Run-on and Run-off Control System Plan

Comanche Station - Active CCR Landfill

Public Service Company of Colorado
Denver Colorado

October 17, 2016

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Table of Abbreviations and Acronyms

Abbreviation	Definition
ADF	Ash Disposal Facility
amsl	above mean sea level
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CLOMR	Conditional Letter of Map Revision
D&O	Design and Operations
EDOP	Engineering Design and Operations Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
NOAA	National Oceanic and Atmospheric Administration
PSCo	Public Service Company of Colorado
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Area

1.0 General Information

On April 17, 2015, the U.S. Environmental Protection Agency published regulations under Subtitle D of the Resource Conservation and Recovery Act meant to control the safe disposal of coal combustion residuals (CCR) generated by coal-fired electric utilities. The rule defines a set of requirements for the disposal and handling of CCR within CCR units (defined as either landfills or surface impoundments). The requirements include preparation of a Run-on and Run-off Control System Plan for all existing and new CCR landfills.

This Run-on and Run-off Control System Plan has been prepared for the CCR landfill at the Comanche Station. It has been prepared in accordance with the requirements of 40 Code of Federal Regulations [CFR] §257.81. The regulation requires that an initial Run-on and Run-off Control System Plan be prepared no later than October 17, 2016.

1.1 Facility Description

Comanche Station is a 1,450-megawatt coal-fired, steam turbine power plant owned and operated by Public Service Company of Colorado (PSCo), an Xcel Energy company. The Station is located at 2005 Lime Road, Pueblo, Colorado, approximately 3 miles south of Colorado Highway 50 in Pueblo County, Colorado.

The station's Ash Disposal Facility (ADF) is located on the southwest corner of the Comanche Station property (see **Figure 1**). The land surface elevations range from approximately 4,830 feet above mean sea level (amsl) in the southwest and northwest corners of the Site to approximately 4,800 feet amsl in the southeast corner of the Site.

The ADF is an active CCR disposal unit that began construction and operation in 1987 and has remained in continuous operation since that time. The ADF is operated under an Engineering Design and Operations Plan (EDOP) developed pursuant to Colorado Department of Health and Environment Solid Waste Regulations.

The ADF is an approximately 280-acre engineered ash monofill consisting of eight permitted disposal cells. Approximately 38.7 acres of the ADF will be used for surface water control structures, access roads, and borrow area. The wastes accepted at the ADF consist primarily of coal ash (fly ash and bottom ash), with smaller quantities of water treatment sludge, process water pond sediment, coal impurities, and excavation soils. Cell 1 is the current active disposal area.

Eight permitted disposal cells make up the ADF. The disposal cells will be constructed in phases as needed to contain ash and waste from power generating activities. The cells may be further subdivided to facilitate construction and operation.

The most recent EDOP was prepared in 2015 (2015 EDOP) by Tetra Tech. The purpose of the 2015 EDOP was to update and replace the previously prepared Design and Operations (D&O) Plan dated August 24, 2005 prepared by Wenck Associates (2005 D&O). This Run-on and Run-off Control System Plan incorporates information and permit drawings from the 2015 EDOP and 2005 D&O Plan.

Figure 1. Site Topography

1.2 Regulatory Requirements

Title 40 CFR §257.81 requires that an owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill design, construct, operate, and maintain:

1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm;
2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm; and
3) A run-off control system designed to handle run-off so that it does not cause a discharge of pollutants to waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System under Section 402 of the Clean Water Act.

2.0 Run-on and Run-off Controls for CCR Landfills

A hydrologic and hydraulic analysis was completed for the active portion of the CCR landfill unit in accordance with 40 CFR §257.81 and Part 1 of 6 CCR 1007-2. Per 40 CFR §257.53, the active portion means *"that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with §257.102."*

Cell 1 is the current active cell and Cell 2 is anticipated to be constructed in 2017. Based on current landfilling projections, these two cells were the only cells evaluated for the initial 5-year period.

The evaluation included preparation of a surface water run-off model using Hydraflow Hydrographs 2014 to determine whether existing run-on and run-off control systems meet the required criteria for controlling run-on and run-off from the 24-hour, 25-year storm event. The evaluation was completed using the best available information at the time and was based on a survey completed in 2013.

2.1 Description of CCR Landfill and Drainage Area

The ADF sits on an upland between the St. Charles River and Salt Creek drainages. The facility is not within the floodplain of either drainage; however, an unnamed ponding area is present within the footprint of the ADF. This area collects precipitation from the upland area between the St. Charles River and Salt Creek. The ponding area is currently designated a Special Flood Hazard Area (SFHA) by the Federal Emergency Management Agency (FEMA). A SFHA is an area that will be inundated by a storm having a 1 percent chance of being equaled or exceeded in any given year. Based on the Conditional Letter of Map Revision (CLOMR) permit application submitted by PSCo Energy on May 23, 2006, the 100-year flood volume draining to the SFHA is 57.3 acre-feet. The storage capacity of the SFHA will be replaced by perimeter ponds when ADF construction intercepts and displaces the SFHA. The 2015 EDOP proposed a series of five ponds constructed concurrent with cell expansions for the purpose of (1) controlling run-on into the active disposal area from surrounding areas and (2) replacing the SFHA storage volume consistent with the requirements of the CLOMR.

The CLOMR permit application indicates that storm water Pond 1 as shown on 2005 D&O Sheet No. 12A is sized to contain the 57.3 acre-feet plus 25.1 acre-feet of run-off from the proposed final cover design. The SFHA is present in Cells 4, 5, 6, 7, and 8. As a result of ADF cell configuration and

construction sequencing, Pond 1 will be installed during construction of Cells 4, 5, and 6 and prior to ADF construction intercepting the portions of the SFHA present in Cells 7 and 8. Cells 1, 2 and 3 are not at risk from flooding prior to construction of Pond 1 during Cell 4 construction.

The December 7, 2006, FEMA response (U.S. Department of Homeland Security, 2006) to the CLOMR application stated that the proposed ADF project meets the minimum floodplain management criteria of Part 65 of the National Flood Insurance Program. The FEMA response also stated that as a result of the project, the City of Pueblo Flood Insurance Rate Map (FIRM) will be revised to remove the existing unnamed ponding area and storm water Pond 1 will be shown as containing the SFHA. To make a final determination on revising the effective FIRM, FEMA requires certified as-builts upon completion of the ADF project for all proposed project elements as shown on 2005 D&O Sheet No. 12A – Pond Boundaries that was submitted with the CLOMR request.

2.2 Description of Run-on Control System

Active Cell 1 is approximately 46 feet above grade and is located in the southeast corner of the permitted ADF. It includes a containment berm constructed around the cell. According to the 2015 EDOP the containment berm has a minimum interior height of 4 feet and a minimum exterior height of 2 feet. The purpose of the berm is to provide containment for waste and leachate during the operational life of the cell and to prevent surface water from entering the cell. Containment berms will limit the potential for surface water to run into the active disposal area. A perimeter access road to the east and south of Cell 1 acts as another deterrent that prevents surface water to run into the active disposal area. Cell 2, when constructed, will include similar control measures implemented with Cell 1.

2.3 Description of Run-off Control System

An existing storm water pond is located immediately north of Cell 1 and receives all surface water run-off from active Cell 1 and the existing undeveloped footprint of future Cell 2. Run-off from the east and south outside side slopes of Cell 1 is conveyed through a perimeter channel and ultimately a 36-inch corrugated metal pipe into the existing storm water pond. Run-off from the north and west outside side slopes and the top portion of Cell 1 and the existing footprint of future Cell 2 is conveyed through perimeter channels that direct discharges into the existing storm water pond or future phased construction ponds. Channels at the toe of slope for both the north and west sides are shown as part of this plan and are intended to convey the design storm event to the appropriate storm water control/ponds. There is no outfall for the existing storm water pond; collected surface water run-off is absorbed into the underlying materials or evaporated. The overall area of the existing storm water pond is approximately 1.35 acres.

2.4 Surface Water Run-off Model

A surface water run-off model was prepared for Cells 1 and 2 for the 5-year period of this Run-on and Run-off Control System Plan using Hydraflow Hydrographs, which utilizes procedures outlined in Soil Conservation Service (SCS) Technical Release 55 (TR-55) for computing curve numbers and times of concentration and SCS TR-20 for calculating and generating run-off hydrographs. The model is included as Appendix A, and a detailed discussion of the information inputted into the model is provided below.

2.4.1 Rainfall Data

Rainfall data were taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Data Server. Rainfall data inputted into the model included the 25-year, 24-hour Type II storm event in the amount of 3.01 inches. The information from the NOAA Precipitation Frequency Data Server is included as Appendix B.

2.4.2 Run-off Curve Number

The run-off curve number is determined according to a hydrologic soil group and ground cover for a delineated drainage basin. The active portions of the landfill (existing Cells 1 and future Cell 2) were delineated into the appropriate drainage basin, which sequentially drains to an existing storm water pond centrally located in the permitted ADF (refer to **Figure 1**). A composite run-off curve number of 90 was used for the ADF, including disposal materials and final cover system.

2.4.3 Time of Concentration

The time of concentration is defined as the time required for run-off to travel from the most hydrologically distant point of a sub-catchment to the point of collection. It is determined by summing the travel time for consecutive flow segments along the sub-catchment's hydraulic path. The path for the time of concentration used to compute surface water run-off from the active landfill area was conservatively estimated as 5 minutes.

2.4.4 Conveyance Channels

Channels will be placed on the north and west sides of the active ADF to convey drainage to the appropriate storm water control pond. The north channel will collect drainage from Sub-basin 1 and discharge to the existing storm water pond. The west channel will collect drainage from Sub-basin 2 and discharge to Pond 2 (which will be constructed with Cell 2). These channels have been sized for the 25-year, 24-hour storm and are required, at a minimum, to be trapezoidal channels with 3:1 side slopes, 2 feet wide at bottom, and 2 feet deep. This minimum sizing assumes a clean, straight, vegetated channel with slope of 0.5 percent.

2.4.5 Storm Water Ponds

Five storm water ponds are intended to be constructed with future Cell 2 that are designed to overflow into the existing storm water pond. Ponds 2, 3-1, 3-2, 3-3, and 4 are located to the south and east of Cells 1 and 2. The ponds are intended to contain and control the drainage area associated with each sub-basin. Drainage that overtops each respective pond is routed to the next pond until it eventually reaches the existing storm water pond. According to the 2015 EDOP, the size constraints for Pond 3-3 and Pond 4 and the existing grade resulted in the need to continue utilizing the existing storm water pond. The existing storm water pond was modeled as a detention basin with exfiltration as its only outlet. The 25-year, 24-hour storm, modelled with each pond dry, indicates that the system will contain, convey, and control the anticipated run-off volume.

2.5 Evaluation of Run-off Controls

To comply with 40 CFR §257.81, the existing storm water pond, and ponds 2, 3-1, 3-2, 3-3, and 4 must be of sufficient size to collect and control run-off resulting from the 25-year, 24-hour storm

event. The model was therefore run using this storm water event to evaluate whether the ponds were of sufficient size to meet the requirements.

Based on the model results, the areas of the ponds, as a system, are of sufficient size and volume to prevent surface water run-off from discharging outside the active landfill area during the 25-year, 24-hour storm event. The model estimated a peak run-off volume of 112.86 cubic feet per second during the 25-year storm event for the largest sub-basin within the model (Sub-basin 4). During the 25-year storm, the high water level was estimated to be 4,796.65 feet, which is 1.35 feet below the lowest berm elevation (4,798 feet).

2.6 Improvements to Existing Run-off Controls

Based on the available information and the model results, the existing run-on and run-off controls in place for the active portion (Cells 1 and 2) of the Comanche CCR landfill unit meet the requirements of 40 CFR §257.81. There are no improvements proposed for the existing designed run-on and run-off control systems for the active portion of the CCR landfill.

3.0 Certification §257.81(c)(5)

In accordance with 40 CFR §257.81(c)(5), the owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the run-on and run-off control system plan meets the requirements of this section.

