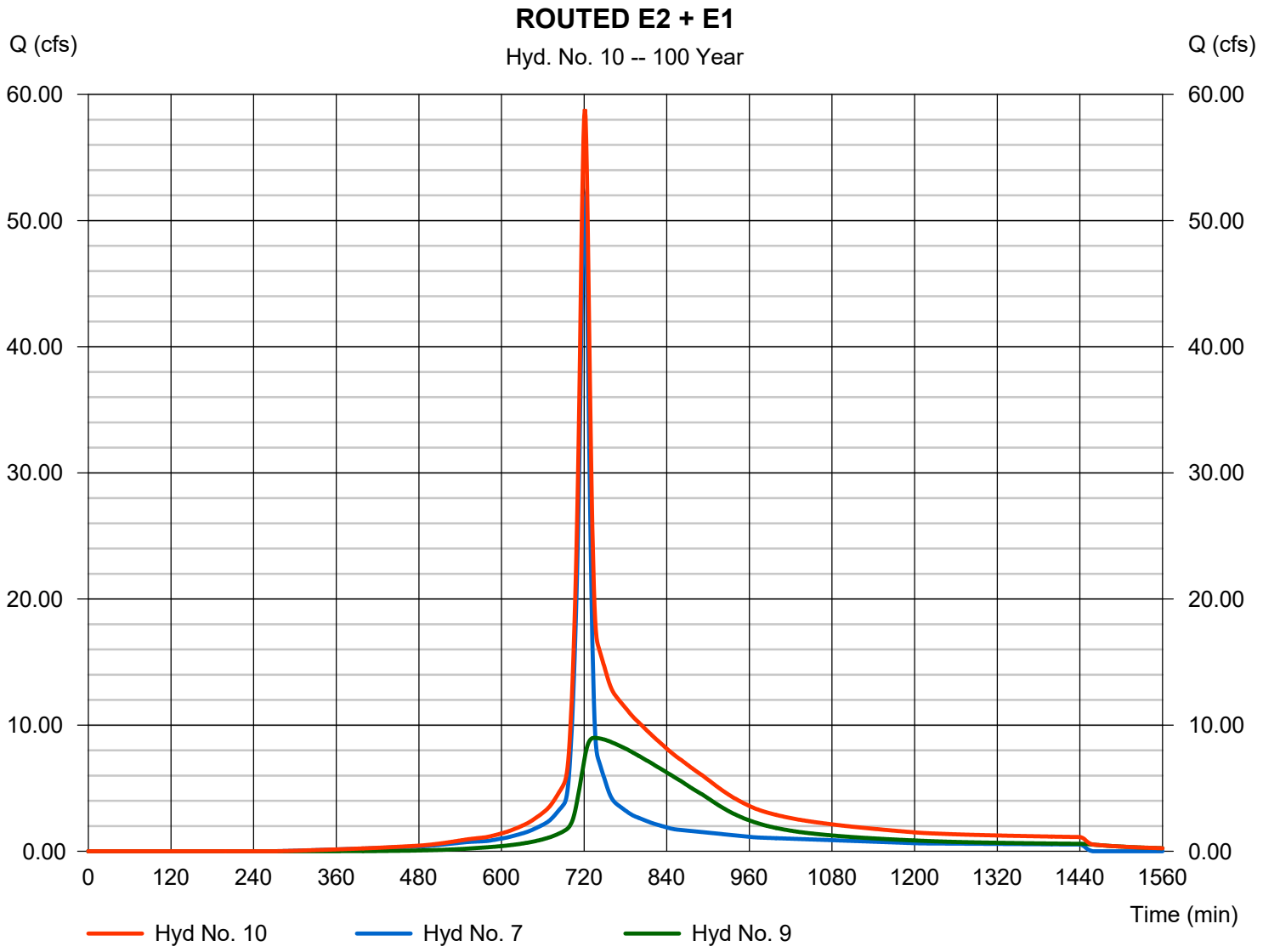


Hydrograph Report

Hyd. No. 10

ROUTED E2 + E1

Hydrograph type	= Combine	Peak discharge	= 58.82 cfs
Storm frequency	= 100 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 270,217 cuft
Inflow hyds.	= 7, 9	Contrib. drain. area	= 6.620 ac



