

**Winsome Subdivision**

17480 Meridian Road North  
Colorado Springs, Colorado 80924

**Preliminary Drainage Report**

**MARCH 11, 2019**

**PREPARED FOR:**

PT McCune, LLC  
Joe DesJardin  
1864 Woodmoor Drive  
Suite 100  
Monument, Colorado 80132

**PREPARED BY:**

The Vertex Companies, Inc.  
2420 W. 26<sup>th</sup> Avenue, Suite 100-D  
Denver, Colorado 80211  
**PHONE:** 303-623-9116

VERTEX Project: 49388  
PCD File No. SP-18-006



Jason Priddy  
Project Engineer




Lance VanDemark, P.E.  
Project Manager



### Engineer's Certification

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.



**Lance VanDemark, P.E.**  
**Registered Professional Engineer**  
**State of Colorado No. 43911**

### Owner's Certification

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

PT McCune, LLC

**Name of Developer**

\_\_\_\_\_  
**Authorized Signature**

### El Paso County

Filed in accordance with the requirements of the Colorado Springs Drainage Criteria Manual Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

\_\_\_\_\_  
**Jennifer Irvine, P.E.**  
**County Engineer / ECM Administrator**

\_\_\_\_\_  
**Date**



## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL LOCATION AND DESCRIPTION.....</b>	<b>4</b>
	GENERAL LOCATION .....	4
	DESCRIPTION OF PROPERTY .....	5
<b>2.0</b>	<b>DRAINAGE BASINS AND SUB-BASINS .....</b>	<b>6</b>
	MAJOR BASIN DESCRIPTION .....	6
	DRAINAGE STUDIES, OUTFALL SYSTEM PLANS, & SITE CONSTRAINTS.....	6
	EXISTING SUB-BASIN DESCRIPTION .....	6
	PROPOSED SUB-BASIN DESCRIPTION .....	11
<b>3.0</b>	<b>DRAINAGE DESIGN CRITERIA .....</b>	<b>22</b>
	REGULATIONS .....	22
	HYDROLOGICAL CRITERIA .....	22
	TR-55 CURVE NUMBER SELECTION.....	23
	FLOODPLAIN STUDY .....	24
	HYDRAULIC CRITERIA .....	25
	PRUDENT LINE ANALYSIS .....	27
<b>4.0</b>	<b>DRAINAGE FACILITY DESIGN .....</b>	<b>29</b>
	GENERAL CONCEPT .....	29
	SPECIFIC DETAILS .....	30
	CONSTRUCTION PHASING.....	30
	RISK ASSESSMENT .....	31
	DRAINAGE BASIN FEE.....	32
	CONCLUSIONS.....	32
<b>5.0</b>	<b>REFERENCES.....</b>	<b>34</b>



## **ATTACHMENTS**

1. VICINITY MAP
2. HYDROLOGIC SOILS MAP
3. LOT RELEASE EXHIBIT
4. STORM MODEL INPUTS
  - 4.1 MODEL SCHEMATICS
  - 4.2 FRONTAL STORM RAIN GAGE DATA
  - 4.3 STORAGE LAG CALCULATIONS
  - 4.4 INITIAL ABSTRACTION CALCULATIONS
  - 4.5 TIME OF CONCENTRATION CALCULATIONS
  - 4.6 BASIN INPUT DETAILS
  - 4.7 REACH INPUT DETAILS
  - 4.8 DETENTION POND SUMMARY
  - 4.9 UD DETENTION CALCULATIONS
5. STORM MODEL OUTPUTS
  - 5.1 BASIN RUNOFF SUMMARY
  - 5.2 CONVEYANCE REACH SUMMARY
6. PRUDENT LINE ANALYSIS AND EXHIBIT
7. FIRM AND FEMA FLOODPLAIN EXHIBIT
  - 7.1 FLOODPLAIN EXHIBITS
  - 7.2 FLOODPLAIN PROFILES
  - 7.3 FLOODPLAIN CROSS SECTION
  - 7.4 FIRM MAP
8. DAM FAILURE RISK ASSESSMENT
  - 8.1. FLOODPLAIN EXHIBIT
  - 8.2. FLOODPLAIN SECTIONS
  - 8.3. LETTER FROM COLORADO STATE DAM AUTHORITY
9. SITE PHOTOGRAPHS
10. DRAINAGE PLANS



**Preliminary Drainage Report  
Winsome Subdivision**

Page 3



## **1.0 GENERAL LOCATION AND DESCRIPTION**

The following report provides detailed drainage information for existing and proposed conditions for the Winsome Subdivision project. The intent of this report is to show the routing of minor and major storms through the proposed site in accordance with El Paso County Standards. For this site, a minor flow is defined as the 5-year frequency storm and a major flow as the 100-year frequency storm. The information given in this report is intended to provide an adequately detailed analysis of on-site drainage areas and receiving facilities. This development will consist of large-lot single family residential lots, access roads, and the required infrastructure to serve them.

### **GENERAL LOCATION**

The site is located at 17480 Meridian Road North or, more generally, at the northwest corner of Hodgen Road and Meridian Road North in unincorporated El Paso County, latitude 39°04'38" N and longitude 104°36'47" W. The subject property is undeveloped and situated in Sections 13 and 24, Township 11 South, Range 65 West of the 6th P.M., County of El Paso, State of Colorado.

The site is bounded to the south by Hodgen Road, to the east by Meridian Road North, and to the north and west by several parcels zoned primarily as Agricultural and Residential use with some Forest Land. On the east side of Median Road is Forest Green Subdivision, a low-density single-family development. On the south side of Hodgen Road is Bison Meadows Subdivision which is also a low-density single family residential subdivision. The remainder of properties surrounding the site have not yet been formally platted. The site has not been included in any previous drainage study. West Kiowa Creek flows approximately through the center of the property from the southwest corner to the northeast corner, upstream to the west and southwest of the property lie 3 Kiowa Creek Watershed Reservoirs notated as 1-N-10, 1-P-10, and 1-P-20. There are no irrigation ditches on the property.



## DESCRIPTION OF PROPERTY

The existing site contains 767 acres of agricultural grazing land and dry farm land. Ground cover consists mainly of native grasses, shrubs, and several stands of evergreen trees along its northern and southern boundary. Existing wetlands are present along West Kiowa Creek and its tributaries, wetland boundaries are located roughly 50 feet to either side of the thalweg of West Kiowa Creek and the drainageway way to the south of the creek on the property. There are no existing irrigation canals or ditches on the project site nor are there any major geologic features. The property generally slopes in a northeasterly direction with slopes ranging between 1-16%. Soils consist of Alamosa loam, Brussett loam, Cruckton sandy loam, Elbeth sandy loam, Holderness loam, Kettle gravelly loamy sands, Peyton sandy loam, Peyton-Pring complex, Pring course sandy loam, Tomah-Crowford loamy sands and Tomah-Crowfoot complex. Most of the site has soils classified in Hydrologic Soil Group B; however, the property also contains a small mixture of soils from Hydrologic Soils Groups C and D located in the areas in and adjacent to West Kiowa Creek and its tributaries. A soils map prepared by Natural Resources Conservation Service is included in the Appendix.

The development of this property will consist of 143 2.5 to 10-acre single family residential lots and the requisite public roads and stormwater infrastructure to serve them. The project will have a phased development plan. Anticipated construction activities include earthwork and paving associated with the public road development, as well as the installation of culverts and stormwater detention ponds to convey and treat stormwater on the site. As previously discussed, West Kiowa Creek bisects the property, flowing from southwest to northeast. In addition, a major tributary of West Kiowa Creek flows north from a point halfway along the southern property boundary and intersects West Kiowa Creek in the middle of the property. The primary access for the site will be from 3 points along Hodgen Road and 1 entry point along Meridian Road.



## **2.0 DRAINAGE BASINS AND SUB-BASINS**

### **MAJOR BASIN DESCRIPTION**

The site resides within the West Kiowa Creek Drainage Basin (KIKI0200) which is located near the northern boundary of El Paso County, approximately 14.5 miles east of downtown Monument, CO. This watershed begins approximately 5 miles southwest of the Winsome property and continues another 10 miles to the northeast where it outfalls into Kiowa Creek which eventually discharges into the South Platte River near Fort Morgan, CO.

### **DRAINAGE STUDIES, OUTFALL SYSTEM PLANS, & SITE CONSTRAINTS**

There are no major drainage studies (DBPS or MDDP) for this area on record and no base flood elevations for this reach of West Kiowa Creek that have been established. In conjunction with the development of this site, a floodplain study has been performed on the section of West Kiowa Creek located within the property. A Conditional Letter of Map Revision (CLOMR) has been submitted to FEMA to establish the floodplain boundary on-site. A plan showing the new proposed 100-year floodplain line is included in the appendix along with supporting documentation. The site is shown on FEMA flood map 08041C0350G with an effective date of 12/7/2018 which indicates that the site is in Zone X – an area outside of the 0.2% annual chance of flood (see the accompanying exhibits in the Appendix). The areas immediately adjacent to West Kiowa Creek are designated as Zone A, which is a 100-year Flood Hazard Area in which no base flood elevations have been determined. There are no known irrigation facilities located on the property at the current time.

### **EXISTING SUB-BASIN DESCRIPTION**

Historically, the runoff from the property flows into West Kiowa Creek, which bisects the site flowing from the southwest corner of the property to the northeast corner. There are 10 on-site sub-basins and 6 off-site sub-basin that contribute flows to West Kiowa Creek. The 10 on-site



sub-basins correspond to the largest defined natural drainage channels that occur on site, while the 6 off-site basins are defined by the entire West Kiowa Creek watershed that is upstream from the subject property.

As previously discussed, the site is currently undeveloped, containing mainly native grasses and shrubs, with limited forested areas along the northern and southern boundary of the site. The existing topography of the site slopes generally in a northerly direction with grades varying from 1-16%. There are no existing irrigation canals or ditches on the project site nor are there any major geologic features. The existing site can be described as 12 sub-basins as follows:

Sub-Basin A is the 915.4-acre watershed of the western tributary to West Kiowa Creek. This sub-basin contains the West Kiowa Creek 1-N-10 Reservoir which is located about a quarter-mile upstream of the property to the west. The sub-basin generates peak runoff of 56.4cfs in the 5-year event and peak runoff of 345.6cfs in the 100-year event. Stormwater generated within the basin flows east from Southwood Drive to the subject property and discharges into West Kiowa Creek immediately to the east of the western property boundary.

Consisting of the entire West Kiowa Creek watershed that is south of Hodgen Road, Sub-Basin Ba encompasses 3836.7 acres and generates peak runoff of 180.9cfs in the 5-year event and peak runoff of 893.3cfs in the 100-year event. This sub-basin contains 2 Kiowa Creek Watershed Reservoirs noted as 1-P-10 and 1-P-20 located upstream of the property to the southwest. The largest of these reservoirs is evaluated later in the report for risk hazard. Sub-Basin Ba begins approximately 5 miles to the southwest of the Winsome property near Black Forest, CO. Stormwater generated within the basin flows from southwest to northeast passing under a bridge on Hogden Road into sub-basin Bb.

Stormwater generated within the 100.6-acre sub-basin Bb has a peak runoff of 9.9cfs in the 5-year event and peak runoff of 66.5cfs in the 100-year event. Sub-Basin Bb is located at the



southwest corner of the property and consists of the land immediately tributary to West Kiowa Creek on the north side of Hodgen Road. Flows from this sub-basin travel to the northeast discharging into the Creek.

Sub-Basin Ca consists of an off-site area located near the southwest corner of the property. This sub-basin has an area of 162.7-acres and generates peak runoff of 14.4cfs in the 5-year event and peak runoff of 81.5cfs in the 100-year event. This sub-basin discharges into a 30" CMP culvert under Hodgen Road flowing into sub-basin Cb.

Sub-Basin Cb located in the southwest corner of the property. This sub-basin has an area of 70-acres and generates peak runoff of 6.0cfs in the 5-year event and peak runoff of 53.8cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that discharges into sub-basin H.

Sub-Basin Da is the 161.3-acre watershed of the southern tributary to West Kiowa Creek. The sub-basin generates peak runoff of 14.7cfs in the 5-year event and peak runoff of 83.7cfs in the 100-year event. Stormwater generated within the basin flows north from Pole Pine Point to the subject property and discharges into a 72" CMP culvert under Hodgen Road into sub-basin Dc.

Sub-Basin Db is the 49.9-acre watershed of the southern tributary to West Kiowa Creek. The sub-basin generates peak runoff of 4.0cfs in the 5-year event and peak runoff of 21.9cfs in the 100-year event. Stormwater generated within the basin flows north from Pole Pine Point to the subject property and discharges into a 30" CMP culvert under Hodgen Road into sub-basin Dc.

Sub-Basin Dc is the 249.7-acre watershed of the southern tributary to West Kiowa Creek. This sub-basin contains a significant fraction of the southern half of the Winsome property. The sub-basin generates peak runoff of 18.1cfs in the 5-year event and peak runoff of 177.1cfs in the 100-



year event. Stormwater generated within the basin flows north discharges into West Kiowa Creek immediately near the center of the project site.

Sub-Basin Ea consists of an off-site area located near the southeast corner of the property. This sub-basin has an area of 37.9-acres and generates peak runoff of 3.9cfs in the 5-year event and peak runoff of 22.7cfs in the 100-year event. This sub-basin discharges into a 30" RCP culvert under Hodgen Road flowing into sub-basin Eb.

Sub-Basin Eb located in the southeast corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek at the eastern property line. This sub-basin has an area of 74.6-acres and generates peak runoff of 2.2cfs in the 5-year event and peak runoff of 41.9cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Sub-Basin F located in the southeast corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek to the east of the property. This sub-basin has an area of 44.5-acres and generates peak runoff of 3.8cfs in the 5-year event and peak runoff of 33.1cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Sub-Basin G located on the western side of the property and consists of an on-site watershed of a minor natural drainage channel that flows from west to east and discharges into West Kiowa Creek near the west of the property. This sub-basin has an area of 107.6 acres and generates peak runoff of 28.9cfs in the 5-year event and peak runoff of 132.4cfs in the 100-year event.

Sub-Basin H located in the northern side corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek on the north side of the property. This sub-basin has an area of 121.8 acres and generates peak runoff of 21.6cfs in the 5-year event and



peak runoff of 126.4cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of West Kiowa Creek on the western side of the site.

Sub-Basin I located in the northeast corner of the property and consists of an on-site watershed that discharges into West Kiowa Creek to the east of the property. This sub-basin has an area of 37.5-acres and generates peak runoff of 17.6cfs in the 5-year event and peak runoff of 62.0cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of West Kiowa Creek on the eastern side of the site.

Sub-Basin J located in the northeast corner of the property and consists of an on-site watershed that discharges to the north of the property in existing natural drainage channels. This sub-basin has an area of 10.1-acres and generates peak runoff of 2.5cfs in the 5-year event and peak runoff of 14.2cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Sub-Basin K located in the northeast corner of the property and consists of an on-site watershed that discharges to the north of the property in existing natural drainage channels. This sub-basin has an area of 17.8-acres and generates peak runoff of 9.1cfs in the 5-year event and peak runoff of 32.9cfs in the 100-year event. This sub-basin consists of the land tributary to a minor drainage channel that is north of Hodgen Road on the eastern side of the site.