> I, Douglas T. DeCesare, being a registered Professional Engineer, in accordance with the Colorado State Board of Licensure for Architects, Professional Engineers, and Professional Land Surveyors, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 17, 2016, was conducted in accordance with the requirements of 40 CFR §257.281(c)(5), is true and correct, and was prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE:

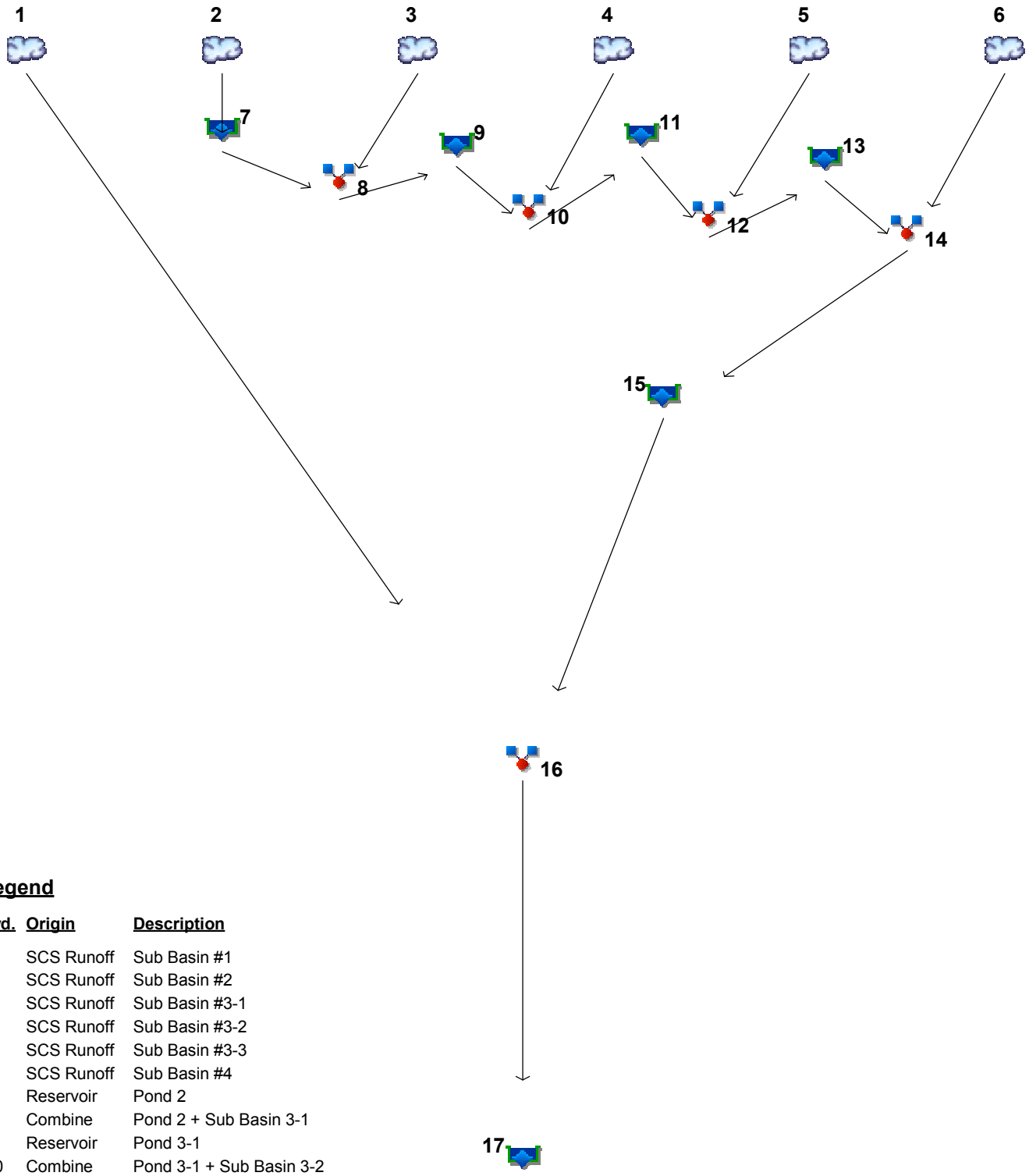
Colorado PE 0051341

DATE: October 14, 2016

APPENDIX A - SURFACE WATER RUNOFF MODEL

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3



Legend

Hyd.	Origin	Description
1	SCS Runoff	Sub Basin #1
2	SCS Runoff	Sub Basin #2
3	SCS Runoff	Sub Basin #3-1
4	SCS Runoff	Sub Basin #3-2
5	SCS Runoff	Sub Basin #3-3
6	SCS Runoff	Sub Basin #4
7	Reservoir	Pond 2
8	Combine	Pond 2 + Sub Basin 3-1
9	Reservoir	Pond 3-1
10	Combine	Pond 3-1 + Sub Basin 3-2
11	Reservoir	Pond 3-2
12	Combine	Pond 3-2 + Sub Basin 3-3
13	Reservoir	Pond 3-3
14	Combine	Pond 3-3 + Sub Basin 4
15	Reservoir	Pond 4
16	Combine	Pond 4 + Sub Basin 1
17	Reservoir	Existing Sed Basin

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

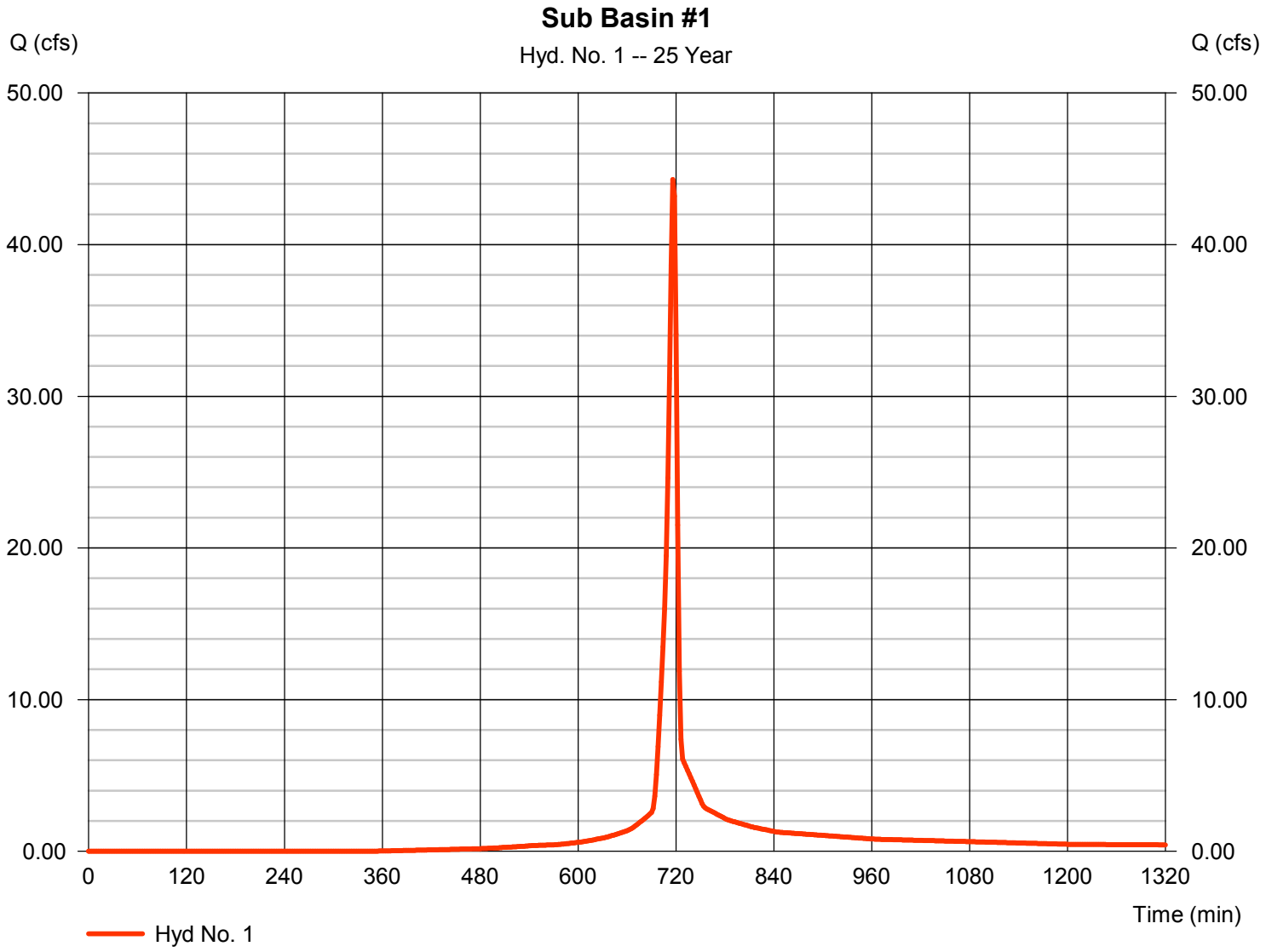
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	44.29	2	716	91,577	------	------	------	Sub Basin #1
2	SCS Runoff	71.53	2	716	147,880	------	------	------	Sub Basin #2
3	SCS Runoff	6.766	2	742	38,349	------	------	------	Sub Basin #3-1
4	SCS Runoff	6.890	2	716	14,245	------	------	------	Sub Basin #3-2
5	SCS Runoff	5.250	2	716	10,854	------	------	------	Sub Basin #3-3
6	SCS Runoff	112.87	2	716	233,352	------	------	------	Sub Basin #4
7	Reservoir	0.790	2	1180	23,773	2	4819.95	129,895	Pond 2
8	Combine	6.766	2	742	62,123	3, 7	------	------	Pond 2 + Sub Basin 3-1
9	Reservoir	0.000	2	n/a	0	8	4814.15	62,123	Pond 3-1
10	Combine	6.890	2	716	14,245	4, 9	------	------	Pond 3-1 + Sub Basin 3-2
11	Reservoir	0.081	2	1158	1,501	10	4807.82	12,850	Pond 3-2
12	Combine	5.250	2	716	12,355	5, 11	------	------	Pond 3-2 + Sub Basin 3-3
13	Reservoir	0.235	2	790	5,366	12	4799.86	7,209	Pond 3-3
14	Combine	112.87	2	716	238,718	6, 13	------	------	Pond 3-3 + Sub Basin 4
15	Reservoir	1.172	2	1350	24,219	14	4799.90	220,067	Pond 4
16	Combine	44.29	2	716	115,795	1, 15	------	------	Pond 4 + Sub Basin 1
17	Reservoir	0.000	2	n/a	0	16	4796.65	115,796	Existing Sed Basin

Hydrograph Report

Hyd. No. 1

Sub Basin #1

Hydrograph type	= SCS Runoff	Peak discharge	= 44.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 91,577 cuft
Drainage area	= 13.500 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

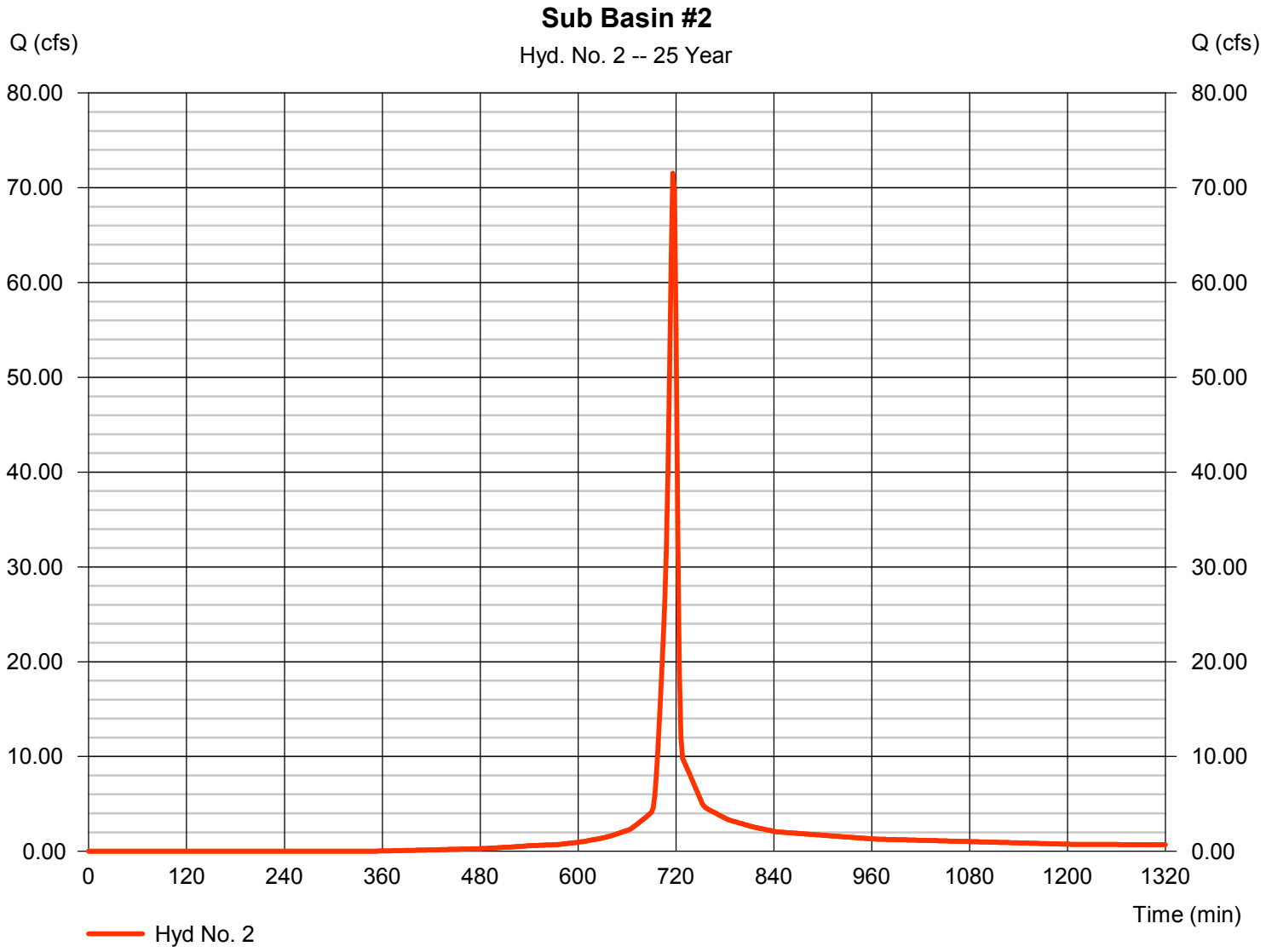


Hydrograph Report

Hyd. No. 2

Sub Basin #2

Hydrograph type	= SCS Runoff	Peak discharge	= 71.53 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 147,880 cuft
Drainage area	= 21.800 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