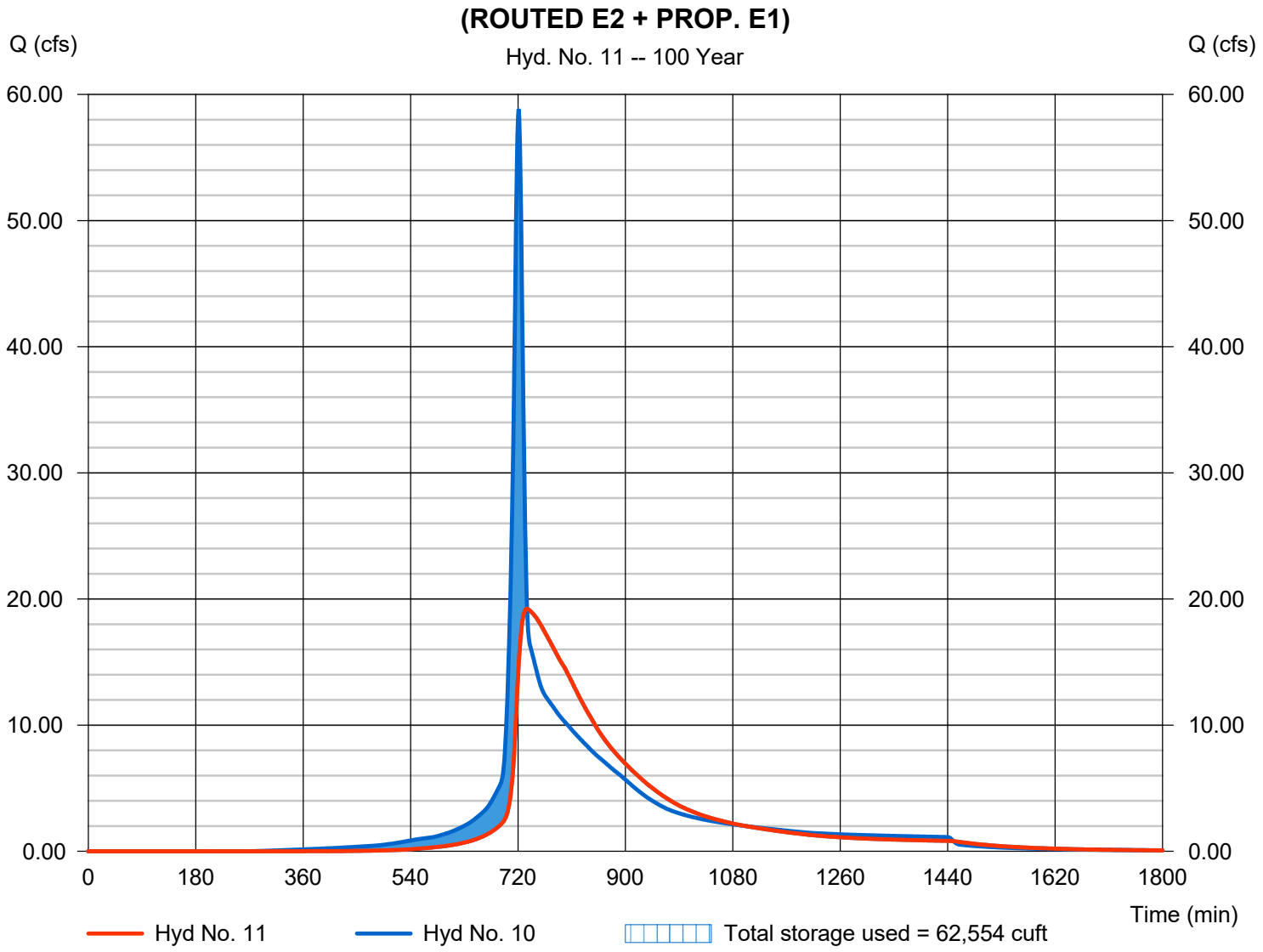
Hydrograph Report

Hyd. No. 11

(ROUTED E2 + PROP. E1)

Hydrograph type	=	Reservoir	Peak discharge	=	19.22 cfs
Storm frequency	=	100 yrs	Time to peak	=	735 min
Time interval	=	1 min	Hyd. volume	=	236,743 cuft
Inflow hyd. No.	=	10 - ROUTED E2 + E1	Max. Elevation	=	910.12 ft
Reservoir name	=	BASIN E1 (CELL 2)	Max. Storage	=	62,554 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