Flow rate numbers were generated using NRCS Curve Number Methodology with HEC-HMS modeling software. Colorado Springs Stormwater Manual criteria was used for identifying curve numbers of the type B, C, and D NRCS Hydrologic Soil Groups as they applied to the various sub-basins. A summary of the results of calculations for the existing conditions can be found in the Appendix.



## **PROPOSED SUB-BASIN DESCRIPTION**

In the proposed condition, stormwater runoff will generally flow from southwest to northeast as it does in the existing condition. The main difference between the existing and proposed conditions is the flow paths of West Kiowa Creek and the various tributary drainageways will intersect the proposed public roads that access the residential lots. All existing drainage patterns will be maintained throughout the site to the extent possible. To calculate the design flows for each of the proposed culverts that will convey runoff across the proposed roads, the existing basins were subdivided to create design points at each of the proposed crossing locations. As a result, there are 35 on-site sub-basins and 8 off-site sub-basins in the proposed condition.

In accordance with the above-mentioned drainage patterns, the proposed project will be divided into 43 sub-basins that are described as follows:

Sub-Basin A1 is an off-site sub-basin to the west of the property that consists mostly of agricultural land and has an area of 865.9 acres. Sub-Basin A1 also contains West Kiowa Creek 10-N-1 Reservoir. The curve number for Sub-Basin A1 is 60.36. The basin will generate runoff of 54.9cfs and 291.5cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed by a natural drainage channel through Sub-Basin A3 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin A2 is a small off-site sub-basin to the west of the property consisting of mostly of native grasslands and has an area of 37.0 acres. The curve number for Sub-Basin A2 is 66.00. The basin will generate runoff of 3.1cfs and 26.7cfs in the minor and major storms, respectively. Flows from this sub-basin will also be conveyed by a natural drainage channel through Sub-Basin A3 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin A3 consists of 3 large residential lots to the west of Alamar Way on the western boundary of the site and has an area of 41.5 acres. The curve number for Sub-Basin A3 is 76.50.



The basin will generate runoff of 15.0cfs and 58.6cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed by natural drainageways and along the side of Alamar Way from the northwest to the southeast end of the basin into Sub-basin G2.

Sub-Basin B1 consists of the West Kiowa Creek watershed to the south of Hodgen Road. This sub-basin has an area of 3836.70 acres. The curve number for Sub-Basin B1 is 60.34. The basin will generate runoff of 190.0cfs and 948.8cfs in the minor and major storms, respectively. Flows from this sub-basin will pass under Hodgen Road and then conveyed by a natural drainage channel through Sub-Basin B3 via West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin B2 consists of 4 large residential lots at the southwest corner of the project. This sub-basin has an area of 13.10 acres. The curve number for Sub-Basin B2 is 64.00. The basin will generate runoff of 2.5cfs and 14.2cfs in the minor and major storms, respectively. Flows from this basin will travel across the lots from south to north where they will be intercepted by a culvert in Clove Hitch Ct. From the culvert flows will be conveyed by a natural drainage channel through Sub-Basin B4 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin B3 is an off-site sub-basin to the west of the site near the southwest corner of the property. This sub-basin has an area of 54.90 acres. The curve number for Sub-Basin B3 is 65.10. The basin will generate runoff of 4.0cfs and 30.4cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed by a natural drainage channel through Sub-Basin B4 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin B4 consists of 6 large residential lots and West Kiowa Creek at the southwest corner of the property. This sub-basin has an area of 41.48 acres. The curve number for Sub-Basin B4 is 47.99. The basin will generate runoff of 5.6cfs and 33.2cfs in the minor and major storms, respectively. Flows from this basin will flow north to northeast and will be conveyed by a natural



drainage channel through Sub-Basin B4 to West Kiowa Creek, which will convey flows off the site to the northeast.

Sub-Basin C1 is an off-site sub-basin to the south of Hodgen Road. This sub-basin has an area of 162.70 acres. The curve number for Sub-Basin C1 is 60.00. The basin will generate runoff of 14.3cfs and 81.3cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed north by a natural drainage channel to Hodgen Road or through an existing 30" CMP culvert that will convey flows under Hodgen Road into Sub-Basin C2.

Sub-Basin C2 consists of 7 large residential lots along the southern boundary of the property. This sub-basin has an area of 22.40 acres. The curve number for Sub-Basin C2 is 64.00. The basin will generate runoff of 2.2cfs and 13.1cfs in the minor and major storms, respectively. Stormwater from this basin will flow north across the lots to a culvert under Mosey Trail. The culvert flows will be conveyed across Sub-Basin C3 and ultimately will discharge into West Kiowa Creek.

Sub-Basin C3 consists of 5 large residential lots in southern half of the property, just south of Winding Way Circle. This sub-basin has an area of 16.10 acres. The curve number for Sub-Basin C3 is 64.00. The basin will generate runoff of 2.6cfs and 14.4cfs in the minor and major storms, respectively. Runoff from this basin will flow to the northwest across the lots to a culvert under Winsome Way. From the culvert runoff will convey across Sub-Basin B4 and will be discharged into West Kiowa Creek.

Sub-Basin C4 consists of only two residential lots and a portion of West Kiowa Creek north of the southern loop of Alamar Way. This sub-basin has an area of 23.80 acres. The curve number for Sub-Basin C4 is 65.00. The basin will generate runoff of 1.1cfs and 12.8cfs in the minor and major storms, respectively. Stormwater from this sub-basin will flow north across the residential lots to West Kiowa Creek.



Sub-Basin D1.1 is an off-site sub-basin to the south of Hodgen Road consisting of agricultural land and large residential lots. This sub-basin has an area of 161.30 acres. The curve number for Sub-Basin D1 is 60.00. The basin will generate runoff of 14.7cfs and 83.7cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed north by a natural drainage channel to an existing 72" CMP culvert that will convey flows under Hodgen Road into Sub-Basin D2.

Sub-Basin D1.2 is an off-site sub-basin to the south of Hodgen Road consisting of agricultural land and large residential lots. This sub-basin has an area of 49.90 acres. The curve number for Sub-Basin D1 is 60.00. The basin will generate runoff of 4.0cfs and 21.9cfs in the minor and major storms, respectively. Flows from this sub-basin will be conveyed north by a natural drainage channel to a 30" CMP culvert that will convey flows under Hodgen Road into Sub-Basin D3.

Sub-Basin D2 consists of 17 large residential lots and the southern tributary to West Kiowa Creek. This sub-basin has an area of 68.70 acres. The curve number for Sub-Basin D2 is 65.50. The basin will generate runoff of 8.4cfs and 54.7cfs in the minor and major storms, respectively. A culvert will convey flows across Alamar Way into Sub-Basin D5.

Sub-Basin D3 consists of 12 large residential lots at the southeast corner of the property. This sub-basin has an area of 41.20 acres. The curve number for Sub-Basin D3 is 64.00. The basin will generate runoff of 5.4cfs and 27.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin will flow west across the residential lots to a natural channel that will convey flows to the north to a culvert under Asteria Lane. From the culvert runoff will continue to flow north through Sub-Basin D4 in a natural drainageway.

Sub-Basin D4 consists of 12 large residential lots to the south of the southern loop of Alamar Way. This sub-basin has an area of 34.30 acres. The curve number for Sub-Basin D4 is 64.00. The basin will generate runoff of 5.7cfs and 30.7cfs in the minor and major storms, respectively.



Stormwater from this sub-basin will flow across the residential lots to a natural drainage channel that will convey flows north to a culvert under Alamar Way. From the culvert, runoff will continue north through Sub-Basin D6 to stormwater detention pond 3 and then discharge to a natural drainage channel flowing to West Kiowa Creek.

Sub-Basin D5 consists of a portion of the southern tributary to West Kiowa Creek immediately to the north of the southern loop of Alamar Way. This sub-basin has an area of 12.80 acres. The curve number for Sub-Basin D5 is 67.20. The basin will generate runoff of 0.5cfs and 11.2cfs in the minor and major storms, respectively. Stormwater from this sub-basin generally flows south to north along the southern tributary streambed.

Sub-Basin D6 consists of 5 large residential lots and the portion of West Kiowa Creek on the northwest corner of Twinkling Star Lane and Alamar Way. This sub-basin has an area of 41.80 acres. The curve number for Sub-Basin D6 is 64.80. The basin will generate runoff of 2.9cfs and 20.3cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows northwest across the residential lots to the 7.1 ac-ft stormwater detention pond, Pond 3, which will discharge to West Kiowa Creek. Flows in the creek pass under Alamar Way through a double box culvert.

Sub-Basin E0 off-site sub-basin is located south of the southeast corner of the property. This sub-basin has an area of 37.9 acres. The curve number for Sub-Basin E0 is 60.00. The basin will generate runoff of 3.4cfs and 19.1cfs in the minor and major storms, respectively. Stormwater from this sub-basin will flow north across the residential lots to a 30" RCP culvert under Hodgen Road. From the culvert flows proceed north through Sub-Basin E1.1 to be treated in stormwater detention pond P6.

Sub-Basin E1.1 consists of one commercial lot in the southeast corner of the property. The commercial lot will have its own full spectrum stormwater detention pond, Pond 6 in place and



outlet to the road side ditch still ultimately flowing to the culvert at the north end of the basin. This sub-basin has an area of 7.9 acres. Half of this lot is forested and will remain undeveloped. The curve number for Sub-Basin E1.1 is 76.00. The basin will generate runoff of 6.3cfs and 14.6cfs in the minor and major storms, respectively.

Sub-Basin E1.2 consists of 3 large lots towards the southeast corner of the property. This sub-basin has an area of 16.30 acres. The curve number for Sub-Basin E1.2 is 64.00. The basin will generate runoff of 2.0cfs and 10.4cfs in the minor and major storms, respectively. Stormwater from this sub-basin will flow north across the residential lots through a culvert under Woodridge Terrace to Sub-basin F1.

Sub-Basin E2 consists of a portion of a large residential lot at the southwest corner of Flapjack Lane and Early Light Drive. This sub-basin has an area of 2.60 acres. The curve number for Sub-Basin E2 is 64.00. The basin will generate runoff of 0.5cfs and 2.8cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows north to a culvert under Flapjack Lane. From the culvert, runoff flows in a natural drainage channel to Sub-Basin E3.

Sub-Basin E3 consists of 6 large residential lots on the south side of Asteria Lane. This sub-basin has an area of 19.80 acres. The curve number for Sub-Basin E3 is 64.00. The sub-basin will generate runoff of 3.4cfs and 18.5cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows east across the lots to a natural drainage channel which conveys flows north to the culvert under Asteria Lane. From the culvert, runoff continues down the proposed swale through Sub-Basins E4.

Sub-Basin E4 consists of 5 large residential lots to the north of Asteria Lane in the southeast corner of the property. This sub-basin has an area of 18.20 acres. The curve number for Sub-Basin E4 is 64.00. The basin will generate runoff of 3.1cfs and 16.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows to the proposed swale running through the



center of the sub-basin and are conveyed north to the culvert under Alamar Way. From the culvert, the flows continue north through the proposed swale that runs through Sub-Basin E7.

Sub-Basin E5 consists of portions of 7 large residential lots south of Alamar Way near the southern terminus of Clove Hitch Ct. This sub-basin has an area of 13.50 acres. The curve number for Sub-Basin E5 is 64.00. The basin will generate runoff of 2.3cfs and 13.0cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots through the center of the sub-basin and is conveyed north to the culvert under Alamar Way. From the culvert the flows continue north through Sub-Basin E6 in a natural drainage channel.

Sub-Basin E6 consists of 6 large residential lots along the eastern boundary of the property north of Alamar Way. This sub-basin has an area of 28.90 acres. The curve number for Sub-Basin E6 is 61.70. The basin will generate runoff of 4.0cfs and 23.0cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin and are conveyed north to stormwater detention pond 5. From the pond flows continue north in a natural drainage channel and are discharged from the property to the north as they were in the existing condition.

Sub-Basin E7 consists of a portion of 5 large residential lots on the eastern side of the property north of Alamar Way. This sub-basin has an area of 9.80 acres. The curve number for Sub-Basin E7 is 62.00. The basin will generate runoff of 1.5cfs and 8.4cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the proposed swale running through the center of the sub-basin and discharges to the proposed swale to the north that flows through to Sub-basin E6 into stormwater detention pond 5.

Sub-Basin F1 consists of portions of 8 large residential lots along the eastern boundary of the project, on the east side of Twinkling Star Lane. This sub-basin has an area of 42.90 acres. The curve number for Sub-Basin F2 is 60.40. The basin will generate runoff of 4.0cfs and 22.2cfs in



the minor and major storms, respectively. Stormwater from this sub-basin flows across the existing drainage channel through the center of the sub-basin and is discharged from the property to the north to a proposed swale that runs along the north property line ultimately entering detention pond P5.

Sub-Basin G1 consists of a portion of 3 large residential lots and off-site grassland along the western boundary of the project, on the west side of Alamar Way. This sub-basin has an area of 25.20 acres. The curve number for Sub-Basin G1 is 66.00. The basin will generate runoff of 1.8cfs and 24.5cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin and are conveyed east to a culvert under Alamar Way. From the culvert the flows continue east through Sub-Basin G2.

Sub-Basin G2 consists of a portion of 5 large residential lots on the east side of the western loop of Alamar Way. This sub-basin has an area of 21.20 acres. The curve number for Sub-Basin G2 is 73.40. The basin will generate runoff of 4.5cfs and 21.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the proposed swale running through the center of the sub-basin and are conveyed east to the 8.8 ac-ft stormwater detention pond, Pond 1. From the pond flows continue east and are discharged to West Kiowa Creek.

Sub-Basin H1 consists portions of 3 large residential lots along the western boundary of the project, on the north side of Alamar Way. This sub-basin has an area of 13.90 acres. The curve number for Sub-Basin H1 is 60.00. The basin will generate runoff of 3.7cfs and 17.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin and are conveyed southeast to the culvert under Alamar Way. From the culvert, the flows continue southeast through Sub-Basin H4.



Sub-Basin H2 consists portions of 6 large residential lots along the northern boundary of the project, on the north side of Alamar Way. This sub-basin has an area of 39.10 acres. The curve number for Sub-Basin H2 is 67.20. The basin will generate runoff of 3.7cfs and 34.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin and are conveyed southeast to the culvert under Alamar Way. From the culvert the flows continue southeast through Sub-Basin H6.

Sub-Basin H3 consists of portions of 3 large residential lots, and a small offsite residential area, along the northern boundary of the project. This sub-basin has an area of 5.80 acres. The curve number for Sub-Basin H2 is 66.00. The basin will generate runoff of 0.9cfs and 6.8cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin and are conveyed southeast to the culvert under Alamar Way. From the culvert the flows continue southeast through Sub-Basin H7.

Sub-Basin H4 consists of a portion of 4 large residential lots on the east side of the western loop of Alamar Way. This sub-basin has an area of 27.10 acres. The curve number for Sub-Basin H4 is 73.75. The basin will generate runoff of 7.6cfs and 31.7cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin and are conveyed southeast to stormwater detention pond 1. From the pond, flows continue southeast and are discharged to West Kiowa Creek.

Sub-Basin H5 consists of a portion of 3 large residential lots on the east side of the western loop of Alamar Way. This sub-basin has an area of 20.20 acres. The curve number for Sub-Basin H5 is 74.10. The basin will generate runoff of 6.0cfs and 24.7cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the proposed swale running



through the center of the sub-basin and are conveyed southeast to stormwater detention pond 2. From the pond, flows continue southeast and are discharged to West Kiowa Creek.