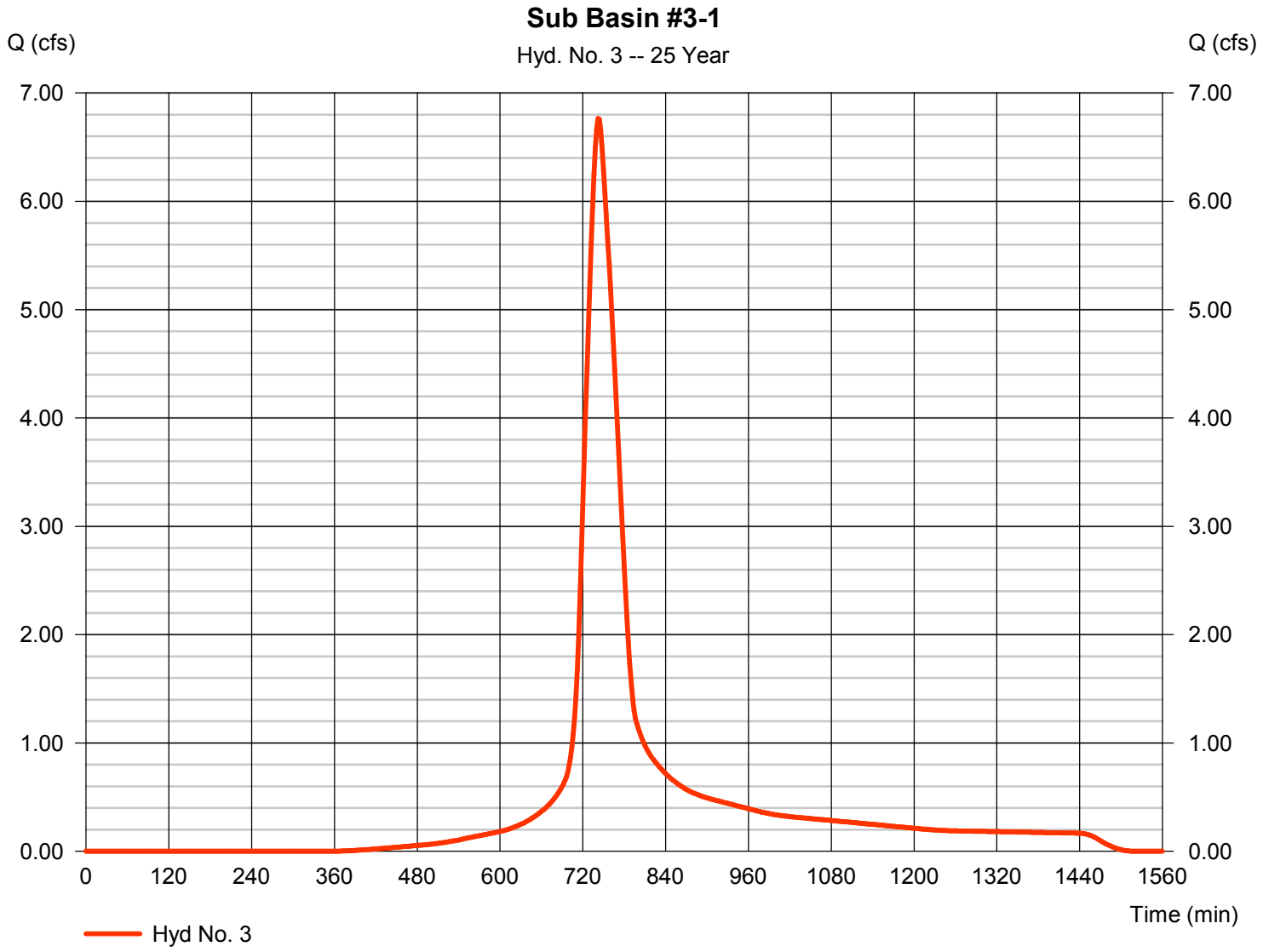


Hydrograph Report

Hyd. No. 3

Sub Basin #3-1

Hydrograph type	= SCS Runoff	Peak discharge	= 6.766 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 38,349 cuft
Drainage area	= 5.300 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 50.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

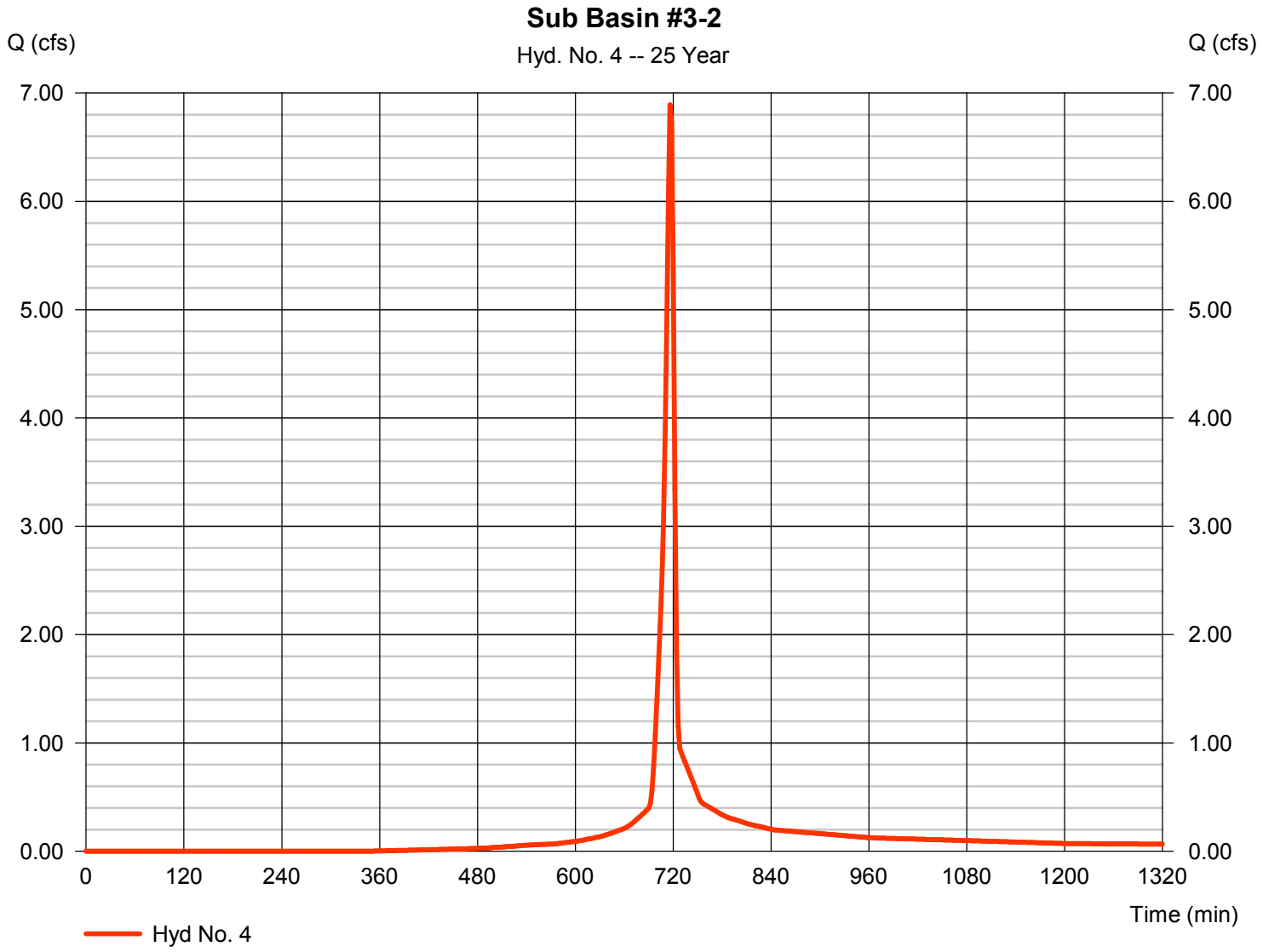


Hydrograph Report

Hyd. No. 4

Sub Basin #3-2

Hydrograph type	= SCS Runoff	Peak discharge	= 6.890 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 14,245 cuft
Drainage area	= 2.100 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

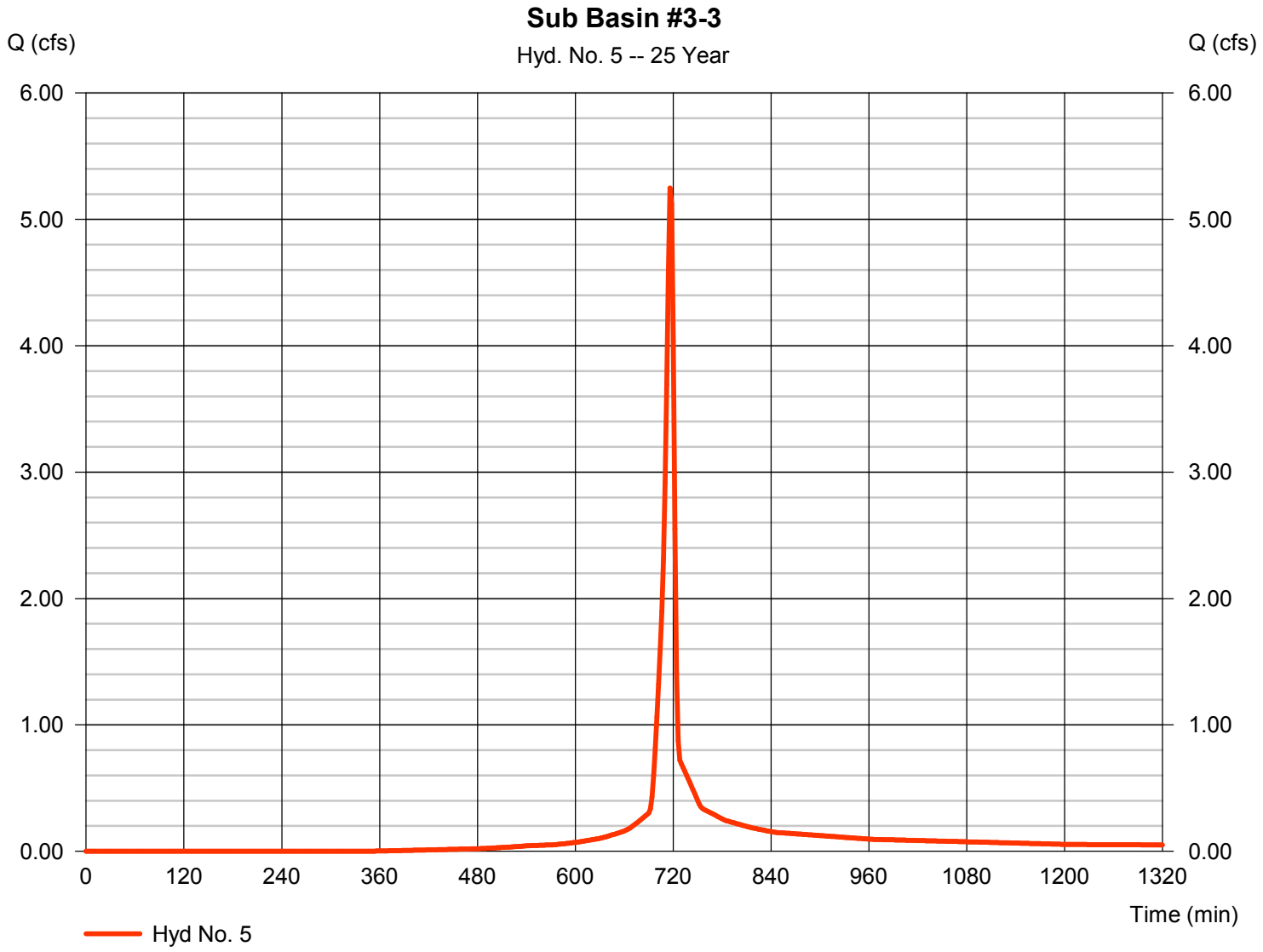


Hydrograph Report

Hyd. No. 5

Sub Basin #3-3

Hydrograph type	= SCS Runoff	Peak discharge	= 5.250 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 10,854 cuft
Drainage area	= 1.600 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

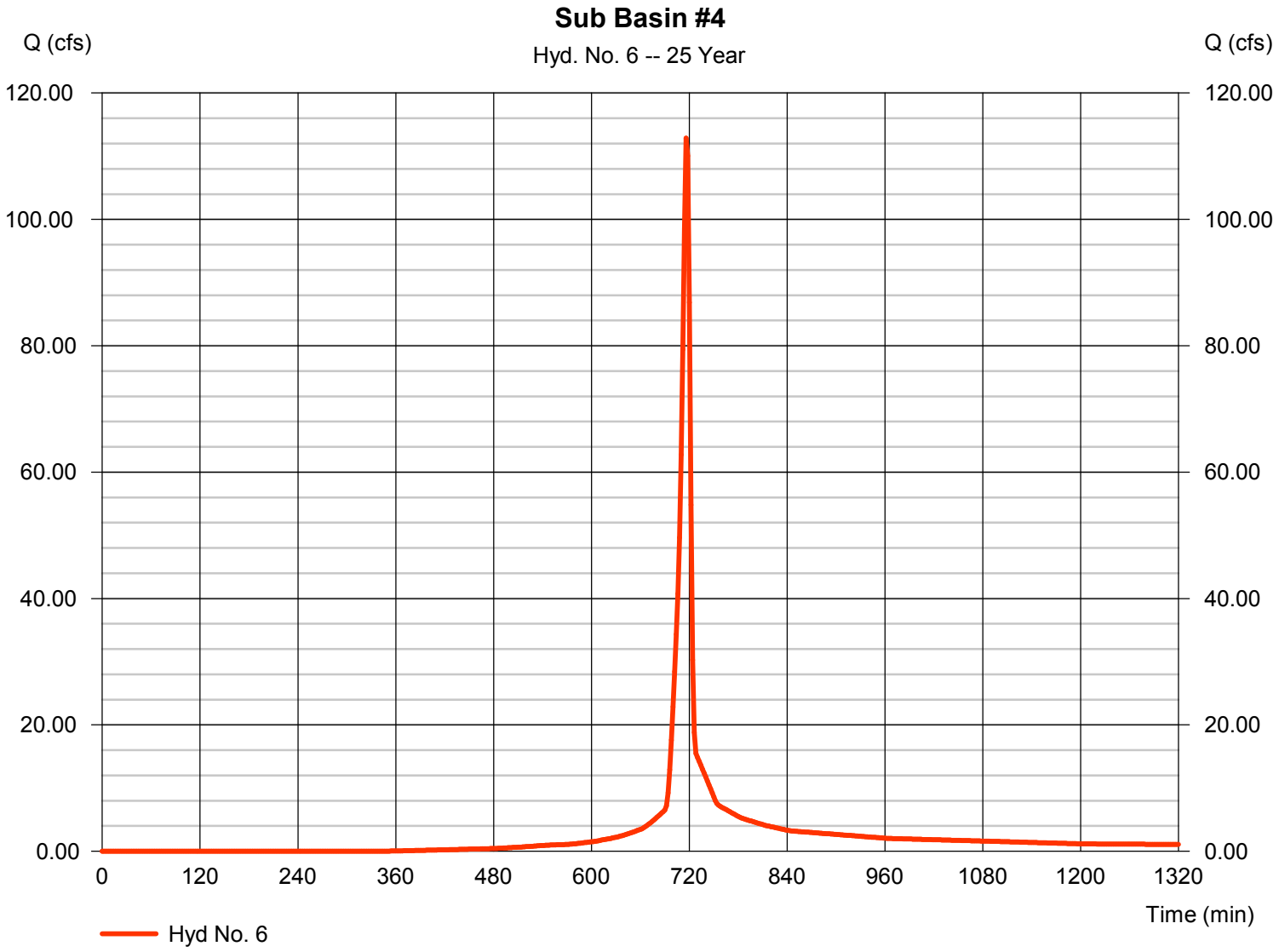


Hydrograph Report

Hyd. No. 6

Sub Basin #4

Hydrograph type	= SCS Runoff	Peak discharge	= 112.87 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 233,352 cuft
Drainage area	= 34.400 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.01 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