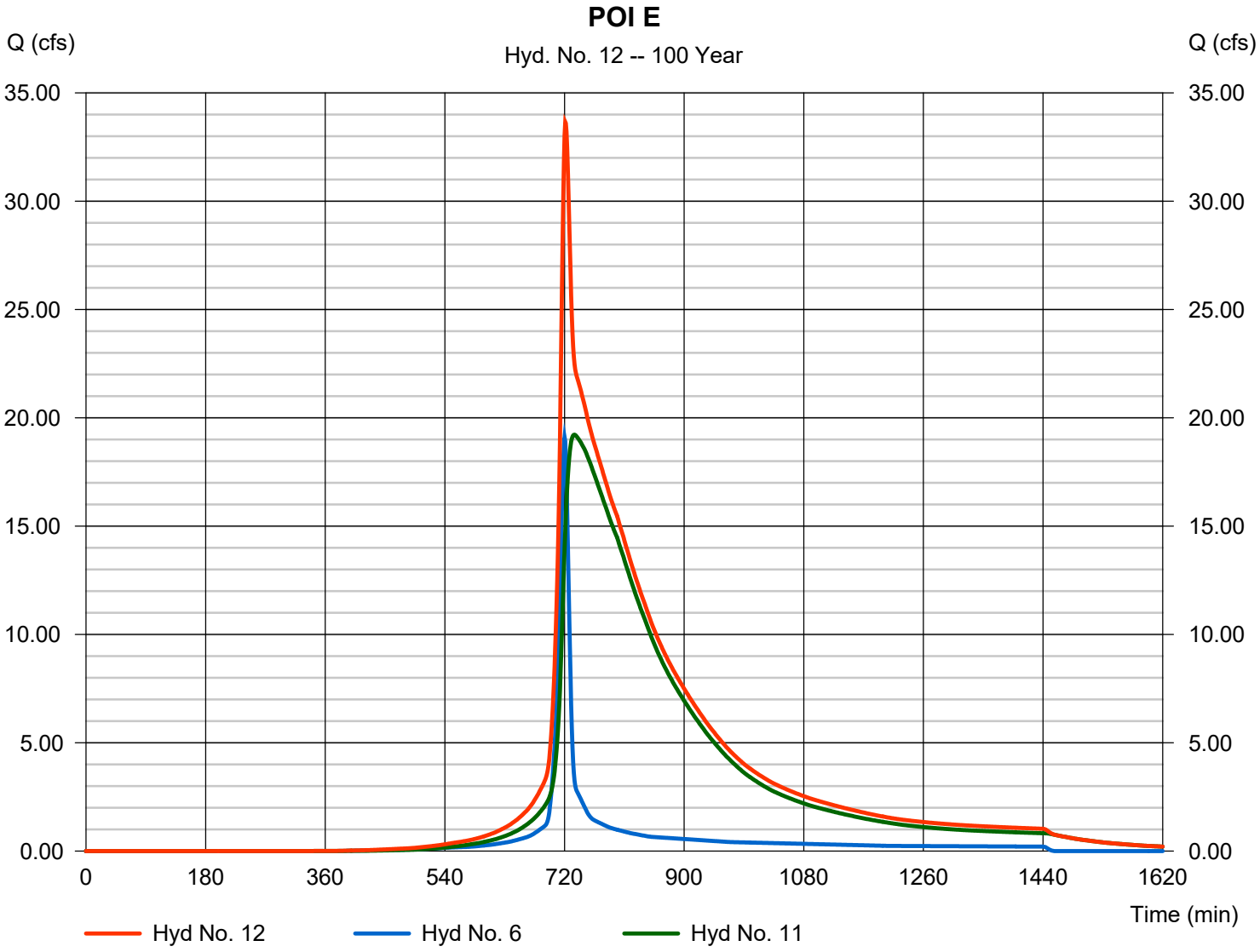


Hydrograph Report

Hyd. No. 12

POI E

Hydrograph type	=	Combine	Peak discharge	=	33.66 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	283,497 cuft
Inflow hyds.	=	6, 11	Contrib. drain. area	=	2.590 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	64.1474	17.7000	0.8922	--------
2	95.7859	19.2000	0.9317	--------
3	0.0000	0.0000	0.0000	--------
5	118.7799	19.1000	0.9266	--------
10	125.1300	18.2000	0.9051	--------
25	158.9867	18.7000	0.9180	--------
50	171.2459	18.3000	0.9078	--------
100	187.3624	18.1000	0.9031	--------