Sub-Basin H6 consists of a portion of 2 large residential lots on the east side of the western loop of Alamar Way. This sub-basin has an area of 31.60 acres. The curve number for Sub-Basin H6 is 66.60. The basin will generate runoff of 1.1cfs and 21.6cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the proposed swale running through the center of the sub-basin and are conveyed southeast to the 8.1 ac-ft stormwater detention pond, Pond 2. From the pond flows continue southeast and are discharged to West Kiowa Creek.

Sub-Basin H7 consists of a portion of 3 large residential lots on the east side of the western loop of Alamar Way. This sub-basin has an area of 25.80 acres. The curve number for Sub-Basin H7 is 70.50. The basin will generate runoff of 5.3cfs and 28.4cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin and are discharged to West Kiowa Creek.

Sub-Basin H8 consists of a portion of 2 large residential lots on the east side of Clove Hitch Ct. This sub-basin has an area of 8.50 acres. The curve number for Sub-Basin H8 is 74.55. The basin will generate runoff of 3.2cfs and 13.2cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots and south along the road, conveyed southeast to the eastern boundary of the project and discharged onto the neighboring property as they were in the existing condition.

Sub-Basin H9 consists of a portion of 2 large residential lots on the east side of Clove Hitch Ct. This sub-basin has an area of 6.90 acres. The curve number for Sub-Basin H9 is 60.00. The basin will generate runoff of 2.0cfs and 9.7cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the



center of the sub-basin and are conveyed southeast to the proposed swale and into the 1.5 ac-ft stormwater detention pond, Pond 4. From the pond flows continue southeast and are discharged from the property to the east as they were in the existing condition.

Sub-Basin I1 consists of a portion of 3 large residential lots at the northwest corner of the intersection of Twinkling Star Lane and Alamar Way. This sub-basin has an area of 6.80 acres. The curve number for Sub-Basin H2 is 72.00. The basin will generate runoff of 2.2cfs and 10.2cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots and along the road, conveyed southeast to the culvert under Twinkling Star Lane. From the culvert the flows continue southeast through Sub-Basin I2.

Sub-Basin I2 consists of a portion of 3 large residential lots on the east side of Clove Hitch Ct, north of Sub-Basin H9. This sub-basin has an area of 14.80 acres. The curve number for Sub-Basin I2 is 72.00. The basin will generate runoff of 5.1cfs and 23.2cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows across the lots to the natural drainage channel running through the center of the sub-basin. A proposed swale then directs the water south to detention pond P4.

Sub-Basin J1 consists of portions of 2 large residential lots along the northern boundary of the project. This sub-basin has an area of 10.10 acres. The curve number for Sub-Basin J1 would appear to be lower than the historic use at 68.5 versus 69.5. This could result from cleanup of leaves, pine needles, and other debris exposing more ground and allowing more direct contact with water. Conservatively however, using the larger of the two curve numbers, the basin will generate runoff of 2.5cfs and 14.2cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows north across the lots from the property to the north boundary of the project as it did in the existing condition. Flows going offsite will be at or below historic levels.



Sub-Basin K1 consists of portions of 4 large residential lots along the northern boundary of the project. This sub-basin has an area of 17.80 acres. The curve number for Sub-Basin K1 would appear to be lower than the historic use at 72 versus 76. This could result from cleanup of leaves, pine needles, and other debris exposing more ground and allowing more direct contact with water. Conservatively however, using the larger of the two curve numbers, the basin will generate runoff of 9.1cfs and 32.9cfs in the minor and major storms, respectively. Stormwater from this sub-basin flows north across the lots from the property to the north boundary of the project as it did in the existing condition. Flows flowing offsite will be at or below historic levels.

### 3.0 DRAINAGE DESIGN CRITERIA

#### REGULATIONS

The hydrologic calculations in this report comply with the El Paso County Drainage Criteria Manuals. There are no previous drainage studies that cover this property.

#### HYDROLOGICAL CRITERIA

Since this project contains both sub-basins over 100 acres and sub-basins less than 100 acres, times of concentration and peak runoff values were calculated for the 5-year and 100-year storm events using the NRCS Curve Number Method as required by the City of Colorado Springs/El Paso County Drainage Criteria Manuals. The model utilizes the NRCS Type II 24-hr rainfall distribution, the cumulative depth for the 5-year storm is 2.7 inches and cumulative depth of the 100-year storm is 4.6 inches. Per the Drainage Criteria Manual, both Frontal Storms and Thunder Storms were evaluated to determine the higher design flow. The comparative analysis of these storms show that the Frontal Storm produces significantly higher flow rates, so this storm type was used for drainage design. The table below outlines the rain gage data used for the comparison.

#### Frontal Storm Rainfall Depths



	1 H	24 H
5 Year	1.5	2.7
100 Year	2.52	4.6

Thunder Storm 2H Rainfall Depths

Minutes	Fraction of 1 H	5Y	100Y
5	0.01	0.02	0.04
10	0.05	0.07	0.12
15	0.08	0.12	0.20
20	0.12	0.18	0.30
25	0.18	0.27	0.45
30	0.26	0.39	0.65
35	0.42	0.63	1.06
40	0.71	1.07	1.79
45	0.82	1.24	2.08
50	0.89	1.34	2.25
55	0.94	1.40	2.36
60	0.97	1.46	2.45
65	1.00	1.51	2.53
70	1.02	1.53	2.57
75	1.03	1.55	2.60
80	1.04	1.56	2.62
85	1.05	1.58	2.65
90	1.06	1.59	2.68
95	1.07	1.61	2.70
100	1.08	1.62	2.73
105	1.09	1.64	2.75
110	1.10	1.65	2.77
115	1.11	1.66	2.79
120	1.12	1.68	2.82

The peak outfall results for each storm type were reviewed and the frontal storm was identified to have over a 200% greater peak.

#### NRCS TR-55 CURVE NUMBER SELECTION

Basin runoff curve numbers were generated using the runoff curve tables and methods presented in the Colorado Springs/El Paso County Stormwater Criteria Manual.



With curve values for a developed condition only listed up to a 2-acre lot size, some conservative interpolation was necessary. Taking into account that the curve numbers are not linear as the lot sizes increase, the following table was extrapolated for this study.

LOT SIZE	IMPERVIOUS %	SOIL GROUP A	SOIL GROUP B	SOIL GROUP C	SOIL GROUP D
2 ½ ACRE	11%	NA	64	76	81
5 ACRE	7%	NA	60	72	77

Impervious areas were referenced from the county Engineering Criteria Manual (Appendix L Table 3-1) in the table shown below.

**Table 3-1**  
**Typical Values of Percent Impervious**

Type of Development	Percent Impervious
Commercial	95%
Industrial	85%
Multi-Family	65%
Single Family - 0.1377 acre lots (6,000 SF)	53%
Single-Family – 0.20 acre lots	43%
Single-Family – 0.25 acre lots	40%
Single-Family – 0.33 acre lots	30%
Single-Family – 0.5 acre lots	25%
Single-Family – 1.0 acre lots	20%
Single-Family – 2.5 acre lots	11%
Single-Family – 5 acre lots	7%

## FLOODPLAIN STUDY

A formal floodplain study has not been done for this site in the past. A CLOMR submittal has been assembled for this project and was submitted to FEMA in November 2018. The proposed 100-year floodplain line has been calculated and is shown on the plans.



## HYDRAULIC CRITERIA

Routing of stormwater runoff and modelling of drainageways on the site, was done using the NRCS Curve Number Method as required by the City of Colorado Springs. However, ultimate culvert and full spectrum detention pond sizing shall be based on Rational Method peak flows and will utilize Urban Drainage UD-Culvert & UD-Detention calculations. Culvert sizing will be included in the final drainage report and has not been completed at this time.

### Time of Concentration

Assumptions were made for channelized flows through basins to calculate Time of Concentration values. To recognize that larger basins produce more runoff, we structured the hydrology model as with 2 channelized flow profiles for basin over and under 100 acres. The table below outlines these assumptions:

	Shape	Side Slopes	Depth	Wetted Perimeter	Cross Sectional Area
< 100 Acre Basin Channels	Triangular	4:1	4'	32.98'	64 sqft
> 100 Acre Basin Channels	Triangular	4:1	3'	24.74'	36 sqft



### Conveyance Flow Paths

For conveyance flow paths between basins and the main channel where basins converge, 3 flow profiles were used. Triangular profiles were used for a majority of the conveyances, larger branching tributaries were trapezoidal with an 8' bottom, and the main channel was modeled as trapezoidal with a 20' bottom. A full HEC-RAS section analysis was completed that modeled the shape of the main floodplain drainage way. The 20' bottom is a conservative average.

### Box Culvert Sizing Requirements

Detailed sizing of road bridge crossings will be included in a subsequent Final Drainage Report. Hydraulic modeling associated with determining the floodplain width and box culvert requirements has been performed and preliminary results are included here. With peak Q100 flows below 1500 CFS there are no freeboard requirements associated with the 2 proposed bridges. The current preliminary design is specifying triple 10' wide x 6' tall box culverts following standard dimensions from the Colorado Department of Transportation. Hw/D requirements have been assessed as shown below per County requirements:

Proposed Culverts = triple 10' wide x 6' tall = 180 sqft opening

$$\frac{500 - 180}{300}$$

= 1.07 Headwater Factor

The upstream culvert has a water depth entering the culvert of 5.0' and the downstream culvert has a water depth of 5.8'. Both are compliant with the Hw/D requirements relative to the 6' tall openings.

### Detention Pond Summary

Preliminary full spectrum detention pond sizing has been completed. A summary is shown in the table below and full details are included in the appendix. A total of 6 ponds are proposed, all



providing over detention to account for basins that are not being detained. This network of detention ponds work together to achieve a lower proposed flow at the main outfall relative to historic levels. Ownership and maintenance of the ponds will be through a subdivision metro district. An overview of the pond characteristics is shown in the table below:

	Proposed Volume	Q100 Flow Entering Pond (Developed)	Flow Exiting Pond (Developed)	Flow Ratio (Developed vs Historic)
Pond 1	8.0 ac-ft	174.1 cfs	31.9 cfs	0.3
Pond 2	7.4 ac-ft	184.5 cfs	35.1 cfs	0.3
Pond 3	7.1 ac-ft	220.6 cfs	126.8 cfs	0.8
Pond 4	1.5 ac-ft	56.1 cfs	30.6 cfs	0.8
Pond 5	9.7 ac-ft	257.1 cfs	120 cfs	0.7
Pond 6	4.0 ac-ft	79.5 cfs	18.0 cfs	0.4

Pond 5 is a unique situation with having tributary basins that flow into it, and also receiving the outfall of Pond 6. To accurately calculate this situation, the outflow hydrograph of Pond 6 was added to the inflow hydrograph of Pond 5. Our analysis found a 12:26 minute lag time between the two ponds which was incorporated as well. The new hydrograph was then imported into UD Detention for the final calculations of Pond 5. Research will continue as to whether this is the most appropriate method to model this situation in UD Detention, and may be updated in the Final Drainage Report.

Review calculations. This lag time seems to be too low.

#### PRUDENT LINE ANALYSIS

A Prudent Line analysis has been performed on the West Kiowa Creek reach for the site, and the resulting prudent line is included on the Drainage Plan. The Prudent Line method decision tree would direct use of the simplified approach based on developed density < 1 unit per acre, channel



capacity > 10-year storm event requirements, dedicated open space determination, and < 15% impervious criteria. An analysis was done for each 500' segment of the Kiowa Creek across the project. The prudent line that was developed crossed a small portion of two proposed lots. Easements have been placed at these locations to prevent any building. A summary of the prudent line calculations can be found in the appendix.

The table below shows the HEC-RAS data for the 100-year storm event at each of our sections through the reach of the drainageway on this project.

Station	Ground Elevation	Water Surface Elevation	Velocity	Froude Number
72+34	7333.54	7336.95	9.08	0.97
69+69	7330.84	7334.51	9.30	0.96
67+63	7328.00	7332.46	9.47	0.96
65+42	7326.00	7330.11	8.52	0.91
63+02	7324.16	7327.98	8.74	0.97
61+34	7323.97	7327.12	5.95	0.68
58+12	7321.68	7324.55	7.56	1.00
54+50	7318.81	7324.58	2.02	0.17
53+75	7318.04	7323.08	8.69	0.71
53+10	<u>Culvert</u>			
52+56	7317.96	7320.75	8.62	1.01
51+58	7316.00	7318.14	3.88	0.50
48+10	7313.47	7315.74	7.77	0.99
47+01	7312.00	7315.79	3.56	0.38
44+67	7312.00	7314.97	5.72	0.62
43+12	7311.43	7313.71	7.26	1.00
40+58	7307.48	7310.30	6.47	0.76
37+56	7304.64	7307.56	8.27	1.01
36+71	7303.99	7306.83	7.79	0.92
33+13	7300.28	7303.59	7.94	0.97
30+53	7296.87	7300.08	8.63	0.97
29+16	7296.00	7299.16	7.99	0.83
25+59	7293.68	7296.35	7.71	0.98
23+56	7291.32	7293.97	7.15	0.85



21+15	7289.16	7291.68	7.83	1.01
18+26	7284.08	7288.52	7.47	0.84
16+18	7283.99	7286.87	6.96	0.96
15+15	7282.00	7287.19	2.58	0.25
12+99	7280.29	7287.17	1.90	0.15
12+24	7280.00	7285.83	8.24	0.61
11+60	<u>Culvert</u>			
11+05	7279.08	7282.30	9.32	1.01
10+07	7278.00	7281.94	6.06	0.61
8+93	7277.98	7280.87	8.01	0.96
6+78	7275.60	7278.01	3.90	0.57
4+40	7273.98	7275.95	6.83	0.91

The basins for the site flow to the 150-acre dedicated open space area containing the onsite reach of West Kiowa Creek. The open space roughly bisects the site from the southwest corner of the property to the northeast corner of the property. In addition to the creek itself, this tract contains preservation areas for wetlands and wildlife. To accommodate these areas, the tract will be further restricted as a natural corridor by the county requiring submittal to the US Fish & Wildlife for habitat preservation, and then also submitted to FEMA for floodplain preservation. The proposed post development flows will all be at or below historic levels. To maintain this natural environment, and likely required by US Fish and Wildlife, we propose not making any channel improvements to this area.

#### **4.0 DRAINAGE FACILITY DESIGN**

##### **GENERAL CONCEPT**

This project is a low density residential development with lots varying between 2.5 acres and 5 acres in size. Adjoining properties and drainage facilities downstream from the site will not be affected. In order to maintain historic runoff levels for this site, a series of 6 full spectrum detention ponds are being proposed that will capture and control the flows from roads and residential lots. The runoff from these areas will be treated before releasing it into West Kiowa



Creek or on to the downstream properties at the historic discharge points. The 6 ponds are sized to over-detain stormwater making up for other basins that are not captured.

As this is a phased project, detention ponds will be installed to maintain flow rates below historic levels at each phase of the project. To achieve this, some ponds will be built and put on line that are outside of the boundary area for a given phase.