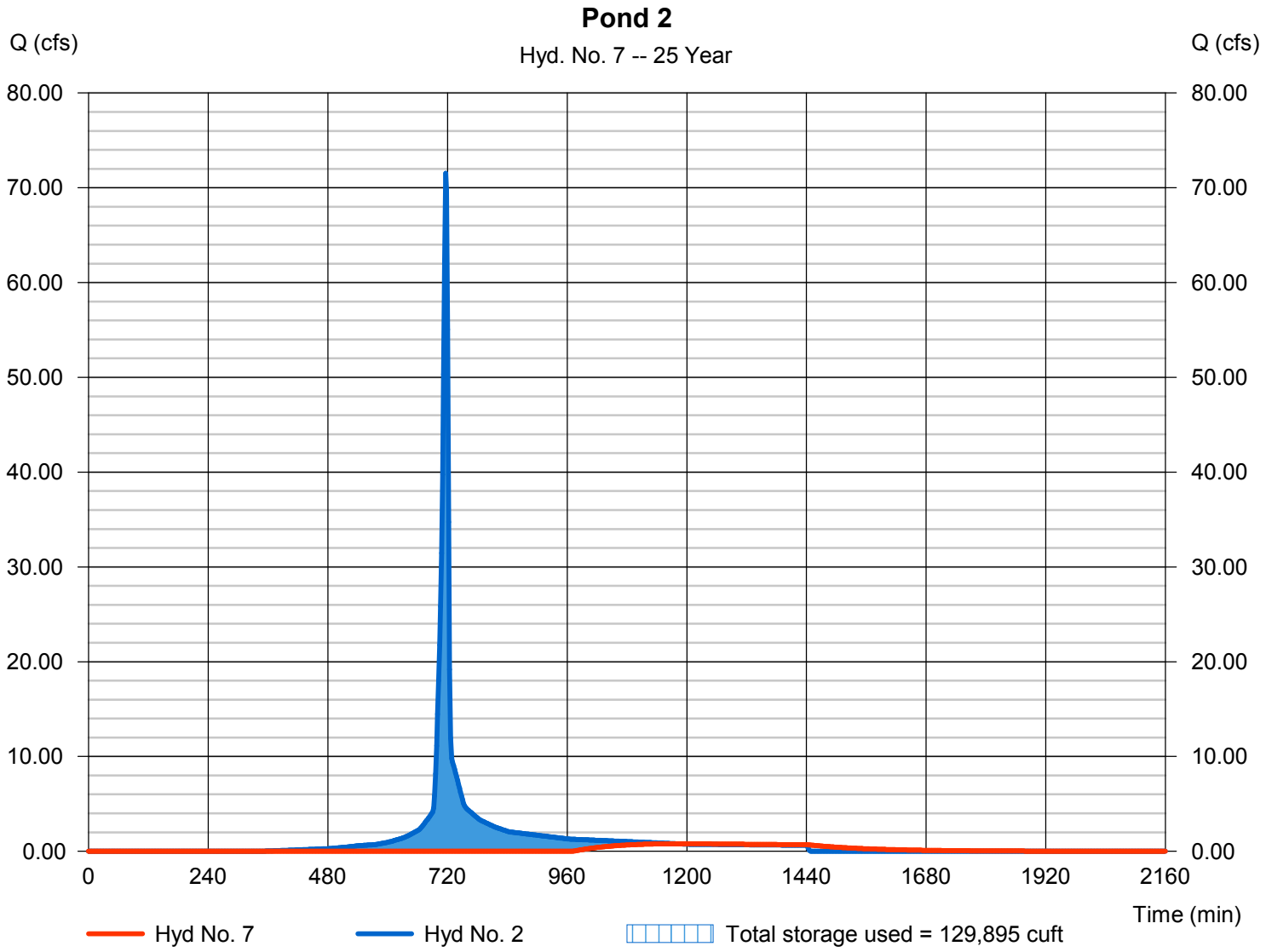
Hydrograph Report

Hyd. No. 7

Pond 2

Hydrograph type	= Reservoir	Peak discharge	= 0.790 cfs
Storm frequency	= 25 yrs	Time to peak	= 1180 min
Time interval	= 2 min	Hyd. volume	= 23,773 cuft
Inflow hyd. No.	= 2 - Sub Basin #2	Max. Elevation	= 4819.95 ft
Reservoir name	= Pond 2	Max. Storage	= 129,895 cuft

Storage Indication method used.



Pond Report

Pond No. 5 - Pond 2

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 4816.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	4816.00	22,187	0	0
2.00	4818.00	32,660	54,505	54,505
4.00	4820.00	45,004	77,327	131,832

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 4819.90	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

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

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

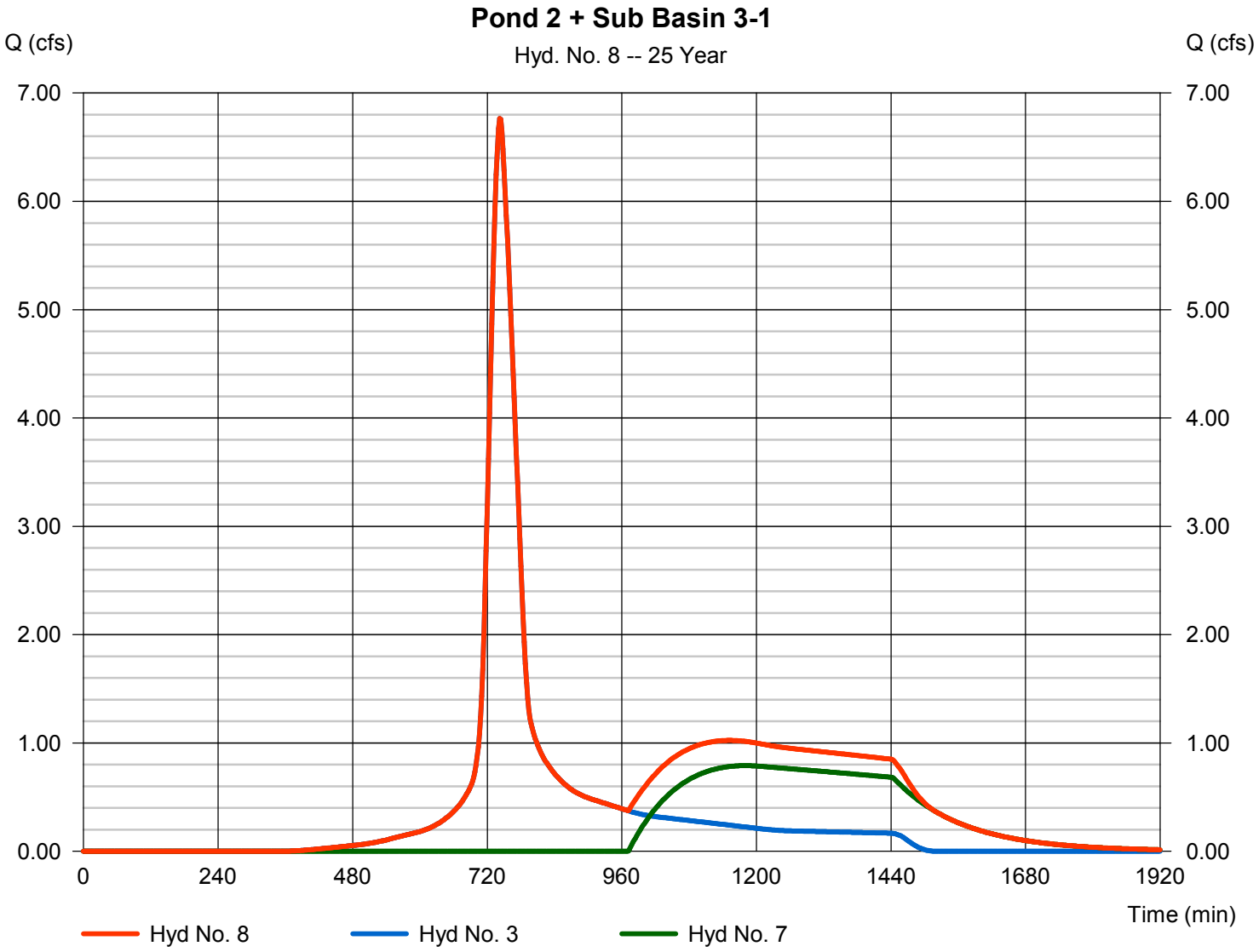
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	4816.00	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	54,505	4818.00	---	---	---	---	0.00	---	---	---	---	---	0.000
4.00	131,832	4820.00	---	---	---	---	1.05	---	---	---	---	---	1.055

Hydrograph Report

Hyd. No. 8

Pond 2 + Sub Basin 3-1

Hydrograph type	= Combine	Peak discharge	= 6.766 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 62,123 cuft
Inflow hyds.	= 3, 7	Contrib. drain. area	= 5.300 ac



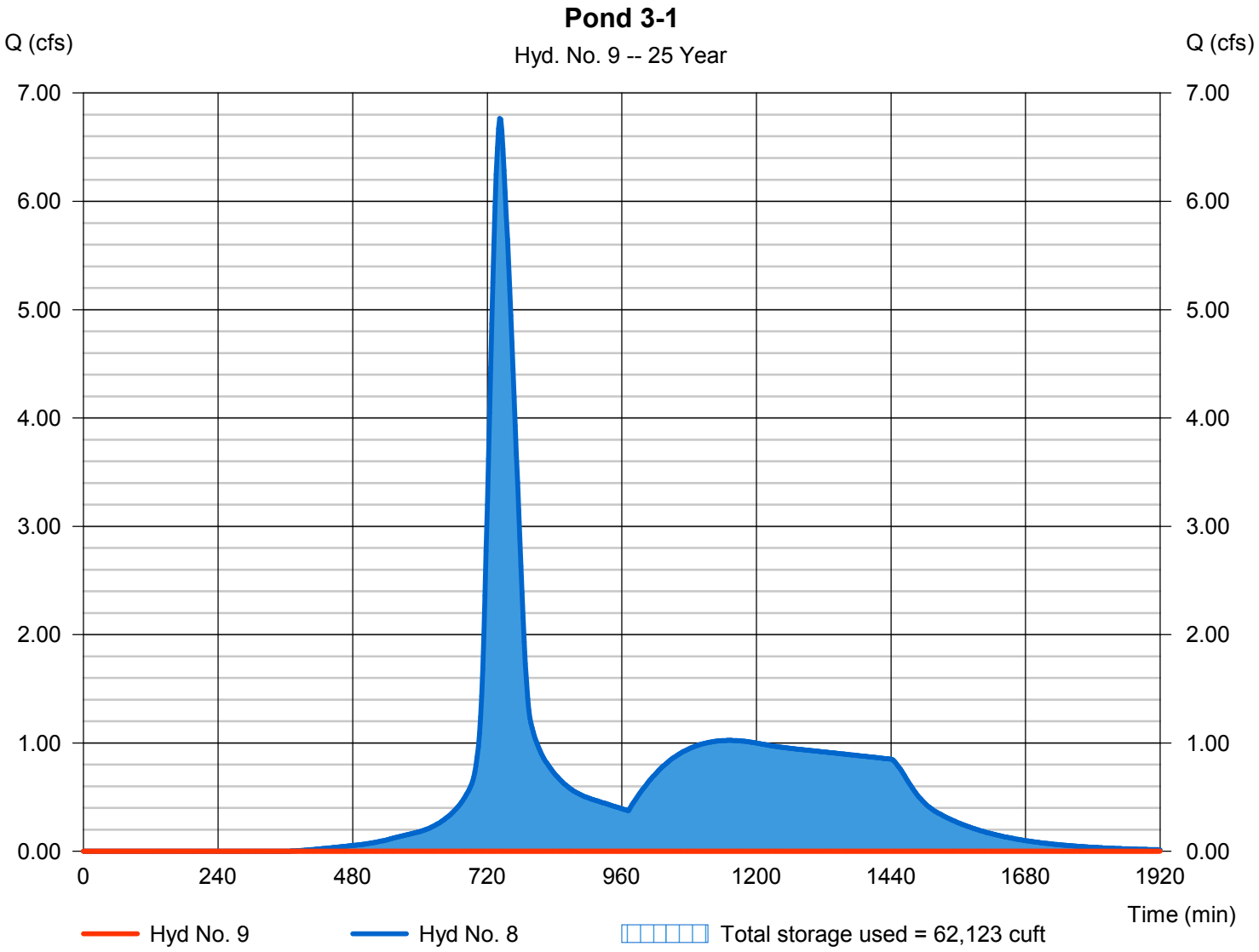
Hydrograph Report

Hyd. No. 9

Pond 3-1

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 8 - Pond 2 + Sub Basin 3-1	Max. Elevation	= 4814.15 ft
Reservoir name	= Pond 3-1	Max. Storage	= 62,123 cuft

Storage Indication method used.