File name: KCMO.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	3.96	3.31	2.86	2.52	2.25	2.04	1.87	1.72	1.60	1.49	1.40	1.32
2	4.92	4.13	3.56	3.14	2.81	2.54	2.32	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	6.23	5.23	4.51	3.98	3.56	3.22	2.94	2.71	2.52	2.35	2.20	2.07
10	7.27	6.09	5.26	4.63	4.14	3.75	3.43	3.16	2.93	2.74	2.57	2.42
25	8.70	7.30	6.30	5.54	4.96	4.49	4.10	3.78	3.51	3.27	3.07	2.89
50	9.83	8.24	7.11	6.26	5.60	5.07	4.64	4.27	3.97	3.70	3.47	3.27
100	11.00	9.21	7.95	7.00	6.26	5.67	5.19	4.78	4.44	4.14	3.89	3.66

Tc = time in minutes. Values may exceed 60.

Precip. file name: Z:\acad\KCMO.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	1.37	3.50	0.00	3.30	5.20	6.00	6.80	7.70
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	2.49	3.10	0.00	4.01	4.64	5.52	6.21	6.90
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	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Exhibit I

Post-Development Drainage Area Map

POST-DEVELOPMENT DRAINAGE AREA MAP

SCALE: 1" = 100'

North

0 50' 100' 200'

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Engineering E-1895
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

Monticello 4th Plat
Lee's Summit, Jackson County, Missouri

Project: Monticello

Issue Date: April 10, 2020

Post-Development Drainage Area Map
Construction Plans for:
Monticello 4th Plat
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
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OK PE 25226

REVISIONS

1 REV. 5/20/2020

REV. 6/19/2020

2 REV. 7/7/2020

Exhibit

Exhibit J

Post-Development Land Usage Map

POST-DEVELOPMENT LAND USAGE MAP

SCALE: 1" = 100'

North

0 50' 100' 200'