### **SPECIFIC DETAILS**

In the existing condition, the subject property is undeveloped land consisting mostly of grassland with a few forested areas near the northern and southern boundaries. Runoff from the site is collected by natural swales and channels that convey flows to West Kiowa Creek, which carries water from the site. The proposed development does not aim to change these natural drainage patterns, but rather to preserve them to the extent possible. With this philosophy in mind, culverts were added to the design to convey water under proposed roads as it flows through the site. Culverts will be sized using the Rational Method and the Urban Drainage UD-Culvert spreadsheets. These sizing results will be presented in the Final Drainage Report.

Results of the hydrologic model show that in the existing condition 100-year storm event, 1601.6cfs leaves the site at the northeast corner of the property and in the proposed condition 1588.8cfs leaves the site. This development will not adversely impact the drainageways and related facilities downstream from the development.

### **CONSTRUCTION PHASING**

Due to the size and scope of this project, the site has been broken into phases that will be built one at a time. There are currently 4 phased land releases planned as shown on the Lot Release Exhibit in the Appendix. Culverts and stormwater detention ponds will be installed and staggered according to these releases. However, stormwater flows will be maintained below



historic levels through all phases of the project. Stormwater will flow through historic conveyances in areas of the project where construction has not started or impacted the area.

Anticipated Detention Pond Buildout	
Phase 1	Pond 1
Phase 2	Pond 2
Phase 3	Pond 3, 5
Phase 4	Pond 4, 6

A separate hydrology model has been constructed for each of the phases. The results show that outfall flow rates will be below historic levels during buildout for all interim phases of the project.

100Y Flow Rates At Main Outfall	
Historic	1601.6 cfs
Phase 1	1174.0 cfs
Phase 2	1601.1 cfs
Phase 3	1587.3 cfs
Phase 4 (final)	1588.8 cfs

## RISK ASSESSMENT

The site has been further evaluated for future flooding risk with respect to three documented reservoirs upstream from the project. The reservoirs are listed as 1-N-10, 1-P-10, and 1-P-20 in the Kiowa Creek Watershed. The reservoirs were installed as part of jurisdictional flood control and are documented by the state. The Colorado State Dam Safety Engineering office has been contacted. With input criteria from John Hunyadi who oversees jurisdictional dams in this area, the largest of the 3 dams in question has been modeled and results have been provided back to the state. A breaching “sunny day” flow rate of 9500cfs is the largest of the 3 dams and results in a small portion of two proposed lots (lot 24 and 64) being affected. Easements have been added so that no building will occur in these areas and the current low risk level associated with the dams will remain unchanged. An exhibit of the floodplain area associated with the dam



failure, and an approval letter from the Colorado Dam Safety Engineering Office is included in the appendix.

#### **DRAINAGE BASIN FEE**

Currently the West Kiowa Creek Drainage Basin is not part of the El Paso County Drainage Basin Fee Program.

#### **CONCLUSIONS**

This report has been prepared in accordance with El Paso County stormwater criteria. It outlines the routing of the 5-Year and 100-year storm events through the project's drainage system. The proposed drainage facilities were designed to convey and treat stormwater flows in accordance with the requirements presented by El Paso County and the Colorado Springs Drainage Criteria Manual. These proposed improvements provide adequate protection to this site without adverse impacts on adjoining upstream and downstream properties.

Consideration has been given to the Four-Step Process outlined in the El Paso County Engineering Criteria Manual for BMP selection as noted below:

##### **Step 1: Employ Runoff Reduction Practices**

This project is a low density residential development with lots varying between 2.5 acres and 5 acres in size. The development is designed to have a minimal impact and maintain the rural nature of the existing area. Relative to the size of the site, a small amount of paving is proposed as residential roadways. Roadside ditches and swales will be placed to slow down the velocity and effectively reduce runoff peaks. Full Spectrum Detention Basins will be used to capture stormwater and maintain flows off the site at below historic levels.



Step 2: Stabilize Drainageways

Stabilizing the flow paths within the development will be addressed by roadside ditch designs, flow controls, and swales. Roadside ditch slopes will be designed to control flow rates, and check dams will be used in areas of steeper slopes to slow storm runoff. Low sloping swales are proposed to direct water from adjacent basins to the full spectrum detention ponds. The swales will be graded to reduce the velocity of the water before it enters the ponds. By controlling stormwater along the flow paths we anticipate minimal erosion.

Step 3: Provide Water Quality Capture Volumes (WQCV)

The development proposes 6 full spectrum detention basins to capture stormwater runoff. These ponds have all been sized using UD-Detention and will provide full spectrum detention. Per ECM Appendix I Section 1.7.1.B in development areas of low density housing, water quality is not required across all areas, but full spectrum detention ponds are required when stormwater detention is employed.

Step 4: Consider Need for Industrial and Commercial BMP's

There is one proposed lot on the site with an intended commercial use. At this time, the specific type of use for this area has not been determined. The only proposed development for this area currently is a dedicated full spectrum detention pond. When the commercial area is developed, Covering of Storage/Handling Areas and Spill Containment & Control can be addressed if appropriate.



## **5.0 REFERENCES**

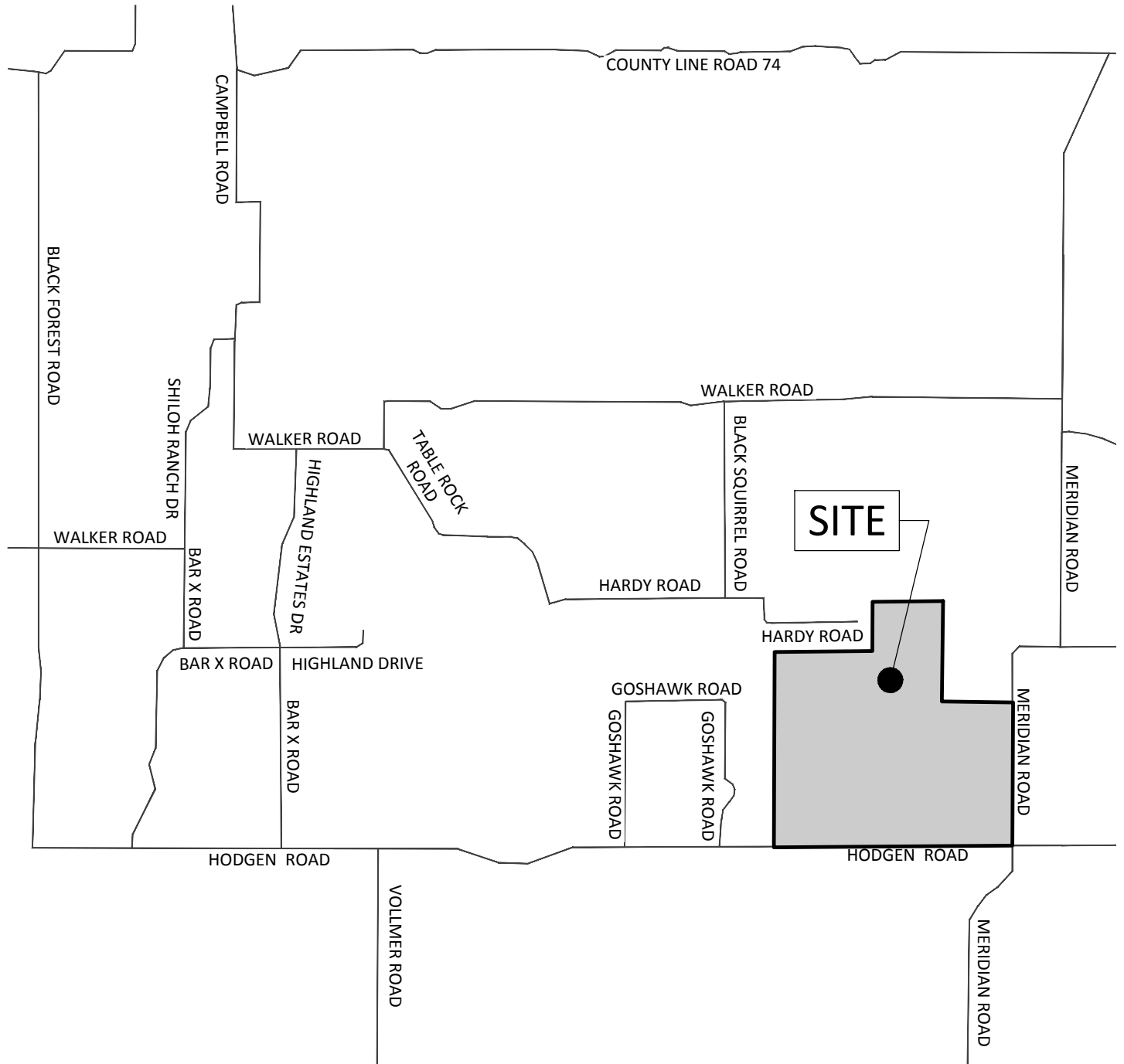
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4. Natural Resources Conservation Service, Web Soil Survey, dated October 10, 2017.
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6. El Paso County Planning Website, Tri-Lakes Drainage and Flood Control Vision:  
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## **1.0 VICINITY MAP**



# VICINITY MAP



VICINITY MAP

MCCUNE RANCH SUBDIVISION

17480 MERIDIAN ROAD  
ELBERT, COLORADO

File No.:	
Date:	10/04/2018
Drawn:	JCP
Checked:	LPV
Job No.:	49388

FIGURE

1

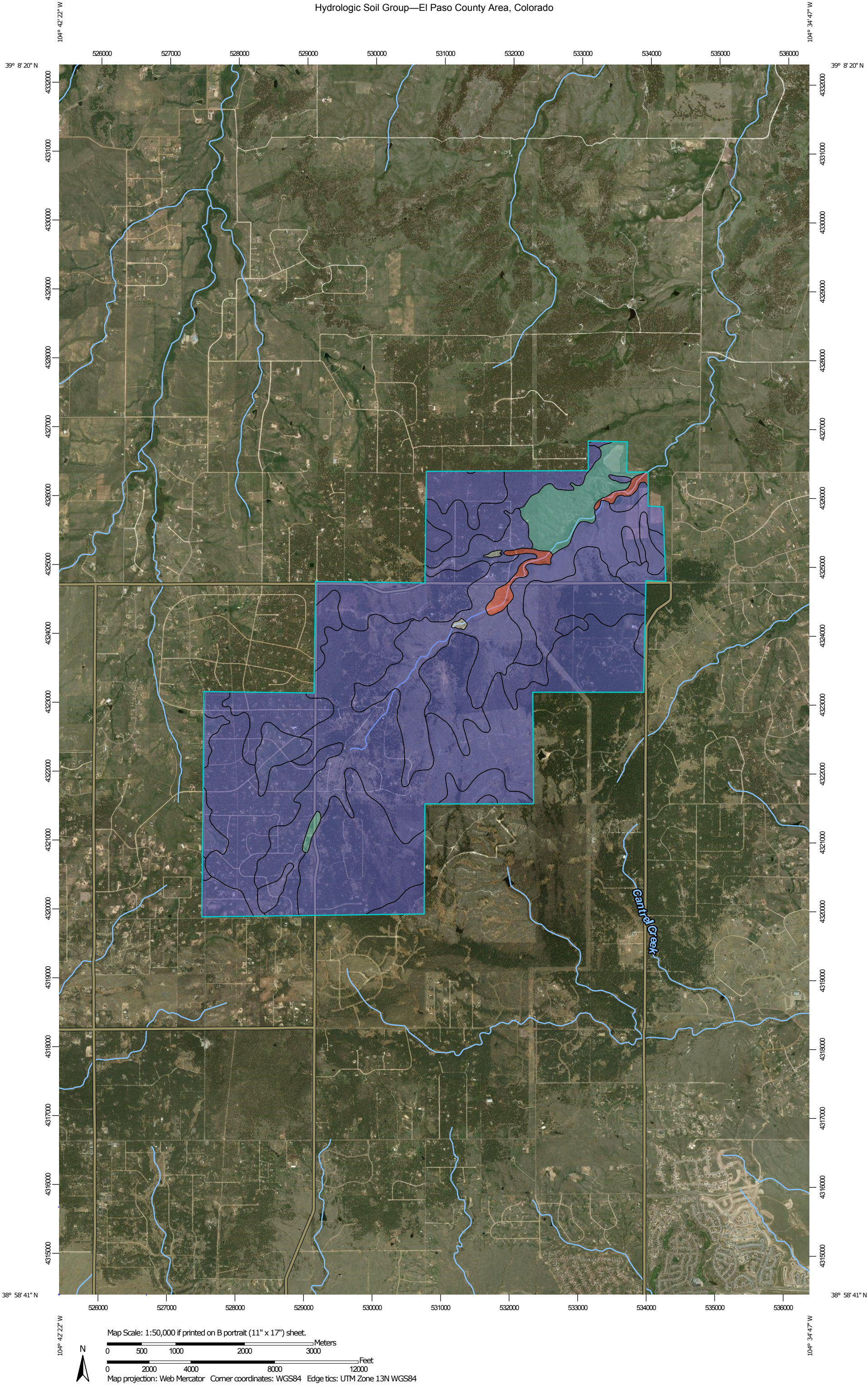
**VERTEX**<sup>®</sup>



## **2.0 HYDROLOGIC SOILS MAP**



Hydrologic Soil Group—El Paso County Area, Colorado




Map Scale: 1:50,000 if printed on B portrait (11" x 17") sheet.  
0 500 1000 2000 3000 Meters  
0 2000 4000 8000 12000 Feet  
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





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

#### Soil Rating Lines

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

#### Soil Rating Points





 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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: El Paso County Area, Colorado

Survey Area Data: Version 15, Oct 10, 2017

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

Date(s) aerial images were photographed: May 22, 2016—Mar 9, 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.



## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	D	80.6	1.2%
15	Brussett loam, 3 to 5 percent slopes	B	6.0	0.1%
21	Cruckton sandy loam, 1 to 9 percent slopes	B	4.7	0.1%
25	Elbeth sandy loam, 3 to 8 percent slopes	B	2,081.3	31.8%
26	Elbeth sandy loam, 8 to 15 percent slopes	B	2,075.9	31.7%
34	Holderness loam, 1 to 5 percent slopes	C	15.5	0.2%
36	Holderness loam, 8 to 15 percent slopes	C	278.7	4.3%
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	B	400.4	6.1%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	265.1	4.0%
67	Peyton sandy loam, 5 to 9 percent slopes	B	36.3	0.6%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	38.1	0.6%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	26.0	0.4%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	661.6	10.1%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	574.4	8.8%
111	Water		10.0	0.2%
<b>Totals for Area of Interest</b>			<b>6,554.4</b>	<b>100.0%</b>



## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

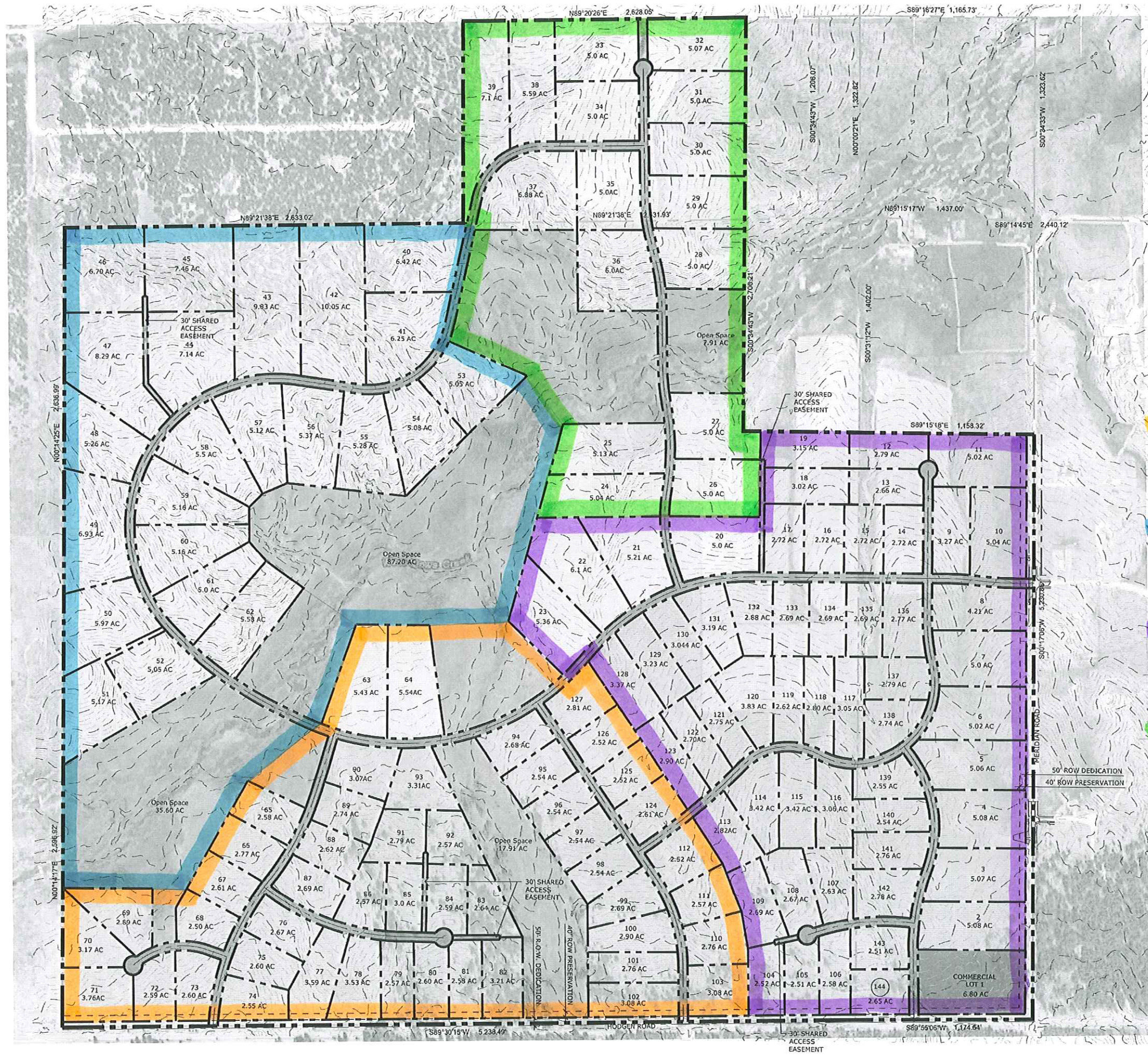
*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher



### **3.0 LOT RELEASE EXHIBIT**





#### LOT COUNT

5+ ACRE LOTS = 52  
2.5 ACRE LOTS = 91  
6.80 ACRE COMMERCIAL = 1  
TOTAL = 144

SHARED ACCESS TRACTS = 2.18 AC

OPEN SPACE AREA TOTAL = 148.62 AC

LINEAR FEET ROAD = 28,334

Phase Lots

1	48
2	23
3	56+1
4	16

Land Planning  
Landscape  
Architecture  
Urban Design

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N.E.S. Inc.  
619 N. Cascade Avenue, Suite 200  
Colorado Springs, CO 80903

Tel. 719.471.0073  
Fax 719.471.0267

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McCune  
Ranch

CONCEPT LAYOUT

DATE: 8/29/18  
PROJECT MGR: A. EARLOW  
PREPARED BY: B. SWENSON

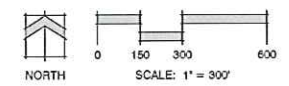
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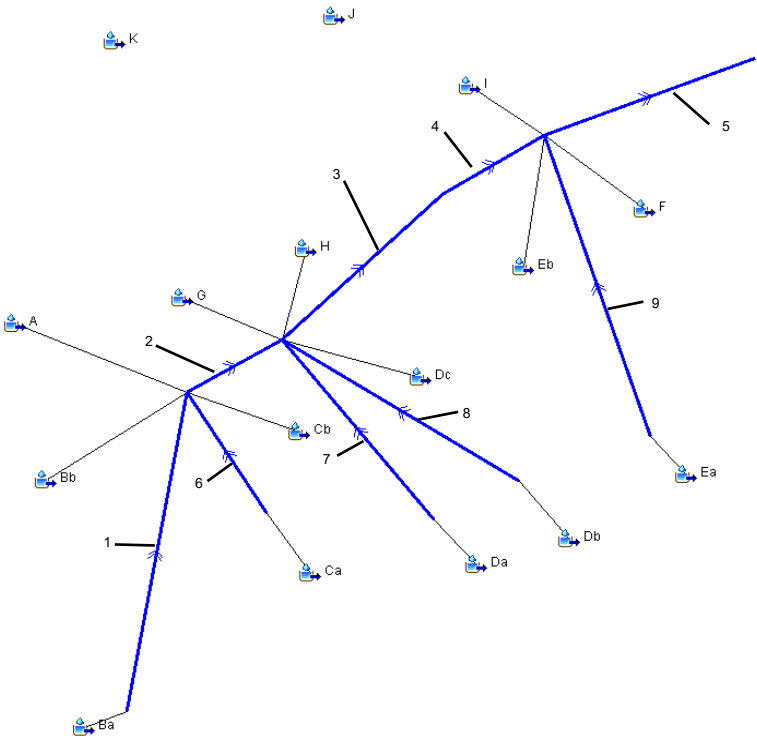




## **4.1 MODEL SCHEMATICS**

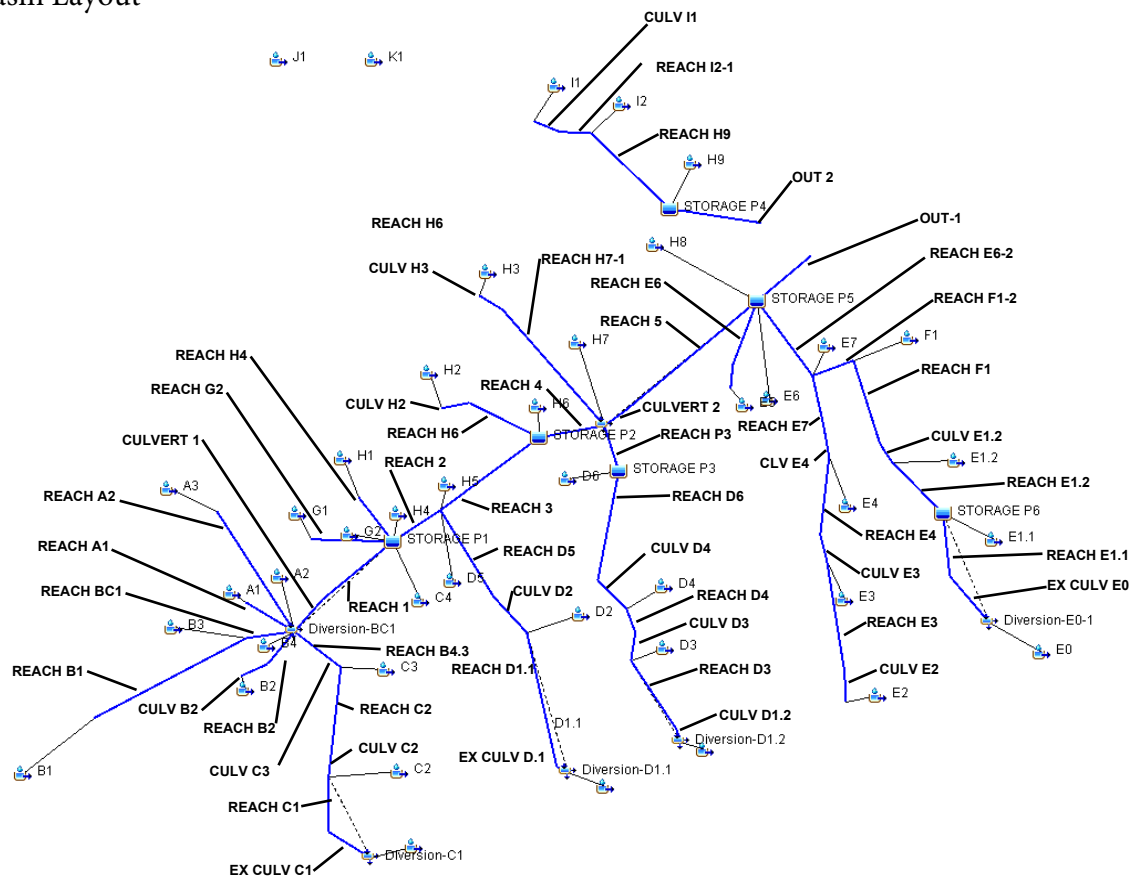


Existing Basin Layout





# Proposed Basin Layout





## **4.2 FRONTAL STORM RAIN GAGE DATA**



Frontal Storm Rain Gage

Time	5Y Values	100Y Values	Time	5Y Values	100Y Values
0:00	0	0	12:00	1.7901	3.0498
0:06	0.00273	0.00465	12:06	1.84129	3.13702
0:12	0.00545	0.00929	12:12	1.88633	3.21374
0:18	0.00824	0.01403	12:18	1.92521	3.27998
0:24	0.01102	0.01877	12:24	1.95793	3.33574
0:30	0.01385	0.0236	12:30	1.9845	3.381
0:36	0.01669	0.02843	12:36	2.00729	3.41982
0:42	0.01958	0.03335	12:42	2.02867	3.45626
0:48	0.02246	0.03827	12:48	2.04865	3.4903
0:54	0.02541	0.04329	12:54	2.06723	3.52194
1:00	0.02835	0.0483	13:00	2.0844	3.5512
1:06	0.03135	0.05341	13:06	2.10049	3.57862
1:12	0.03434	0.05851	13:12	2.11583	3.60474
1:18	0.0374	0.06371	13:18	2.13041	3.62958
1:24	0.04045	0.06891	13:24	2.14423	3.65314
1:30	0.04355	0.0742	13:30	2.1573	3.6754
1:36	0.04666	0.07949	13:36	2.16972	3.69656
1:42	0.04982	0.08487	13:42	2.1816	3.7168
1:48	0.05297	0.09025	13:48	2.19294	3.73612
1:54	0.05619	0.09573	13:54	2.20374	3.75452
2:00	0.0594	0.1012	14:00	2.214	3.772
2:06	0.06267	0.10677	14:06	2.22391	3.78888
2:12	0.06593	0.11233	14:12	2.2336	3.8054
2:18	0.06926	0.11799	14:18	2.24313	3.82163
2:24	0.07258	0.12365	14:24	2.25245	3.8375
2:30	0.07595	0.1294	14:30	2.2616	3.8531
2:36	0.07933	0.13515	14:36	2.27054	3.86832
2:42	0.08276	0.14099	14:42	2.27931	3.88327
2:48	0.08618	0.14683	14:48	2.28787	3.89786
2:54	0.08967	0.15277	14:54	2.29627	3.91216
3:00	0.09315	0.1587	15:00	2.30445	3.9261
3:06	0.09669	0.16473	15:06	2.31247	3.93976
3:12	0.10022	0.17075	15:12	2.32027	3.95306
3:18	0.10381	0.17687	15:18	2.32791	3.96607
3:24	0.10741	0.18299	15:24	2.33534	3.97872
3:30	0.11105	0.1892	15:30	2.3426	3.9911
3:36	0.1147	0.19541	15:36	2.34965	4.0031
3:42	0.1184	0.20171	15:42	2.35653	4.01483
3:48	0.12209	0.20801	15:48	2.3632	4.0262
3:54	0.12585	0.21441	15:54	2.36971	4.03728
4:00	0.1296	0.2208	16:00	2.376	4.048
4:06	0.13341	0.22729	16:06	2.38218	4.05853
4:12	0.13727	0.23386	16:12	2.38828	4.06893
4:18	0.14118	0.24053	16:18	2.39433	4.07923
4:24	0.14515	0.2473	16:24	2.4003	4.0894
4:30	0.14918	0.25415	16:30	2.40621	4.09947
4:36	0.15325	0.2611	16:36	2.41205	4.10941
4:42	0.15738	0.26813	16:42	2.41782	4.11925
4:48	0.16157	0.27526	16:48	2.42352	4.12896
4:54	0.16581	0.28249	16:54	2.42916	4.13857
5:00	0.1701	0.2898	17:00	2.43473	4.14805
5:06	0.17445	0.29721	17:06	2.44023	4.15743
5:12	0.17885	0.3047	17:12	2.44566	4.16668
5:18	0.1833	0.31229	17:18	2.45103	4.17583
5:24	0.18781	0.31998	17:24	2.45632	4.18485
5:30	0.19238	0.32775	17:30	2.46156	4.19377
5:36	0.19699	0.33562	17:36	2.46672	4.20256
5:42	0.20166	0.34357	17:42	2.47182	4.21125
5:48	0.20639	0.35162	17:48	2.47685	4.21981
5:54	0.21117	0.35977	17:54	2.48181	4.22827
6:00	0.216	0.368	18:00	2.4867	4.2366
6:06	0.22089	0.37633	18:06	2.49153	4.24483
6:12	0.22583	0.38474	18:12	2.49629	4.25293
6:18	0.23082	0.39325	18:18	2.50098	4.26093
6:24	0.23587	0.40186	18:24	2.5056	4.2688
6:30	0.24098	0.41055	18:30	2.51016	4.27657
6:36	0.24613	0.41934	18:36	2.51465	4.28421
6:42	0.25134	0.42821	18:42	2.51907	4.29175
6:48	0.25661	0.43718	18:48	2.52342	4.29916
6:54	0.26193	0.44625	18:54	2.52771	4.30647
7:00	0.2673	0.4554	19:00	2.53192	4.31365
7:06	0.27273	0.46465	19:06	2.53608	4.32073
7:12	0.27821	0.47398	19:12	2.54016	4.32768
7:18	0.28374	0.48341	19:18	2.54418	4.33453
7:24	0.28933	0.49294	19:24	2.54812	4.34125
7:30	0.29498	0.50255	19:30	2.55201	4.34787
7:36	0.30067	0.51226	19:36	2.55582	4.35436
7:42	0.30642	0.52205	19:42	2.55957	4.36075
7:48	0.31223	0.53194	19:48	2.56325	4.36701
7:54	0.31809	0.54193	19:54	2.56686	4.37317
8:00	0.324	0.552	20:00	2.5704	4.3792
8:06	0.33008	0.56235	20:06	2.57391	4.38518
8:12	0.33642	0.57316	20:12	2.57739	4.39111
8:18	0.34304	0.58443	20:18	2.58088	4.39705
8:24	0.34992	0.59616	20:24	2.58433	4.40294
8:30	0.35708	0.60835	20:30	2.58779	4.40882
8:36	0.3645	0.621	20:36	2.59122	4.41467
8:42	0.3722	0.63411	20:42	2.59465	4.42051
8:48	0.38016	0.64768	20:48	2.59805	4.4263
8:54	0.3884	0.66171	20:54	2.60145	4.4321
9:00	0.3969	0.6762	21:00	2.60483	4.43785
9:06	0.40554	0.69092	21:06	2.6082	4.4436
9:12	0.41418	0.70564	21:12	2.61155	4.4493
9:18	0.42282	0.72036	21:18	2.6149	4.45501
9:24	0.43146	0.73508	21:24	2.61822	4.46067
9:30	0.4401	0.7498	21:30	2.62154	4.46632
9:36	0.44896	0.76489	21:36	2.62483	4.47194
9:42	0.45824	0.78071	21:42	2.62813	4.47755
9:48	0.46796	0.79727	21:48	2.63139	4.48311
9:54	0.47812	0.81457	21:54	2.63466	4.48868
10:00	0.4887	0.8326	22:00	2.6379	4.4942
10:06	0.49982	0.85155	22:06	2.64114	4.49972
10:12	0.5116	0.87161	22:12	2.64435	4.50519
10:18	0.52402	0.89277	22:18	2.64757	4.51067
10:24	0.53708	0.91503	22:24	2.65075	4.5161
10:30	0.5508	0.9384	22:30	2.65394	4.52152
10:36	0.56538	0.96324	22:36	2.6571	4.52691
10:42	0.58104	0.98992	22:42	2.66026	4.53229
10:48	0.59778	1.01844	22:48	2.66339	4.53762
10:54	0.6156	1.0488	22:54	2.66652	4.54296
11:00	0.6345	1.081	23:00	2.66963	4.54825
11:06	0.65524	1.11633	23:06	2.67273	4.55354
11:12	0.67856	1.15607	23:12	2.67581	4.55878
11:18	0.70448	1.20023	23:18	2.67889	4.56403
11:24	0.733	1.24881	23:24	2.68194	4.56923
11:30	0.7641	1.3018	23:30	2.68499	4.57442
11:36	0.82847	1.41146	23:36	2.68801	4.57958
11:42	0.95677	1.63006	23:42	2.69104	4.58473
11:48	1.16313	1.98163	23:48	2.69403	4.58983
11:54	1.53322	2.61216	23:54	2.69703	4.59494
			24:00:00	2.7	4.6