Pond Report

Pond No. 4 - Pond 3-1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 4810.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	4810.00	6,500	0	0
2.00	4812.00	14,589	20,549	20,549
4.00	4814.00	23,180	37,435	57,985
6.00	4816.00	32,055	54,990	112,975

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 4815.90	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 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

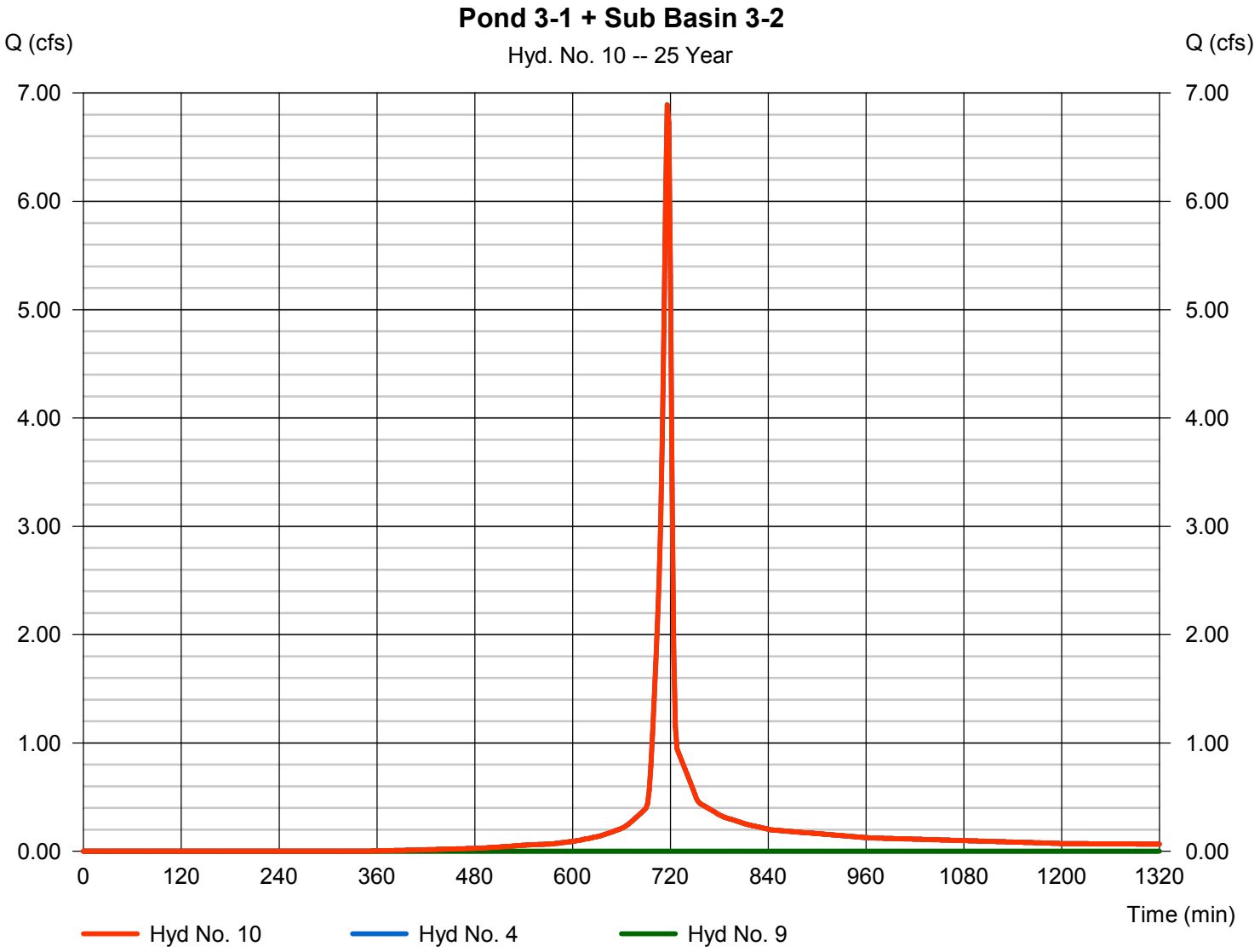
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	4810.00	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	20,549	4812.00	---	---	---	---	0.00	---	---	---	---	---	0.000
4.00	57,985	4814.00	---	---	---	---	0.00	---	---	---	---	---	0.000
6.00	112,975	4816.00	---	---	---	---	0.82	---	---	---	---	---	0.823

Hydrograph Report

Hyd. No. 10

Pond 3-1 + Sub Basin 3-2

Hydrograph type	= Combine	Peak discharge	= 6.890 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 14,245 cuft
Inflow hyds.	= 4, 9	Contrib. drain. area	= 2.100 ac



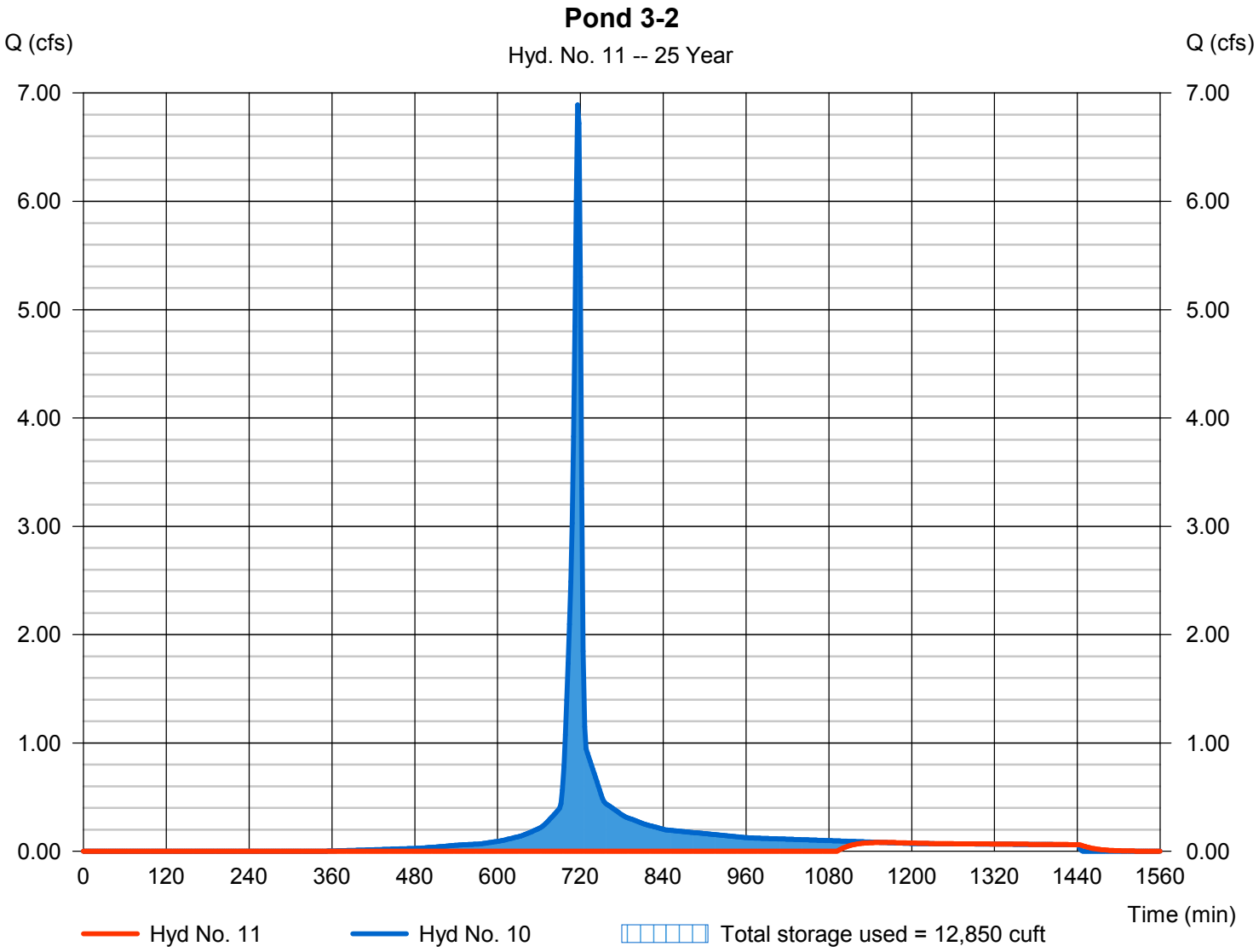
Hydrograph Report

Hyd. No. 11

Pond 3-2

Hydrograph type	= Reservoir	Peak discharge	= 0.081 cfs
Storm frequency	= 25 yrs	Time to peak	= 1158 min
Time interval	= 2 min	Hyd. volume	= 1,501 cuft
Inflow hyd. No.	= 10 - Pond 3-1 + Sub Basin 3-2	Max. Elevation	= 4807.82 ft
Reservoir name	= Pond 3-2	Max. Storage	= 12,850 cuft

Storage Indication method used.



Pond Report

Pond No. 3 - Pond 3-2

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 4804.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	4804.00	190	0	0
2.00	4806.00	3,454	2,969	2,969
4.00	4808.00	7,685	10,860	13,829

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 4807.90	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 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

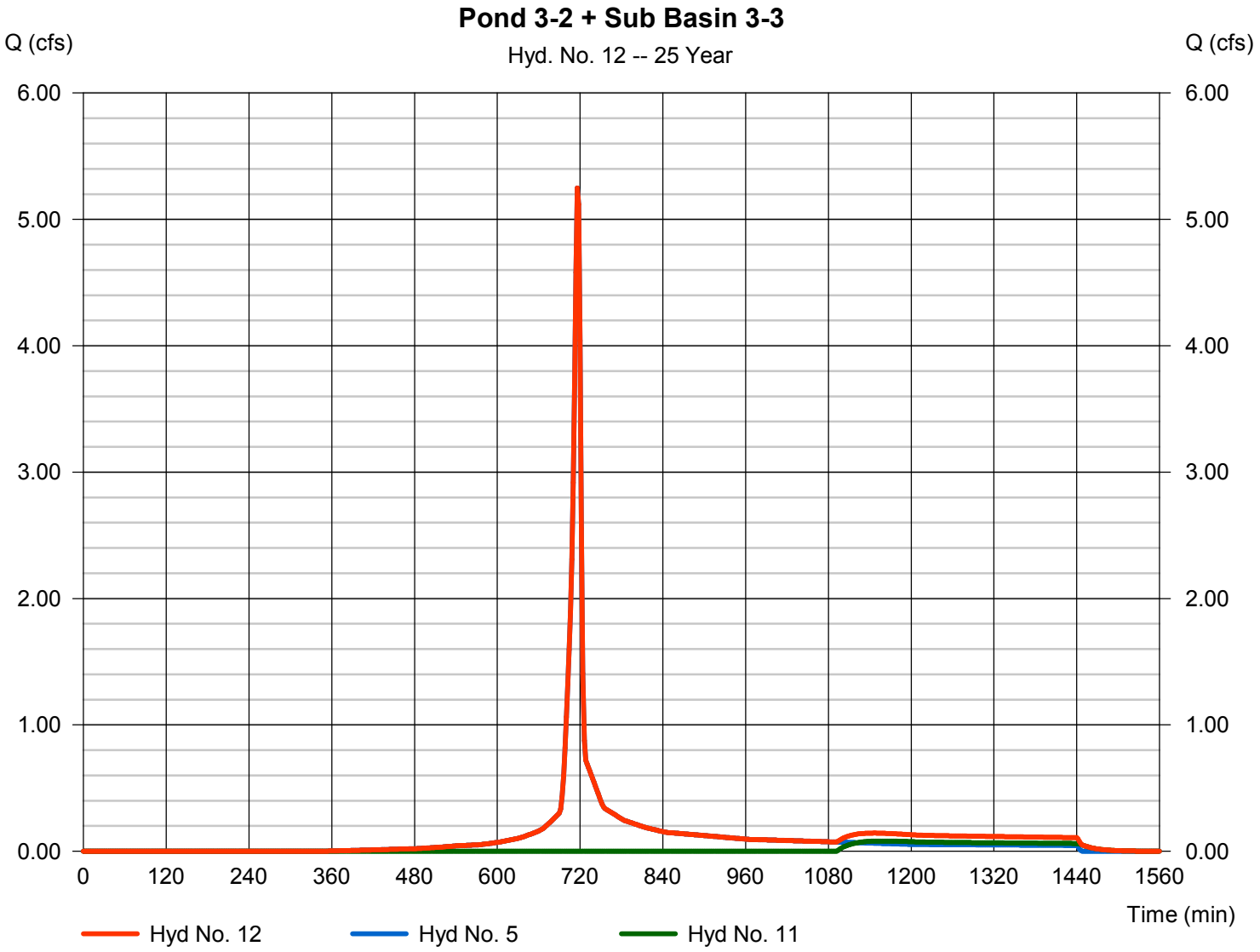
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	4804.00	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	2,969	4806.00	---	---	---	---	0.00	---	---	---	---	---	0.000
4.00	13,829	4808.00	---	---	---	---	0.82	---	---	---	---	---	0.823

Hydrograph Report

Hyd. No. 12

Pond 3-2 + Sub Basin 3-3

Hydrograph type	= Combine	Peak discharge	= 5.250 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 12,355 cuft
Inflow hyds.	= 5, 11	Contrib. drain. area	= 1.600 ac