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REVISIONS

1 REV. 5/20/2020
REV. 6/19/2020
2 REV. 7/7/2020

Exhibit

Exhibit K

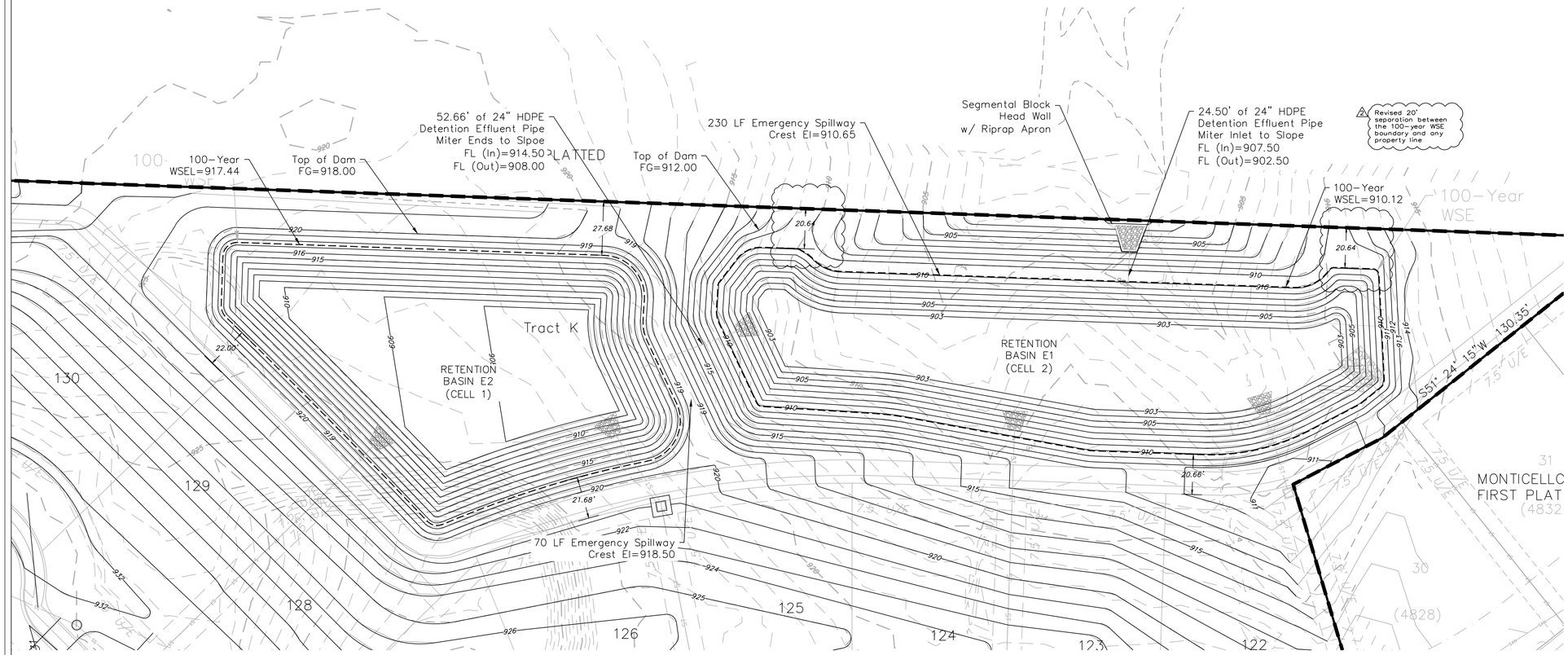
Retention Basin Plan

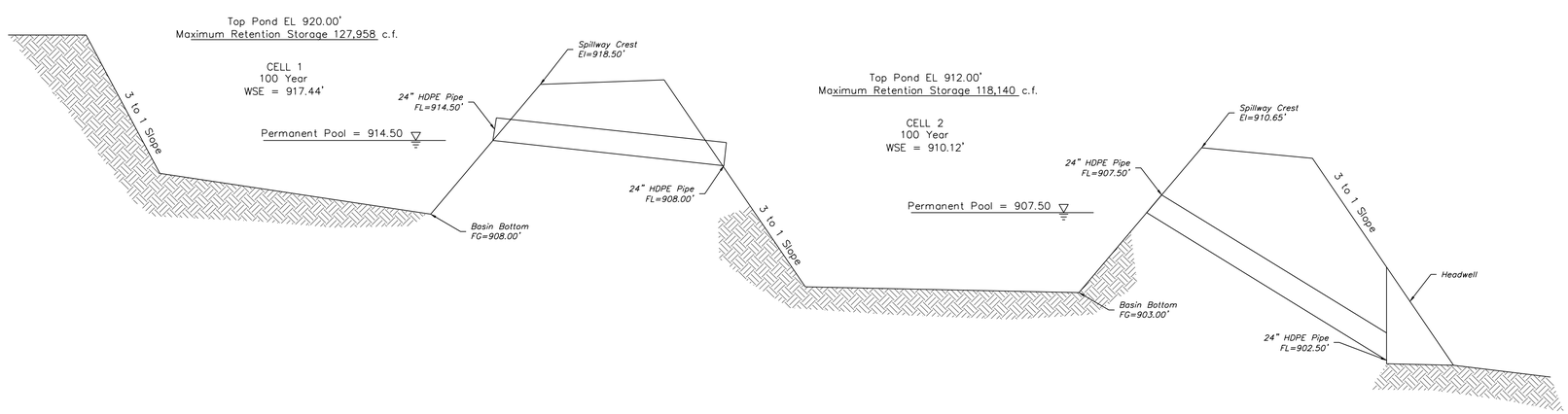
RETENTION SYSTEM PLAN

SCALE: 1" = 30'

0 15' 30' 60'