### **4.3 STORAGE LAG CALCULATIONS**



[illegible]



PROPOSED BASINS LAG TIME CALCULATIONS													
BASIN	AREA (ACRES)	AREA (SQFT)	FLOW LENGTH (FT)			HOURS (MIN)	MIN	SEC (MIN)	ToC (MIN)	ToC (HOURS)	ToC/R	R (HOURS)	BASIN
A1	865.90	37,718,604	11,464		0 00:57:38	0	57	0.63	57.63	0.96	1.1579	0.8296	A1
A2	37.00	1,611,720	2,457		0 00:37:25	0	37	0.42	37.42	0.62	1.1353	0.5493	A2
A3	41.48	1,806,869	1,733		0 00:33:50	0	33	0.83	33.83	0.56	1.3159	0.4285	A3
B1	3836.70	167,126,652	21,454		0 01:23:48	60	23	0.80	83.80	1.40	1.2212	1.1437	B1
B2	13.10	570,636	777		0 00:24:27	0	24	0.45	24.45	0.41	1.3683	0.2978	B2
B3	54.90	2,391,444	3,993		0 00:39:21	0	39	0.35	39.35	0.66	0.8820	0.7436	B3
B4	41.48	1,806,869	2,488		0 00:39:30	0	39	0.50	39.50	0.66	1.1630	0.5661	B4
C1	162.70	7,087,212	4,458		0 00:37:12	0	37	0.20	37.20	0.62	1.2169	0.5095	C1
C2	22.40	975,744	1,201		0 00:32:36	0	32	0.60	32.60	0.54	1.3318	0.4080	C2
C3	16.10	701,316	1,466		0 00:28:22	0	28	0.37	28.37	0.47	1.1943	0.3959	C3
C4	23.80	1,036,728	2,374		0 00:41:07	0	41	0.12	41.12	0.69	0.9887	0.6931	C4
D1.1	161.30	7,026,228	3,636		0 00:36:59	0	36	0.98	36.98	0.62	1.2969	0.4753	D1.1
D1.2	49.90	2,173,644	2,222		0 00:44:12	0	44	0.20	44.20	0.74	1.2631	0.5832	D1.2
D2	68.70	2,992,572	2,148		0 00:34:49	0	34	0.82	34.82	0.58	1.3263	0.4375	D2
D3	41.20	1,794,672	2,428		0 00:39:22	0	39	0.37	39.37	0.66	1.1752	0.5583	D3
D4	34.30	1,494,108	1,458		0 00:30:25	0	30	0.42	30.42	0.51	1.3366	0.3793	D4
D5	12.80	557,568	1,306		0 00:30:31	0	30	0.52	30.52	0.51	1.1948	0.4257	D5
D6	41.80	1,820,808	2,555		0 00:39:40	0	39	0.67	39.67	0.66	1.1492	0.5753	D6
E0	37.90	1,650,924	2,048		0 00:37:15	0	37	0.25	37.25	0.62	1.2397	0.5008	E0
E1.1	7.90	344,124	801		0 00:31:58	0	31	0.97	31.97	0.53	1.2984	0.4103	E1.1
E1.2	16.30	710,028	985		0 00:36:01	0	36	0.02	36.02	0.60	1.3415	0.4475	E1.2
E2	2.60	113,256	586		0 00:22:39	0	22	0.65	22.65	0.38	1.1971	0.3153	E2
E3	19.80	862,488	1,504		0 00:27:21	0	27	0.35	27.35	0.46	1.2326	0.3698	E3
E4	18.20	792,792	1,328		0 00:28:07	0	28	0.12	28.12	0.47	1.2671	0.3698	E4
E5	13.50	588,060	1,135		0 00:27:04	0	27	0.07	27.07	0.45	1.2701	0.3552	E5
E6	28.90	1,258,884	1,659		0 00:28:21	0	28	0.35	28.35	0.47	1.2704	0.3719	E6
E7	9.80	426,888	974		0 00:24:29	0	24	0.48	24.48	0.41	1.2673	0.3220	E7
F1	42.90	1,868,724	2,613		0 00:35:50	0	35	0.83	35.83	0.60	1.1432	0.5224	F1
G1	25.20	1,097,712	1,485		0 00:26:48	0	26	0.80	26.80	0.45	1.2858	0.3474	G1
G2	21.20	923,472	1,995		0 00:34:21	0	34	0.35	34.35	0.57	1.0863	0.5270	G2
H1	13.90	605,484	1,128		0 00:26:57	0	26	0.95	26.95	0.45	1.2778	0.3515	H1
H2	39.10	1,703,196	2,151		0 00:33:00	0	33	0.00	33.00	0.55	1.2245	0.4492	H2
H3	5.80	252,648	633		0 00:23:58	0	23	0.97	23.97	0.40	1.3225	0.3020	H3
H4	27.10	1,180,476	2,091		0 00:33:37	0	33	0.62	33.62	0.56	1.1389	0.4920	H4
H5	20.20	879,912	1,955		0 00:32:24	0	32	0.40	32.40	0.54	1.0834	0.4984	H5
H6	31.60	1,376,496	2,575		0 00:35:35	0	35	0.58	35.58	0.59	1.0424	0.5690	H6
H7	25.80	1,123,848	1,643		0 00:30:53	0	30	0.88	30.88	0.51	1.2517	0.4112	H7
H8	8.50	370,260	959		0 00:25:29	0	25	0.48	25.48	0.42	1.2446	0.3412	H8
H9	6.90	300,564	771		0 00:24:03	0	24	0.05	24.05	0.40	1.2885	0.3111	H9
I1	6.80	296,208	768		0 00:23:54	0	23	0.90	23.90	0.40	1.2874	0.3094	I1
I2	14.80	644,688	785		0 00:23:34	0	23	0.57	23.57	0.39	1.3771	0.2852	I2
J1	10.10	439,956	728		0 00:22:55	0	22	0.92	22.92	0.38	1.3556	0.2818	J1
K1	17.80	775,368	854		0 00:24:06	0	24	0.10	24.10	0.40	1.3784	0.2914	K1
	5998.2												

38  
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50  
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55  
6



#### **4.4 INITIAL ABSTRACTION CALCULATIONS**



$$I_a = 0.1[(1000/CN) - 10]$$

Existing Sub-Basin Initial Abstraction Summary		
Sub-Basin	Curve Number	Initial Abstraction
A	61.83	0.617
Ba	60.34	0.657
Bb	69.79	0.433
Ca	60	0.667
Cb	68.7	0.456
Da	60	0.667
Db	60	0.667
Dc	67.7	0.477
Ea	60	0.667
Eb	67.2	0.488
F	69	0.449
G	74.5	0.342
H	71.76	0.394
I	79	0.266
J	69.5	0.439
K	76	0.316

Proposed Sub-Basin Initial Abstraction Summary		
Sub-Basin	Curve Number	Initial Abstraction
A1	60.36	0.657
A2	66	0.515
A3	76.5	0.307
B1	60.34	0.657
B2	64	0.563
B3	65.1	0.536
B4	68.5	0.460
C1	60	0.667
C2	60	0.667
C3	64	0.563
C4	65	0.538
D1.1	60	0.667
D1.2	60	0.667
D2	64.75	0.544
D3	64	0.563
D4	64	0.563
D5	67.2	0.488
D6	61.65	0.622
E0	60	0.667
E1.1	76	0.316
E1.2	62	0.613
E2	64	0.563
E3	64	0.563
E4	64	0.563
E5	64	0.563
E6	62.4	0.603
E7	62	0.613
F1	60.4	0.656
G1	66	0.515
G2	72.7	0.376
H1	70.8	0.412
H2	67.2	0.488
H3	66	0.515
H4	73.75	0.356
H5	74.8	0.337
H6	66.6	0.502
H7	70.5	0.418
H8	74.55	0.341
H9	70.8	0.412
I1	72	0.389
I2	72	0.389
J1	69.5	0.439
K1	76	0.316



## **4.5 TIME OF CONCENTRATION CALCULATIONS**



Subbasin Hydrology

Subbasin : A

Input Data

Area (ac) ..... 915.40  
Weighted Curve Number ..... 61.83  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	823.86	B	60.00
Pasture, grassland, or range, Fair	9.15	D	84.00
Pasture, grassland, or range, Fair	64.08	C	79.00
Pasture, grassland, or range, Fair	9.15	B	69.00
5 Acre Lots, 7% Impervious	9.15	D	77.00
Composite Area & Weighted CN	915.39		61.83

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

Tc = Time of Concentration (hr)  
n = Manning's roughness  
Lf = Flow Length (ft)  
P = 2 yr, 24 hr Rainfall (inches)  
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (Sf^0.5) (unpaved surface)  
V = 20.3282 \* (Sf^0.5) (paved surface)  
V = 15.0 \* (Sf^0.5) (grassed waterway surface)  
V = 10.0 \* (Sf^0.5) (nearly bare & untilled surface)  
V = 9.0 \* (Sf^0.5) (cultivated straight rows surface)  
V = 7.0 \* (Sf^0.5) (short grass pasture surface)  
V = 5.0 \* (Sf^0.5) (woodland surface)  
V = 2.5 \* (Sf^0.5) (forest w/heavy litter surface)  
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)  
Lf = Flow Length (ft)  
V = Velocity (ft/sec)  
Sf = Slope (ft/ft)

Channel Flow Equation :

$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$   
R = Aq / Wp  
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where :

Tc = Time of Concentration (hr)  
Lf = Flow Length (ft)  
R = Hydraulic Radius (ft)  
Aq = Flow Area (ft²)  
Wp = Wetted Perimeter (ft)  
V = Velocity (ft/sec)  
Sf = Slope (ft/ft)  
n = Manning's roughness

Add a narrative to explain the softwares approach.

T(lag) and Tc are two different values. Based on these values the HEC-HMS model appears to have used Tc. The lag time is from the centroid of the rainfall distribution. City DCM defines it as T(lag) = 0.6xTc.

The computation notes TOC Method as SCS TR-55. Check if the calculated Total TOC is Tc or T(lag).



Sheet Flow Computations	Flowpath	Flowpath	Flowpath
	A	B	C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations	Flowpath	Flowpath	Flowpath
	A	B	C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	10.62	0.00	0.00
Channel Flow Computations	Flowpath	Flowpath	Flowpath
	A	B	C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	10494	0.00	0.00
Channel Slope (%) :	2	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	8.20	0.00	0.00
Computed Flow Time (min) :	21.34	0.00	0.00
Total TOC (min) .....	53.01		

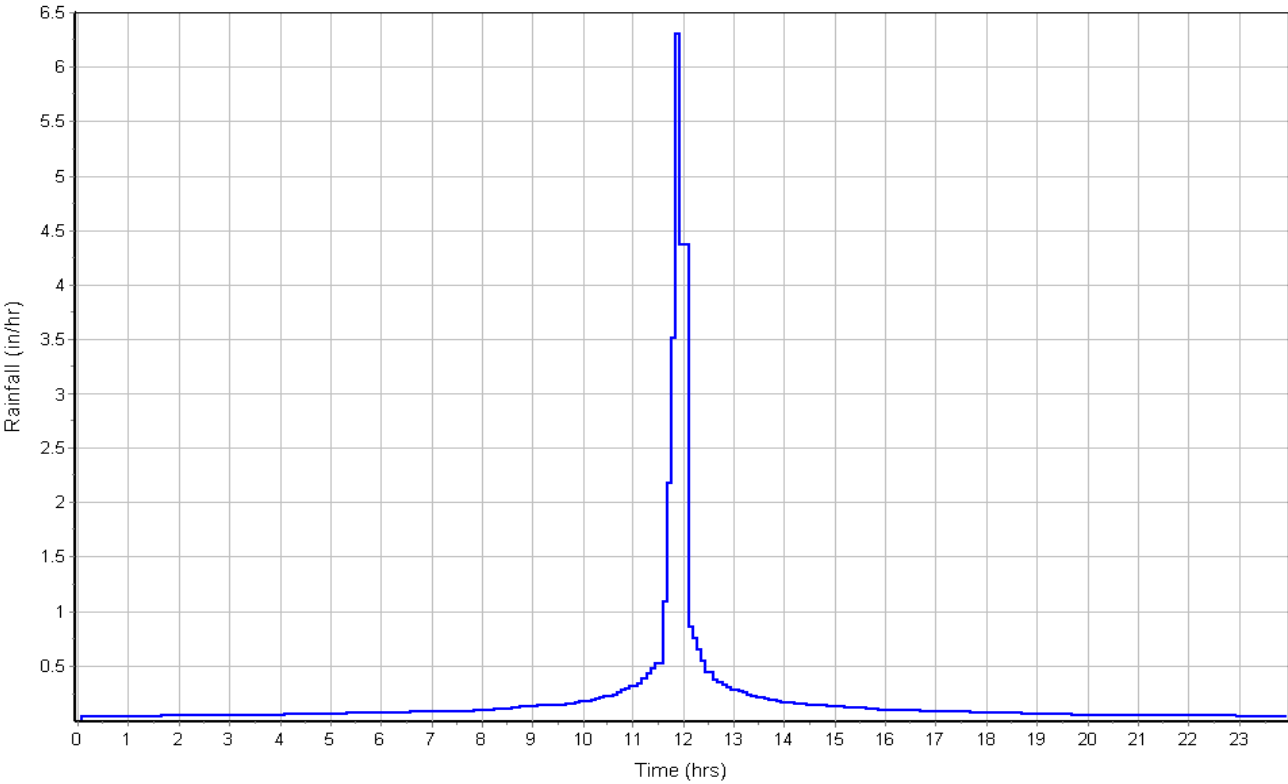
### Subbasin Runoff Results

Total Rainfall (in) .....	4.60
Total Runoff (in) .....	1.19
Peak Runoff (cfs) .....	565.84
Weighted Curve Number .....	61.83
Time of Concentration (days hh:mm:ss) .....	0 00:53:01