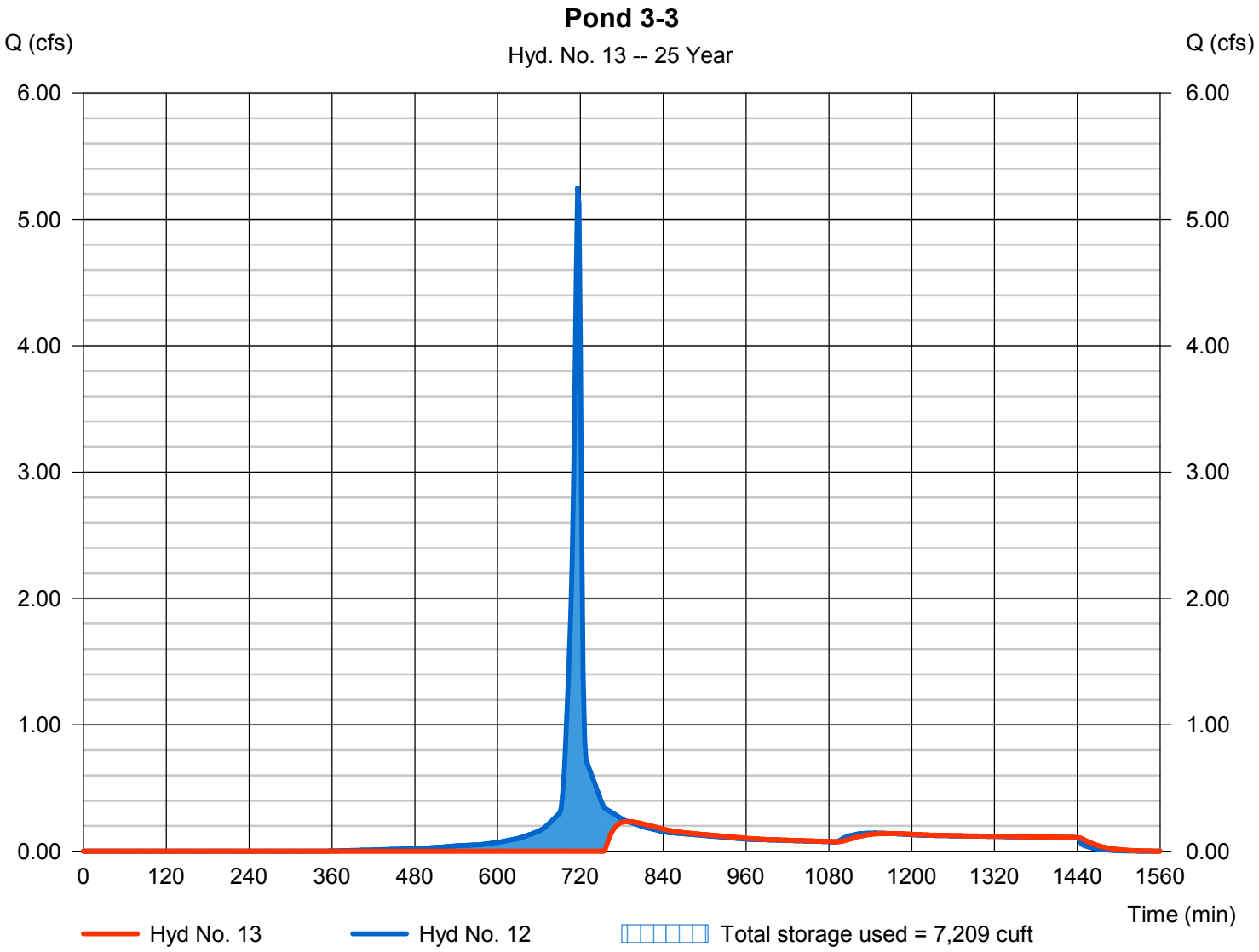
Hydrograph Report

Hyd. No. 13

Pond 3-3

Hydrograph type	= Reservoir	Peak discharge	= 0.235 cfs
Storm frequency	= 25 yrs	Time to peak	= 790 min
Time interval	= 2 min	Hyd. volume	= 5,366 cuft
Inflow hyd. No.	= 12 - Pond 3-2 + Sub Basin 3-3	Max. Elevation	= 4799.86 ft
Reservoir name	= Pond 3-3	Max. Storage	= 7,209 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - Pond 3-3

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 4798.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	4798.00	2,674	0	0
2.00	4800.00	5,233	7,764	7,764

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 4799.90	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 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

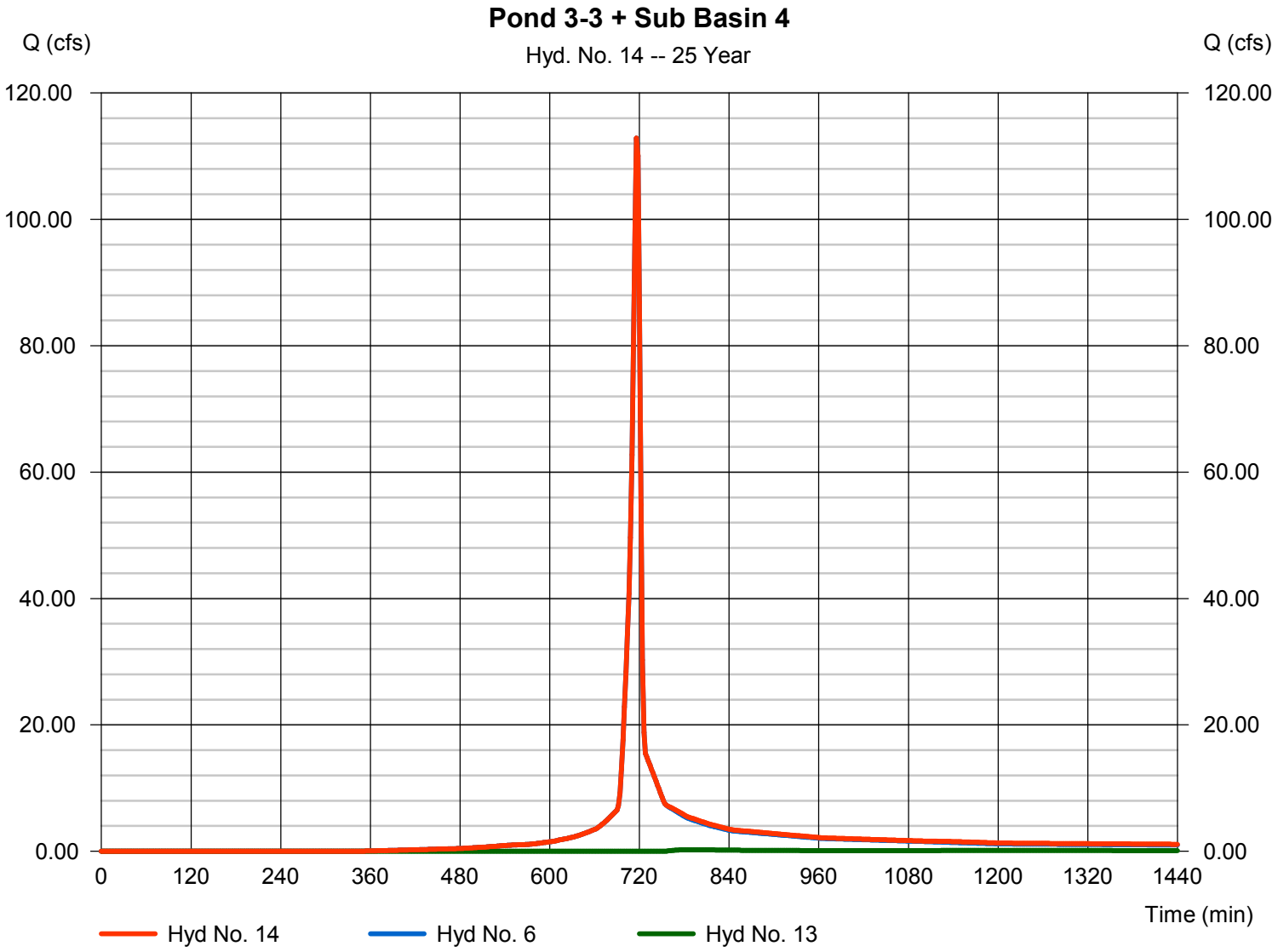
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	4798.00	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	7,764	4800.00	---	---	---	---	0.82	---	---	---	---	---	0.823

Hydrograph Report

Hyd. No. 14

Pond 3-3 + Sub Basin 4

Hydrograph type	= Combine	Peak discharge	= 112.87 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 238,718 cuft
Inflow hyds.	= 6, 13	Contrib. drain. area	= 34.400 ac



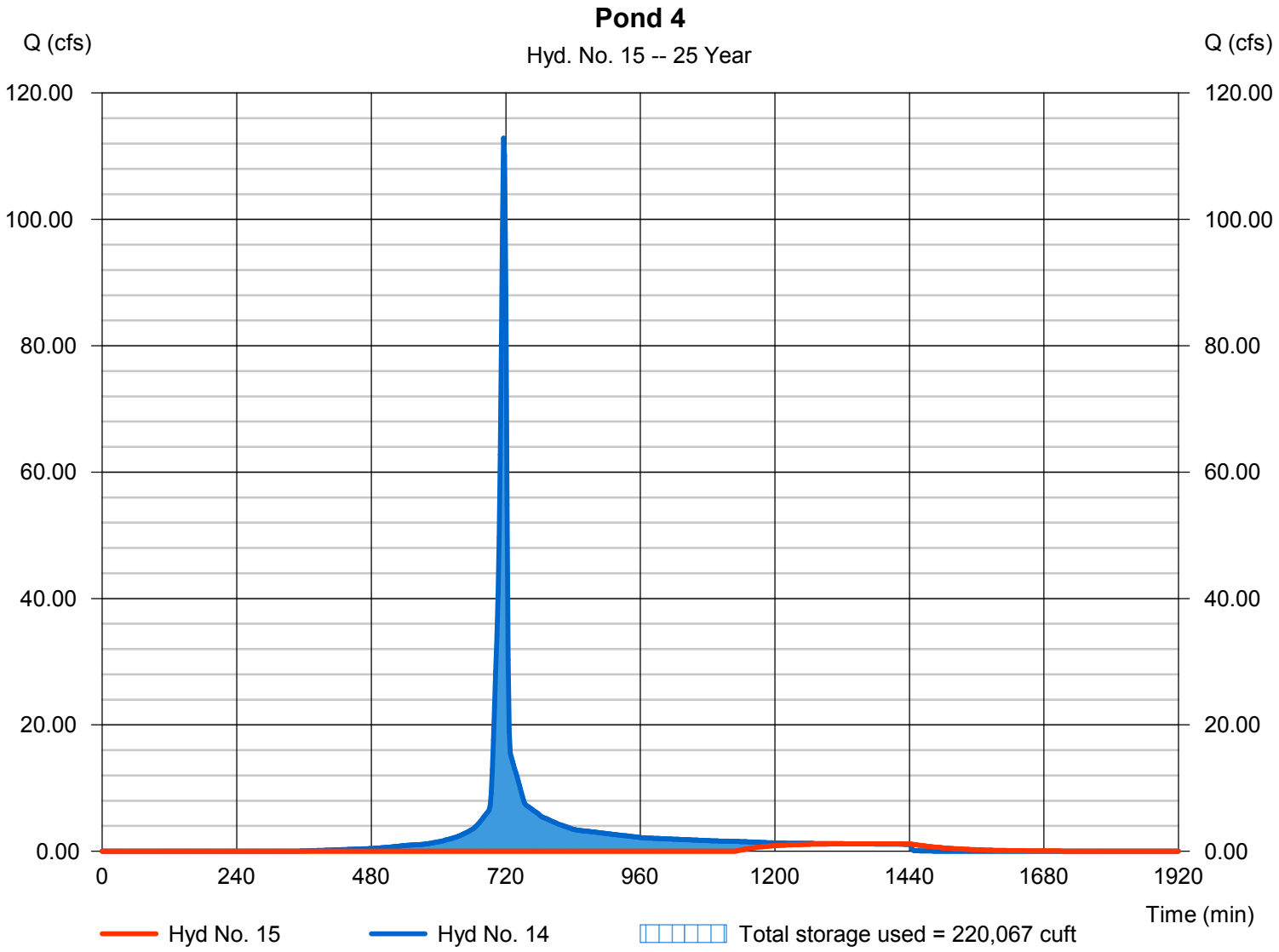
Hydrograph Report

Hyd. No. 15

Pond 4

Hydrograph type	=	Reservoir	Peak discharge	=	1.172 cfs
Storm frequency	=	25 yrs	Time to peak	=	1350 min
Time interval	=	2 min	Hyd. volume	=	24,219 cuft
Inflow hyd. No.	=	14 - Pond 3-3 + Sub Basin 4	Max. Elevation	=	4799.90 ft
Reservoir name	=	Pond 4	Max. Storage	=	220,067 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Pond 4

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 4794.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	4794.00	18,315	0	0
2.00	4796.00	31,270	49,006	49,006
4.00	4798.00	44,558	75,429	124,435
6.00	4800.00	56,316	100,635	225,070

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 4799.80	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 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