North





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REVISIONS

1 REV. 5/20/2020

REV. 6/19/2020

2 REV. 7/7/2020

C.207

Exhibit L

Emergency Spillway Calculations

Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Apr 1 2020

EMERGENCY SPILLWAY - BASIN E1

Rectangular Weir

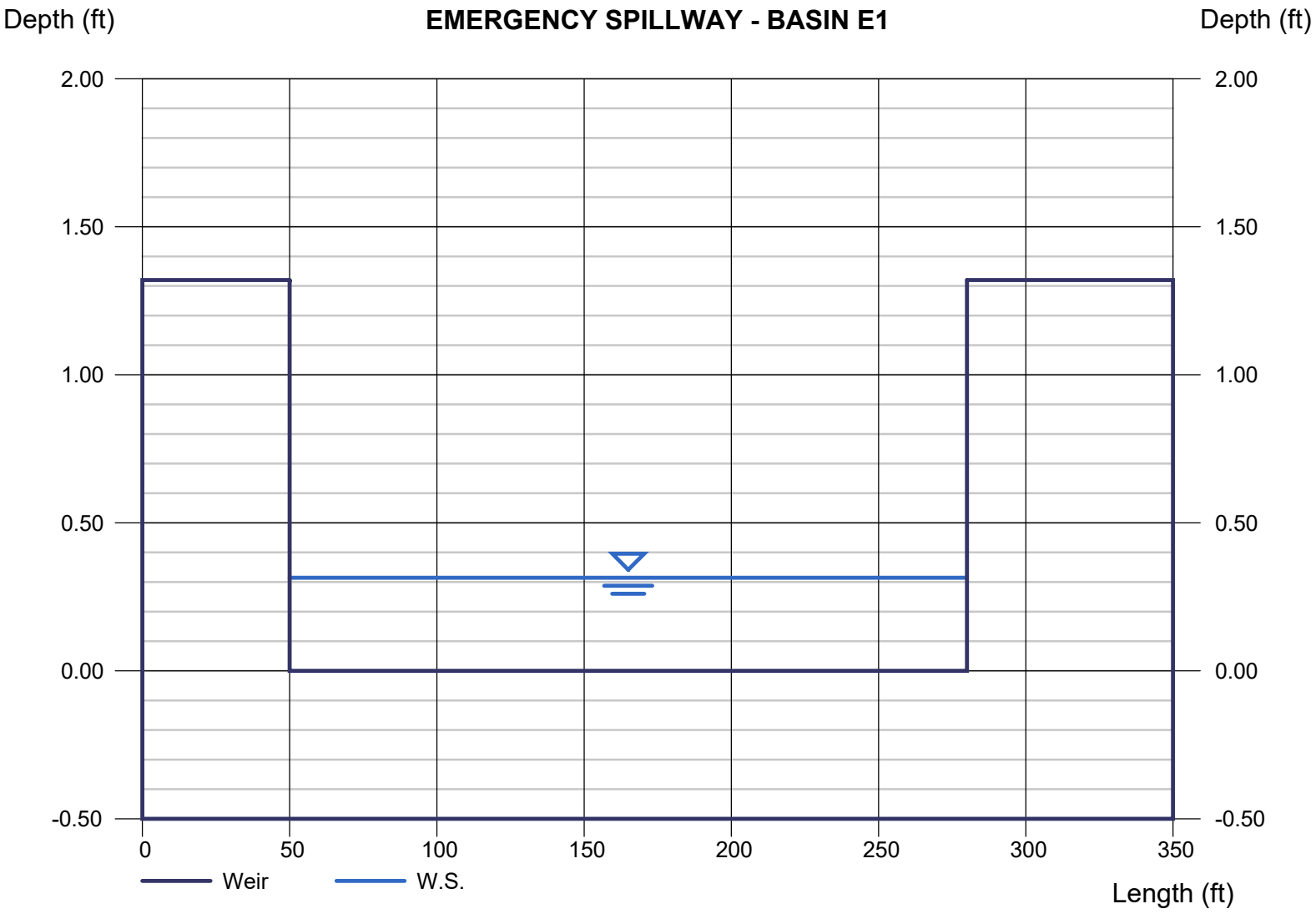
Crest	= Broad
Bottom Length (ft)	= 230.00
Total Depth (ft)	= 1.32

Calculations

Weir Coeff. Cw	= 2.60
Compute by:	Known Q
Known Q (cfs)	= 105.56

Highlighted

Depth (ft)	= 0.31
Q (cfs)	= 105.56
Area (sqft)	= 72.33
Velocity (ft/s)	= 1.46
Top Width (ft)	= 230.00



Weir Report

EMERGENCY SPILLWAY - BASIN E2

Rectangular Weir

Crest	= Broad
Bottom Length (ft)	= 70.00
Total Depth (ft)	= 1.50

Calculations

Weir Coeff. Cw	= 2.60
Compute by:	Known Q
Known Q (cfs)	= 54.21

Highlighted

Depth (ft)	= 0.45
Q (cfs)	= 54.21
Area (sqft)	= 31.21
Velocity (ft/s)	= 1.74
Top Width (ft)	= 70.00