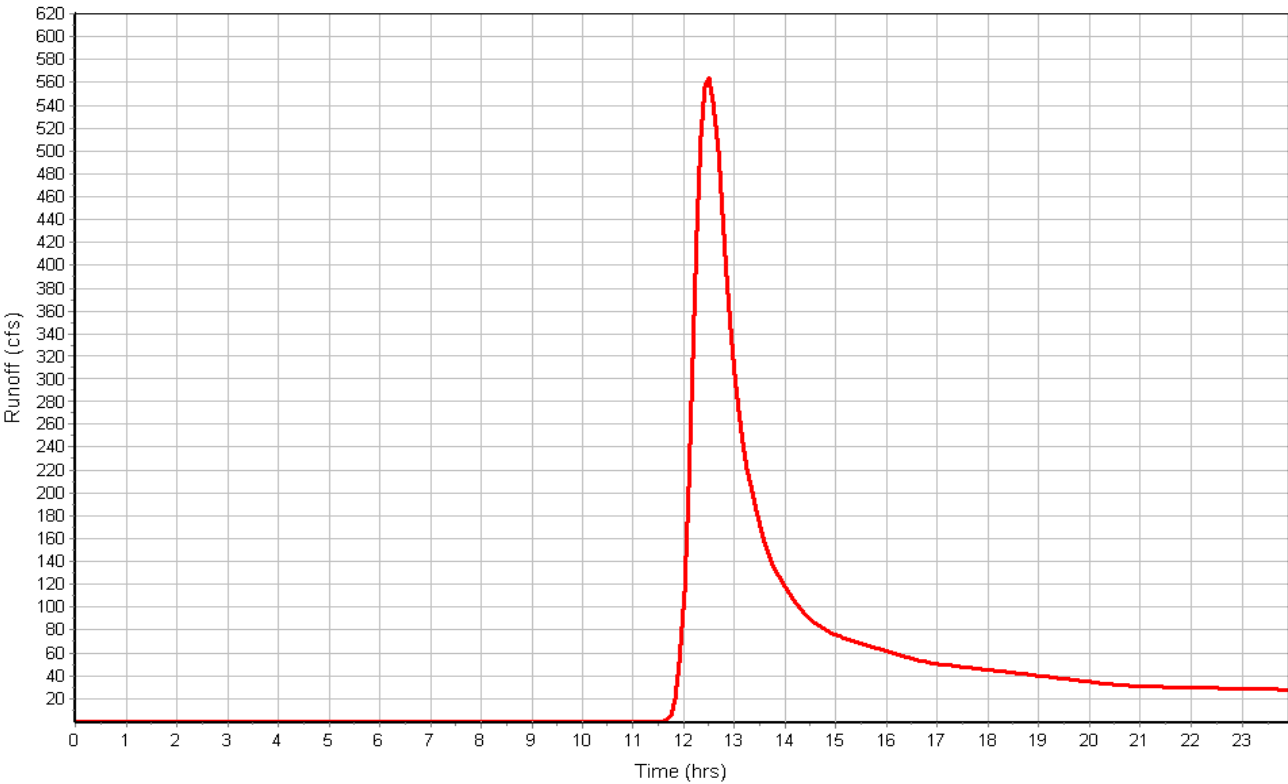


Subbasin : A

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Ba

### Input Data

Area (ac) ..... 3836.70  
Weighted Curve Number ..... 60.34  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	3759.97	B	60.00
5 Acre Lots, 7% Impervious	76.73	D	77.00
Composite Area & Weighted CN	3836.70		60.34

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	11.90	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	23284	0.00	0.00
Channel Slope (%) :	1.4	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	6.86	0.00	0.00
Computed Flow Time (min) :	56.59	0.00	0.00
Total TOC (min) .....	89.56		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.10  
Peak Runoff (cfs) ..... 1443.11  
Weighted Curve Number ..... 60.34  
Time of Concentration (days hh:mm:ss) ..... 0 01:29:34

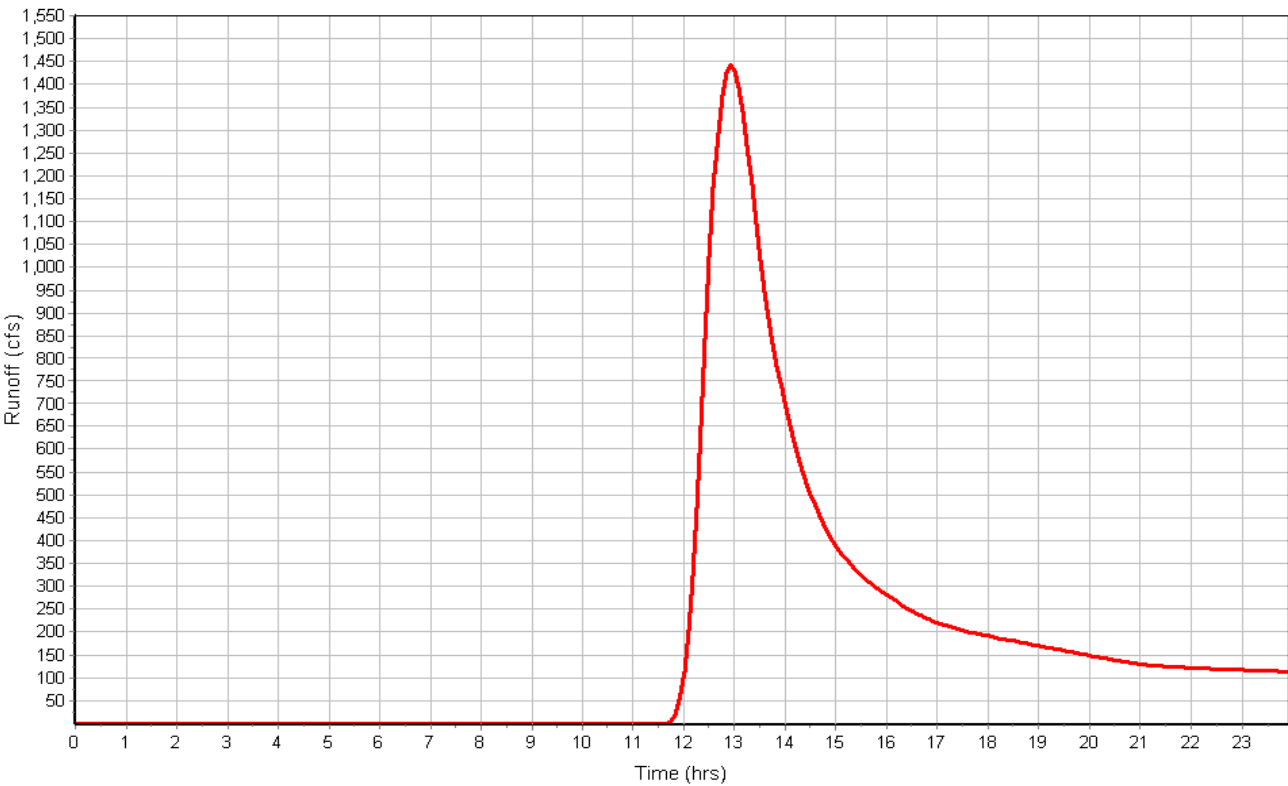


Subbasin : Ba

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Bb

### Input Data

Area (ac) ..... 100.60  
Weighted Curve Number ..... 69.79  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	90.54	B	69.00
Pasture, grassland, or range, Fair	5.03	D	84.00
Composite Area & Weighted CN	95.57		69.79

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.48	0.00	0.00
Computed Flow Time (min) :	11.26	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	4140	0.00	0.00
Channel Slope (%) :	2.4	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	8.98	0.00	0.00
Computed Flow Time (min) :	7.69	0.00	0.00
Total TOC (min) .....	40.00		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.73  
Peak Runoff (cfs) ..... 122.13  
Weighted Curve Number ..... 69.79  
Time of Concentration (days hh:mm:ss) ..... 0 00:40:00

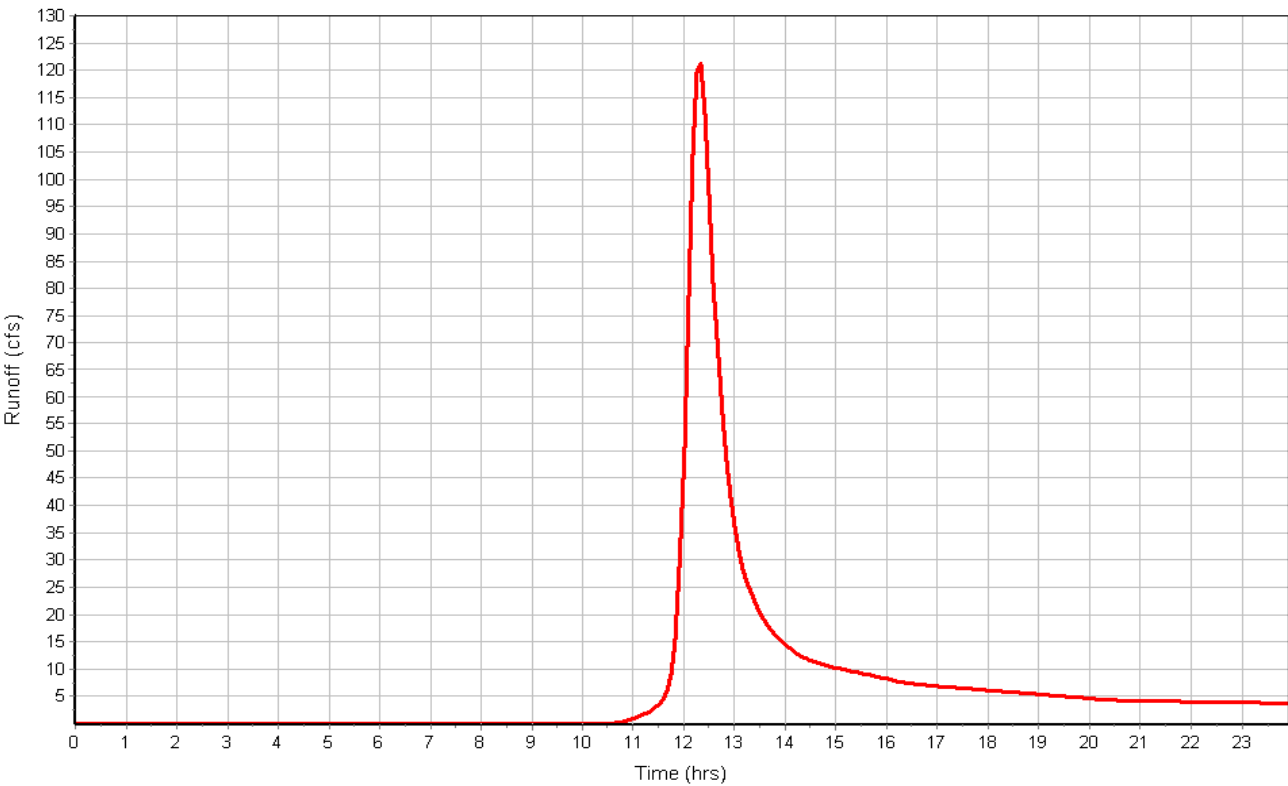


Subbasin : Bb

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Ca

### Input Data

Area (ac) ..... 162.70  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	162.70	B	60.00
Composite Area & Weighted CN	162.70		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0.00	0.00
Computed Flow Time (min) :	11.74	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	3099	0.00	0.00
Channel Slope (%) :	4.1	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	11.73	0.00	0.00
Computed Flow Time (min) :	4.40	0.00	0.00
Total TOC (min) .....	37.20		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 113.04  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:37:12

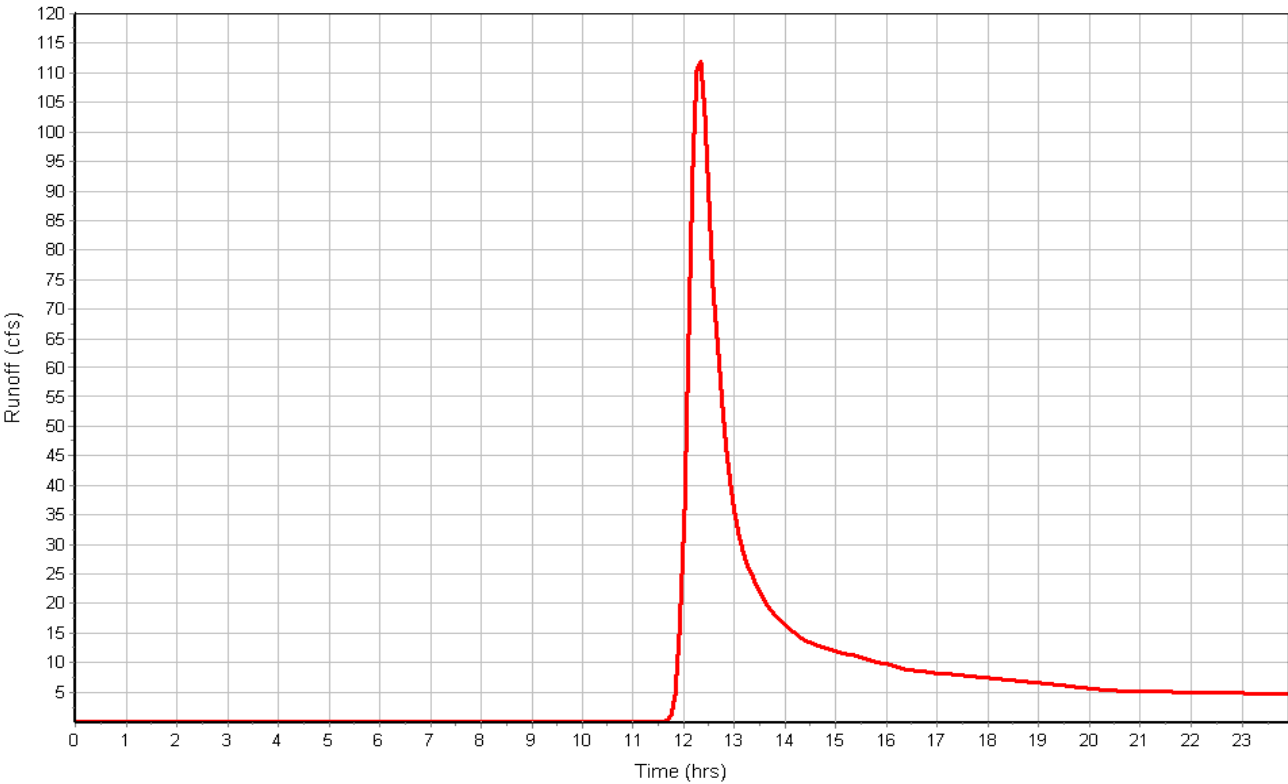


Subbasin : Ca

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Cb

### Input Data

Area (ac) ..... 70.00  
Weighted Curve Number ..... 68.70  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	10.50	B	65.00
Pasture, grassland, or range, Fair	2.10	C	79.00
Pasture, grassland, or range, Fair	57.40	B	69.00
Composite Area & Weighted CN	70.00		68.70