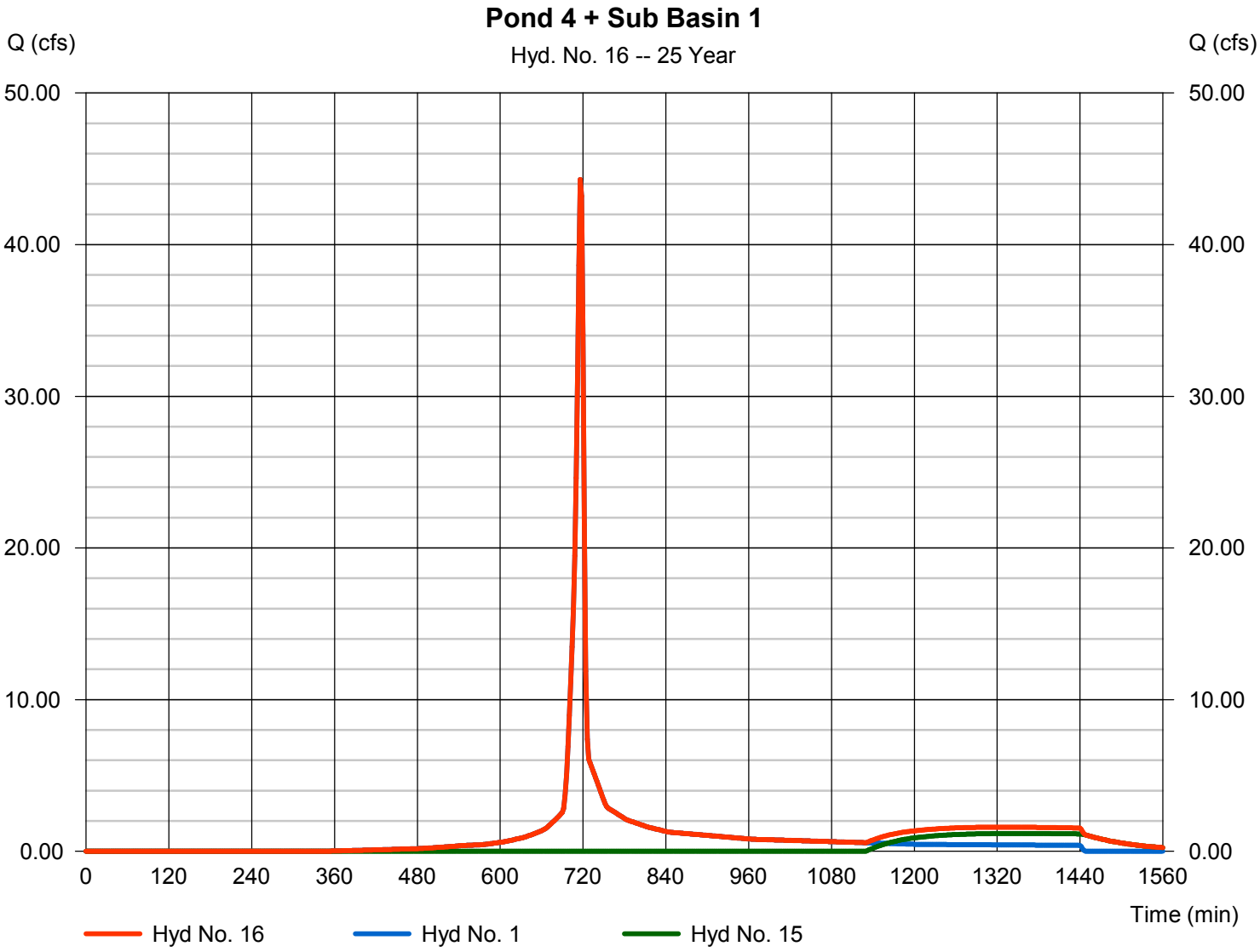
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	4794.00	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	49,006	4796.00	---	---	---	---	0.00	---	---	---	---	---	0.000
4.00	124,435	4798.00	---	---	---	---	0.00	---	---	---	---	---	0.000
6.00	225,070	4800.00	---	---	---	---	2.33	---	---	---	---	---	2.329

Hydrograph Report

Hyd. No. 16

Pond 4 + Sub Basin 1

Hydrograph type	= Combine	Peak discharge	= 44.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 115,795 cuft
Inflow hyds.	= 1, 15	Contrib. drain. area	= 13.500 ac



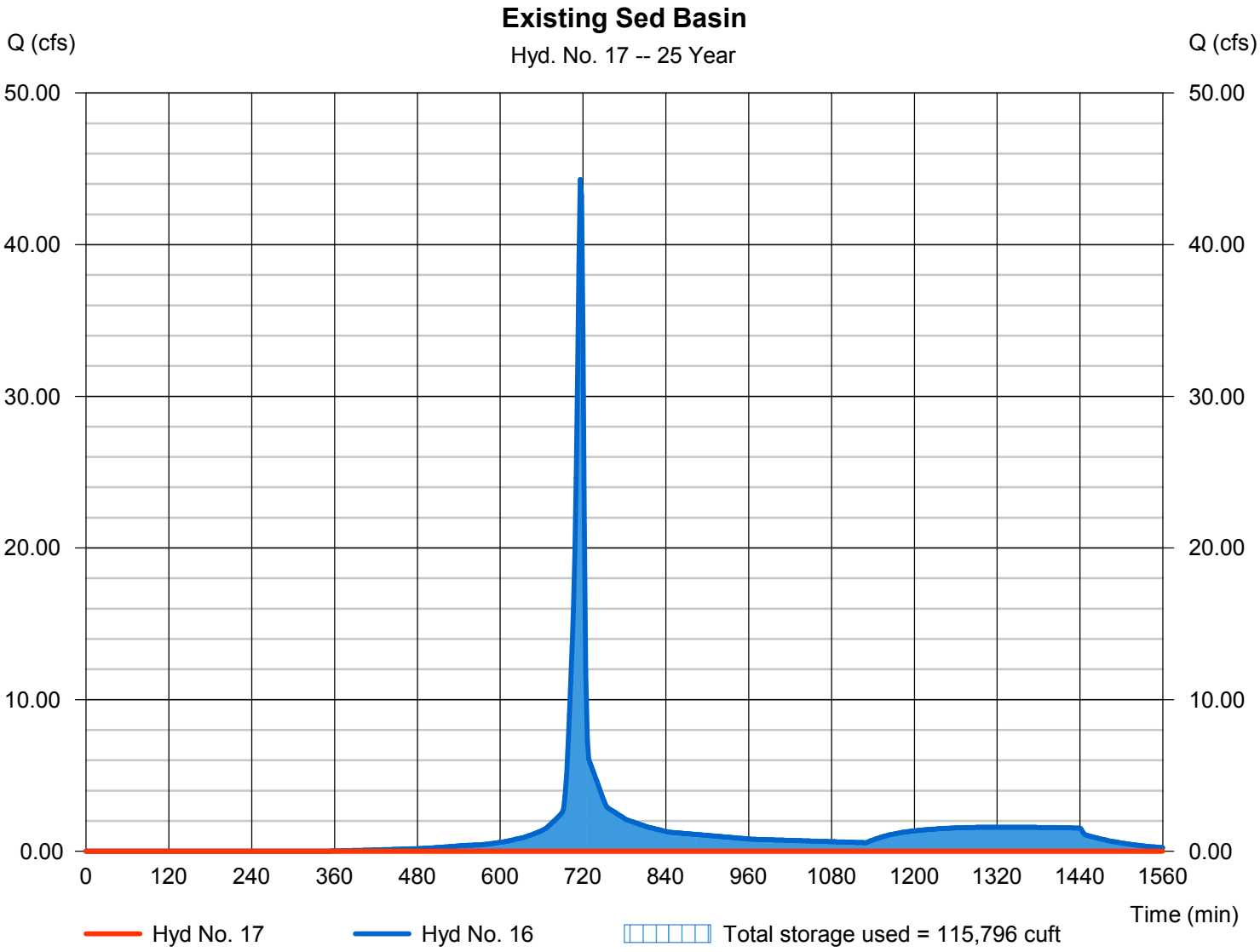
Hydrograph Report

Hyd. No. 17

Existing Sed Basin

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	25 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	16 - Pond 4 + Sub Basin 1	Max. Elevation	=	4796.65 ft
Reservoir name	=	Ex. Sed Basin	Max. Storage	=	115,796 cuft

Storage Indication method used.



Pond Report

Pond No. 6 - Ex. Sed Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 4794.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	4794.00	33,226	0	0
2.00	4796.00	48,757	81,480	81,480
4.00	4798.00	56,516	105,167	186,647

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 4797.90	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	4794.00	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	81,480	4796.00	---	---	---	---	0.00	---	---	---	---	---	0.000
4.00	186,647	4798.00	---	---	---	---	0.82	---	---	---	---	---	0.823

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
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	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.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	0.00	2.20	0.00	3.30	4.25	3.01	6.80	7.95
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	0.00	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	0.00	6.00	7.10

Hydraflow Table of Contents

Xcel.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Wednesday, 09 / 21 / 2016

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Sep 21 2016

Xcel Comanche Drainage Channels

Trapezoidal

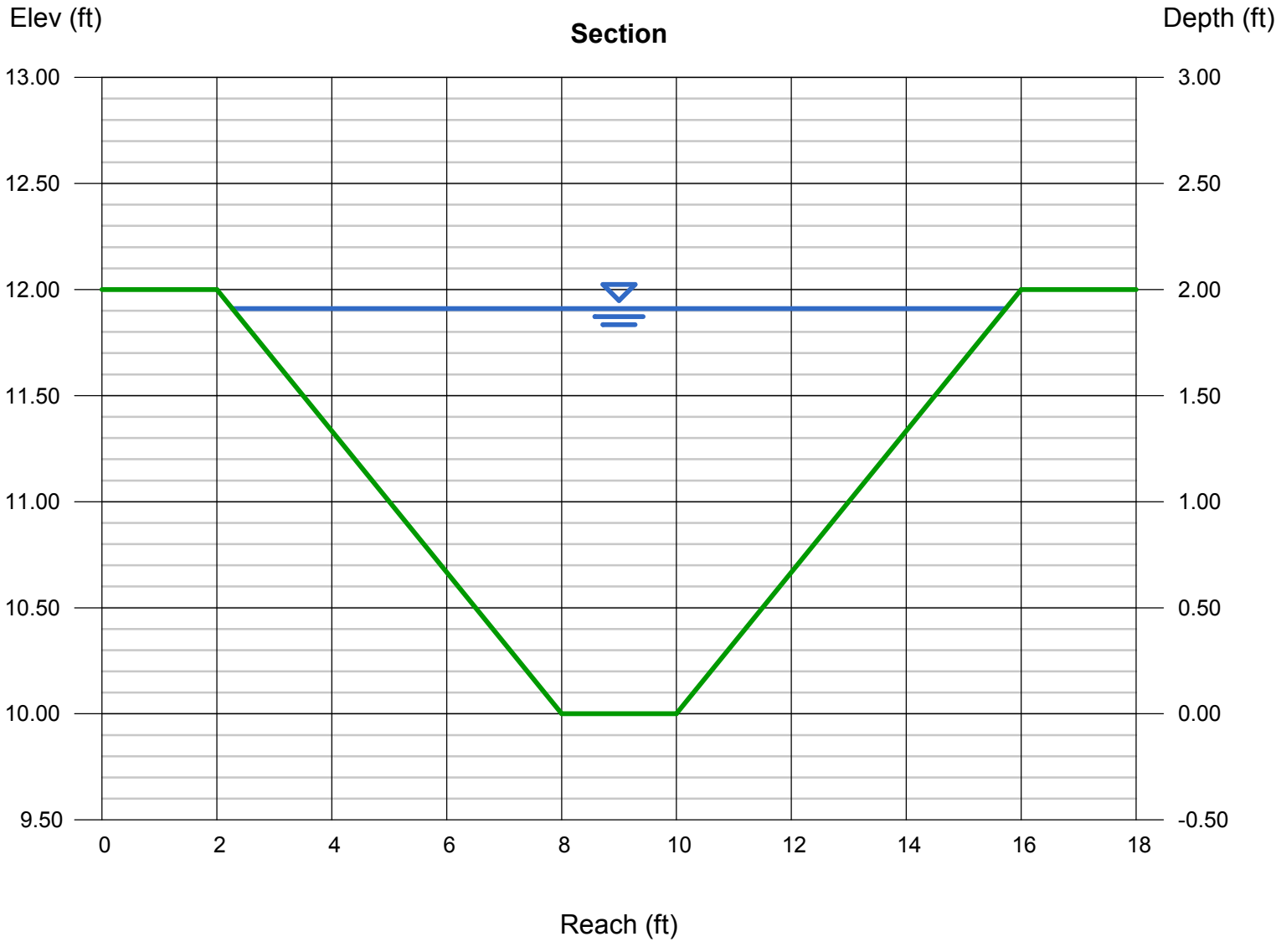
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.50
N-Value	= 0.022

Calculations

Compute by:	Known Q
Known Q (cfs)	= 72.00

Highlighted

Depth (ft)	= 1.91
Q (cfs)	= 72.00
Area (sqft)	= 14.76
Velocity (ft/s)	= 4.88
Wetted Perim (ft)	= 14.08
Crit Depth, Yc (ft)	= 1.75
Top Width (ft)	= 13.46
EGL (ft)	= 2.28



APPENDIX B - NOAA AVERAGE RAINFALL DATA

NOAA Atlas 14, Volume 8, Version 2
Location name: Pueblo, Colorado, US*
Latitude: 38.2067°, Longitude: -104.5800°
Elevation: 4811 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.220 (0.176-0.279)	0.266 (0.212-0.337)	0.350 (0.279-0.445)	0.429 (0.339-0.548)	0.551 (0.424-0.741)	0.655 (0.489-0.887)	0.767 (0.551-1.06)	0.891 (0.610-1.26)	1.07 (0.700-1.55)	1.21 (0.768-1.77)
10-min	0.322 (0.257-0.408)	0.389 (0.311-0.494)	0.513 (0.408-0.652)	0.628 (0.496-0.802)	0.806 (0.621-1.08)	0.958 (0.716-1.30)	1.12 (0.807-1.56)	1.30 (0.894-1.85)	1.56 (1.02-2.27)	1.78 (1.13-2.59)
15-min	0.392 (0.314-0.498)	0.475 (0.379-0.602)	0.625 (0.497-0.795)	0.766 (0.605-0.979)	0.983 (0.758-1.32)	1.17 (0.873-1.58)	1.37 (0.984-1.90)	1.59 (1.09-2.25)	1.91 (1.25-2.77)	2.17 (1.37-3.16)
30-min	0.616 (0.493-0.781)	0.737 (0.589-0.936)	0.961 (0.764-1.22)	1.17 (0.925-1.49)	1.49 (1.15-2.01)	1.77 (1.32-2.40)	2.07 (1.49-2.87)	2.40 (1.65-3.41)	2.88 (1.89-4.18)	3.27 (2.07-4.76)
60-min	0.784 (0.627-0.994)	0.934 (0.745-1.19)	1.21 (0.961-1.54)	1.47 (1.16-1.87)	1.87 (1.44-2.51)	2.21 (1.65-2.99)	2.58 (1.85-3.57)	2.99 (2.05-4.24)	3.58 (2.35-5.19)	4.06 (2.57-5.92)
2-hr	0.952 (0.767-1.20)	1.13 (0.909-1.42)	1.46 (1.17-1.84)	1.76 (1.41-2.23)	2.24 (1.74-2.98)	2.65 (2.00-3.55)	3.09 (2.24-4.24)	3.58 (2.47-5.03)	4.28 (2.83-6.15)	4.85 (3.10-7.01)
3-hr	1.01 (0.814-1.26)	1.19 (0.962-1.49)	1.53 (1.23-1.92)	1.85 (1.48-2.33)	2.34 (1.83-3.10)	2.76 (2.09-3.69)	3.22 (2.34-4.39)	3.72 (2.59-5.20)	4.45 (2.96-6.36)	5.04 (3.24-7.24)
6-hr	1.11 (0.903-1.37)	1.30 (1.06-1.61)	1.65 (1.34-2.05)	1.98 (1.60-2.48)	2.50 (1.97-3.28)	2.94 (2.24-3.88)	3.42 (2.51-4.62)	3.94 (2.77-5.46)	4.70 (3.16-6.66)	5.32 (3.46-7.58)
12-hr	1.25 (1.02-1.53)	1.45 (1.19-1.78)	1.82 (1.49-2.24)	2.17 (1.76-2.68)	2.71 (2.15-3.52)	3.17 (2.44-4.15)	3.67 (2.73-4.92)	4.23 (3.00-5.79)	5.02 (3.41-7.05)	5.67 (3.73-8.00)
24-hr	1.40 (1.16-1.70)	1.63 (1.35-1.98)	2.04 (1.68-2.49)	2.42 (1.99-2.97)	3.01 (2.40-3.86)	3.50 (2.72-4.54)	4.04 (3.02-5.35)	4.62 (3.31-6.27)	5.46 (3.74-7.58)	6.13 (4.07-8.57)
2-day	1.56 (1.30-1.88)	1.84 (1.53-2.21)	2.33 (1.93-2.81)	2.76 (2.28-3.35)	3.42 (2.75-4.33)	3.96 (3.10-5.07)	4.54 (3.42-5.94)	5.16 (3.72-6.92)	6.04 (4.18-8.29)	6.74 (4.52-9.34)
3-day	1.68 (1.41-2.01)	1.98 (1.66-2.38)	2.51 (2.10-3.02)	2.99 (2.48-3.60)	3.69 (2.98-4.64)	4.27 (3.35-5.43)	4.88 (3.70-6.35)	5.54 (4.02-7.39)	6.47 (4.50-8.84)	7.21 (4.87-9.94)
4-day	1.79 (1.51-2.14)	2.10 (1.77-2.51)	2.66 (2.22-3.18)	3.15 (2.62-3.79)	3.88 (3.14-4.87)	4.49 (3.54-5.68)	5.13 (3.90-6.64)	5.82 (4.24-7.72)	6.78 (4.74-9.23)	7.56 (5.13-10.4)
7-day	2.07 (1.75-2.45)	2.40 (2.03-2.85)	2.99 (2.52-3.55)	3.51 (2.94-4.19)	4.29 (3.50-5.34)	4.94 (3.92-6.20)	5.62 (4.31-7.22)	6.36 (4.67-8.37)	7.39 (5.21-9.97)	8.21 (5.62-11.2)
10-day	2.29 (1.95-2.70)	2.66 (2.26-3.14)	3.30 (2.80-3.91)	3.87 (3.26-4.59)	4.70 (3.85-5.80)	5.38 (4.29-6.71)	6.09 (4.69-7.77)	6.85 (5.05-8.96)	7.91 (5.61-10.6)	8.75 (6.03-11.9)
20-day	2.90 (2.48-3.38)	3.42 (2.93-4.00)	4.28 (3.66-5.02)	5.01 (4.25-5.89)	6.01 (4.93-7.29)	6.80 (5.45-8.34)	7.59 (5.88-9.53)	8.40 (6.24-10.8)	9.48 (6.77-12.5)	10.3 (7.17-13.8)
30-day	3.42 (2.95-3.97)	4.05 (3.49-4.71)	5.06 (4.34-5.89)	5.89 (5.02-6.88)	7.00 (5.75-8.40)	7.85 (6.31-9.54)	8.68 (6.74-10.8)	9.51 (7.09-12.1)	10.6 (7.59-13.9)	11.4 (7.97-15.2)
45-day	4.14 (3.59-4.78)	4.85 (4.19-5.60)	5.96 (5.14-6.91)	6.86 (5.88-7.98)	8.05 (6.64-9.57)	8.93 (7.21-10.8)	9.78 (7.64-12.1)	10.6 (7.95-13.4)	11.7 (8.41-15.2)	12.4 (8.75-16.5)
60-day	4.80 (4.17-5.51)	5.52 (4.80-6.35)	6.67 (5.77-7.69)	7.58 (6.53-8.78)	8.79 (7.27-10.4)	9.67 (7.84-11.6)	10.5 (8.24-12.9)	11.3 (8.52-14.3)	12.3 (8.94-16.0)	13.1 (9.25-17.3)

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

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

Please refer to NOAA Atlas 14 document for more information.

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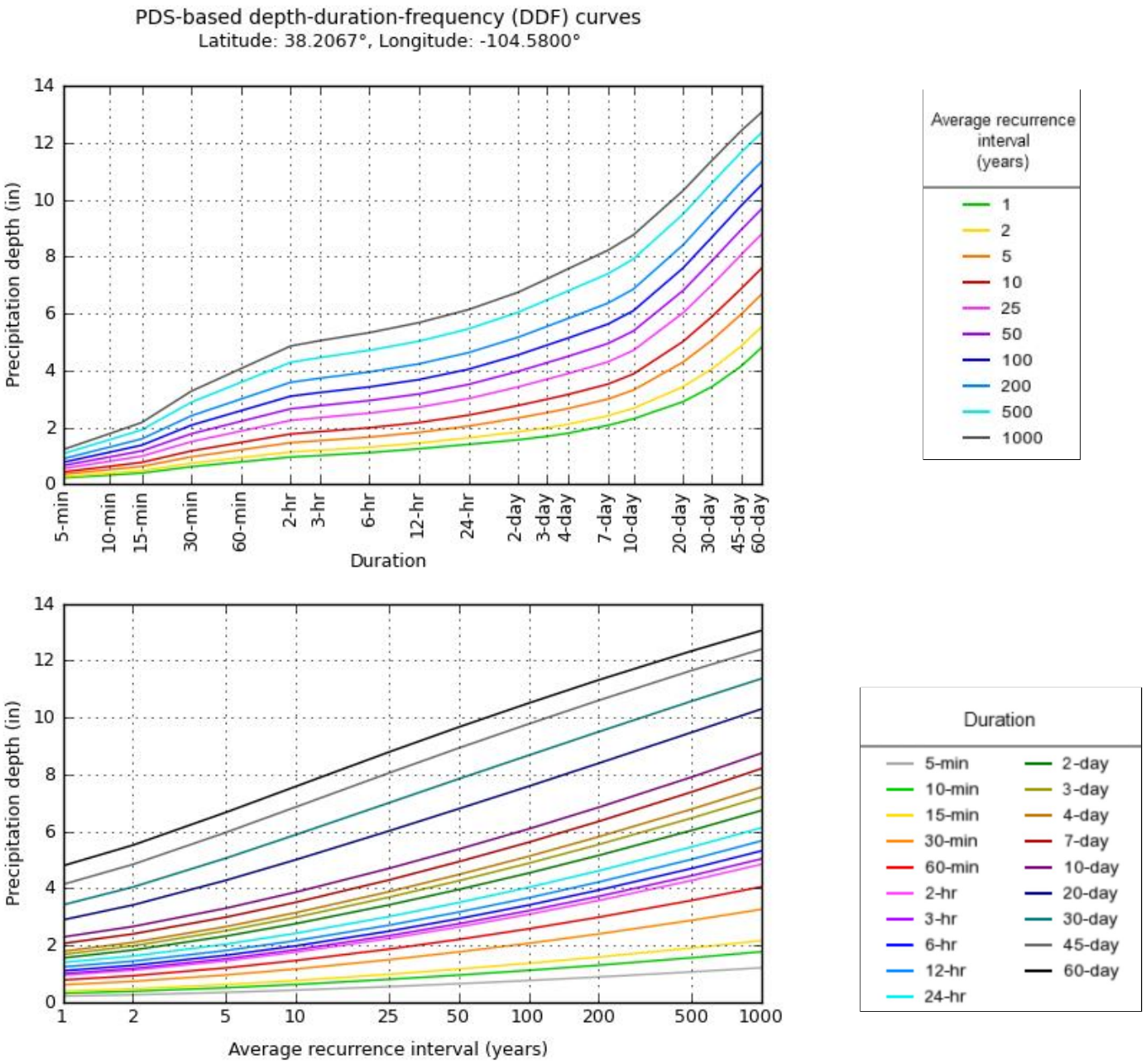
PF graphical



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Created (GMT): Tue Aug 30 14:50:19 2016

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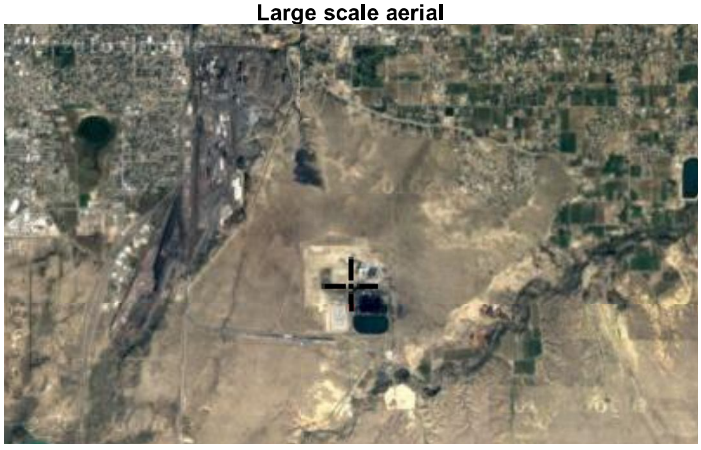
Maps & aerials

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



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

Disclaimer

APPENDIX C – DRAINAGE AREAS AND RUN-OFF CONTROLS

REFERENCE DRAWINGS		
DWG NO.	MANUFACTURER	DRAWING TITLE
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SURVEY NOTES:

1. SURVEY CONDUCTED AUGUST, 2013, BY:
   EDWARD-JAMES SURVEYING, INC.
   4732 EAGLERIDGE CIRCLE
   PUEBLO, CO 81008
   (719) 545-6240
2. PROJECT BENCHMARK: COMANCHE STATION CONTROL POINT 6, ELEVATION 4801.52' (NAVD88).

LEGEND

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING RAILROAD
- EXISTING FENCE
- EXISTING ROAD
- EXISTING STRUCTURE
- CELL BOUNDARY
- MW-1 MONITORING WELL
- PROPOSED ACCESS ROAD
- X / XX DETAIL NUMBER / SHEET NUMBER WHERE DETAIL IS LOCATED

CELL VOLUMES

CELL	VOLUME (CY)
1	1,512,800
2	3,316,500

N

0 100 200 400
SCALE: 1" = 200'

UPPER ACCESS ROAD
POND 4
POND 3-3
POND 3-2
POND 3-1
POND 2
LOWER ACCESS ROAD
PROPERTY LINE
PROPERTY LINE
PROPERTY LINE

CELL 8 PROPOSED ASH STORAGE AREA
CELL 7 PROPOSED ASH STORAGE AREA
CELL 6 PROPOSED ASH STORAGE AREA
CELL 5 PROPOSED ASH STORAGE AREA
CELL 4 PROPOSED ASH STORAGE AREA
CELL 3 PROPOSED ASH STORAGE AREA
CELL 2 PROPOSED ASH STORAGE AREA
CELL 1 PROPOSED ASH STORAGE AREA

SOIL STOCK PILE

70,218.50
Sub Basin #3-3
1.6 Acres

91,391.00
Sub Basin #3-2
2.1 Acres

1,496,885.00
Sub Basin #4
34.4 Acres

233,451.50
Sub Basin #3-1
5.3 Acres

588,099.50
Sub Basin #1
13.5 Acres

949,143.50
Sub Basin #2
21.8 Acres

North Perimeter Channel
West Perimeter Channel

MW-1

4820 4830 4840 4850 4860 4870 4880 4890 4900 4910 4920 4930

COLORADO REGISTERED DAVID JAMES BOWMAN 37684 PROFESSIONAL ENGINEER

NO	REVISION	ZONE	DATE	BY	CHK	ENG

TETRA TECH

COMANCHE – COMMON
ASH LANDFILL
DESIGN & OPERATIONS PLAN
CELL 2 OPERATION GRADES

Xcel Energy®
PUBLIC SERVICE COMPANY OF COLORADO

DWN: SEF	DATE: 8-14-14	CHK: JMS	DATE: 8-14-14	PROJ. NO: 0000000	
ENG: JMS	DATE: 8-14-14	CHK: DHB	DATE: 8-14-14	SCALE:	
PM: JRE	DATE: 8-14-14	D17803-EPDOL00002 SH.6		SHEET 6/14	REV 0
APVD:	DATE:				

MF NO 0000