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.6	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.33	0.00	0.00
Computed Flow Time (min) :	12.53	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	2084	0.00	0.00
Channel Slope (%) :	3.6	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.08	0.00	0.00
Computed Flow Time (min) :	3.83	0.00	0.00
Total TOC (min) .....	37.42		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.65  
Peak Runoff (cfs) ..... 84.46  
Weighted Curve Number ..... 68.70  
Time of Concentration (days hh:mm:ss) ..... 0 00:37:25

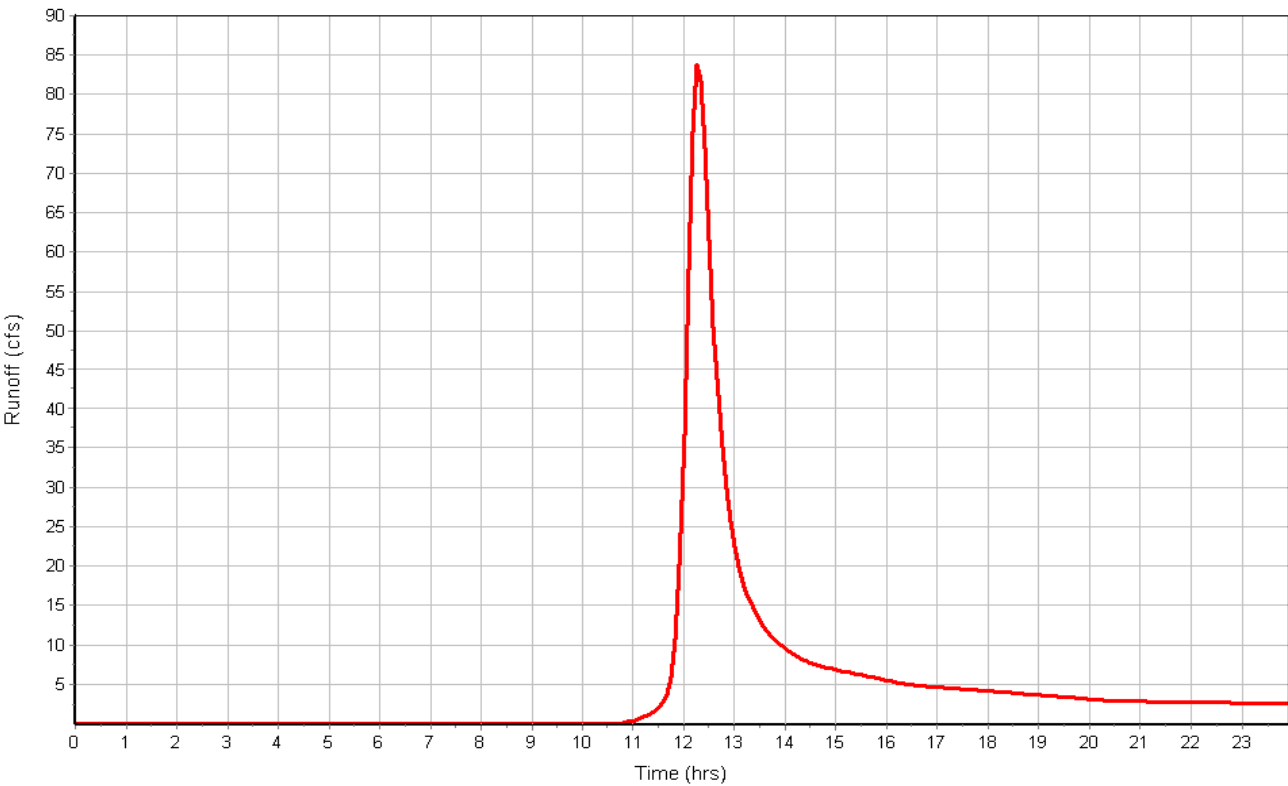


Subbasin : Cb

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Da

### Input Data

Area (ac) ..... 161.30  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	161.30	B	60.00
Composite Area & Weighted CN	161.30		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.7	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0.00	0.00
Computed Flow Time (min) :	14.01	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1601	0.00	0.00
Channel Slope (%) :	5.7	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	13.84	0.00	0.00
Computed Flow Time (min) :	1.93	0.00	0.00
Total TOC (min) .....	36.99		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 112.52  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:36:59

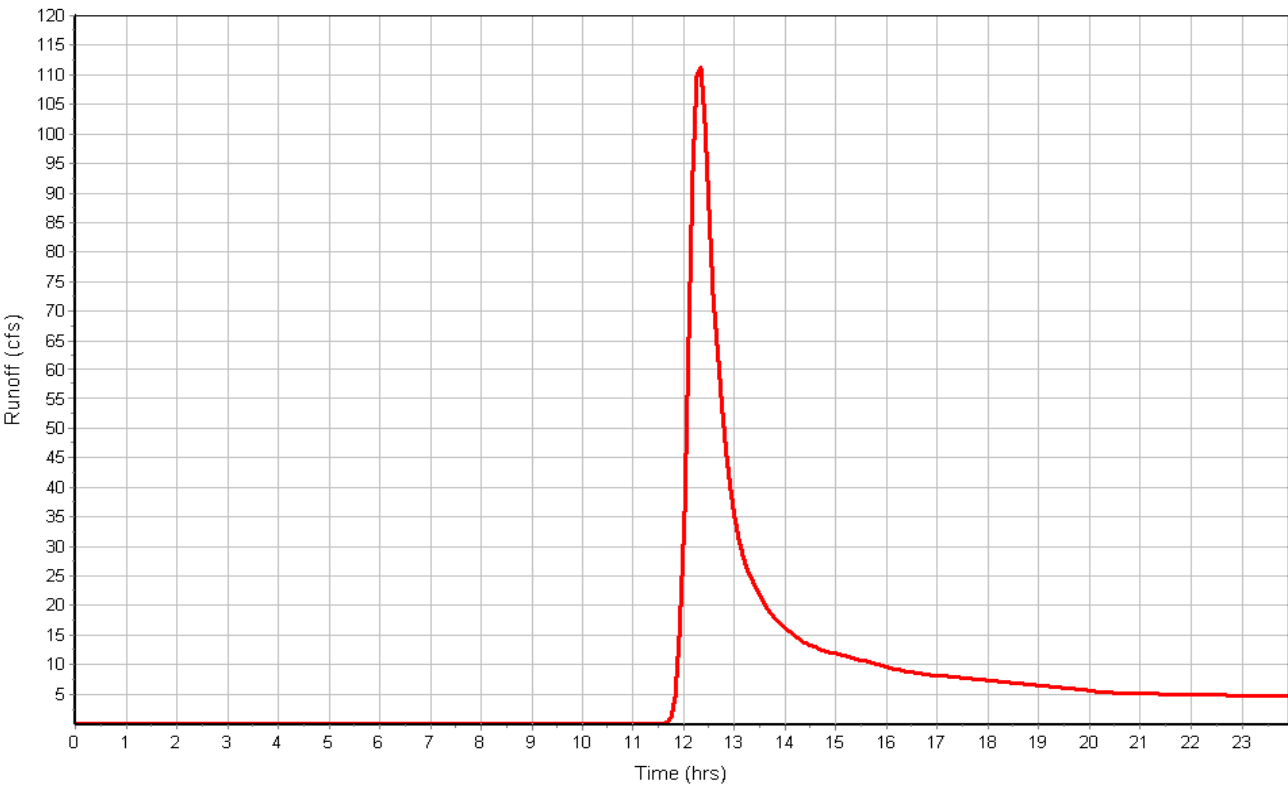


Subbasin : Da

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Db

### Input Data

Area (ac) ..... 49.90  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	49.90	B	60.00
Composite Area & Weighted CN	49.90		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.48	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	0.79	0.00	0.00
Computed Flow Time (min) :	21.10	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	922	0.00	0.00
Channel Slope (%) :	2.48	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.53	0.00	0.00
Computed Flow Time (min) :	2.04	0.00	0.00
Total TOC (min) .....	44.20		

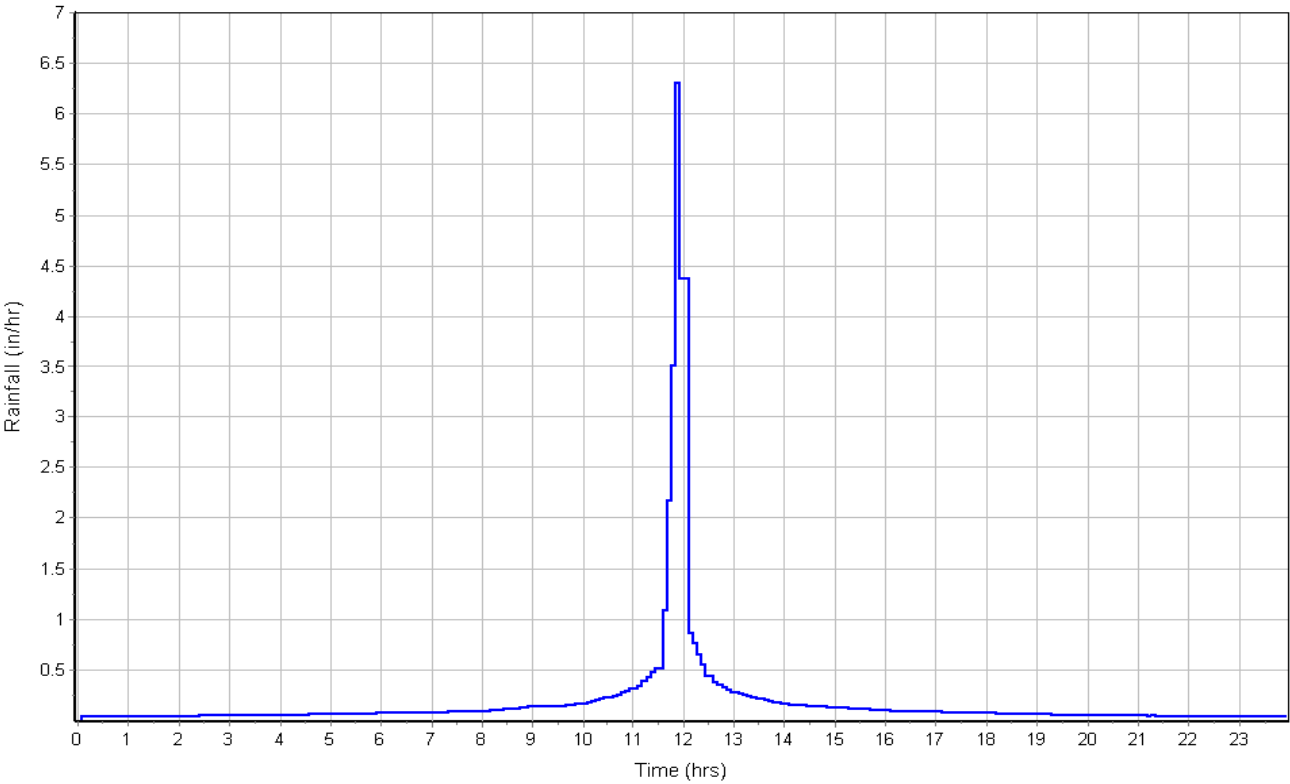
### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 30.63  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:44:12

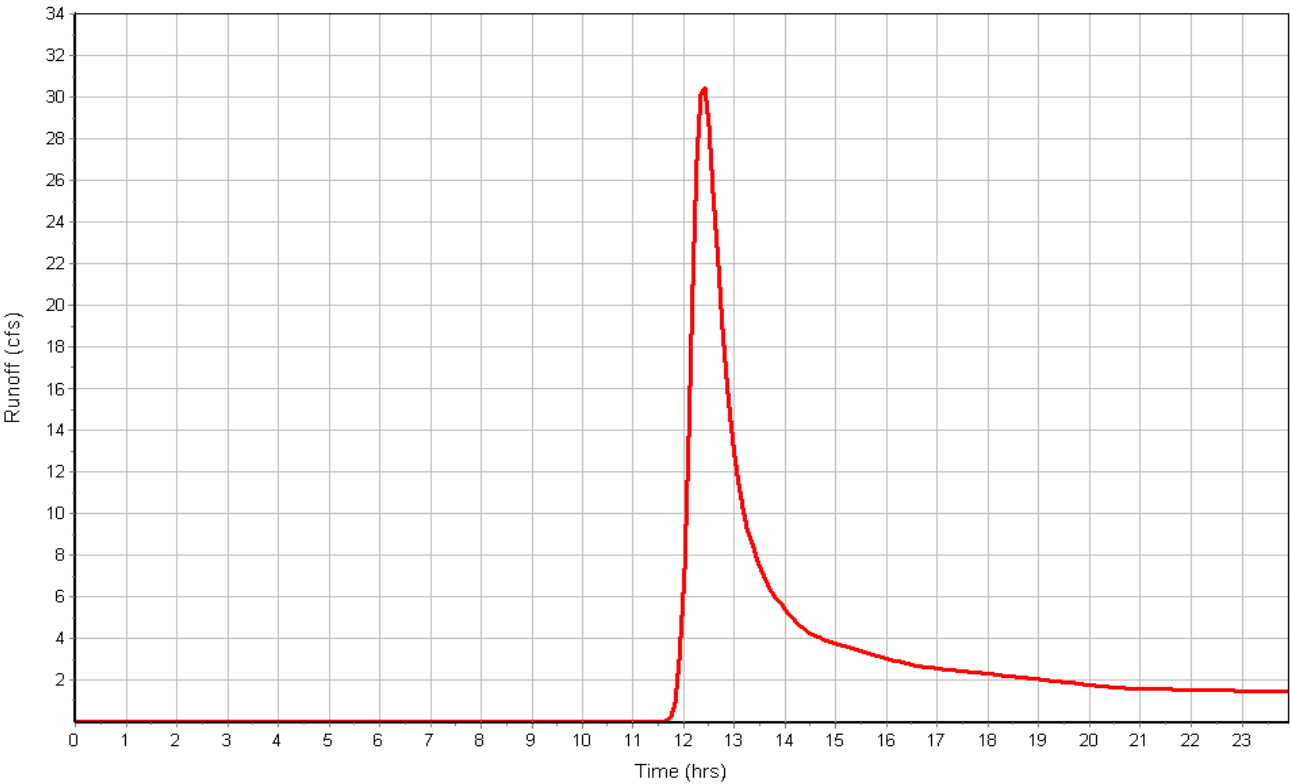


Subbasin : Db

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Dc

### Input Data

Area (ac) ..... 249.70  
Weighted Curve Number ..... 67.70  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	83.80	B	65.00
Pasture, grassland, or range, Fair	4.19	D	84.00
Pasture, grassland, or range, Fair	121.51	B	69.00
Composite Area & Weighted CN	209.50		67.70

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.21	0.00	0.00
Computed Flow Time (min) :	13.77	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	3678	0.00	0.00
Channel Slope (%) :	3	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	10.04	0.00	0.00
Computed Flow Time (min) :	6.11	0.00	0.00
Total TOC (min) .....	40.94		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.58  
Peak Runoff (cfs) ..... 267.69  
Weighted Curve Number ..... 67.70  
Time of Concentration (days hh:mm:ss) ..... 0 00:40:56

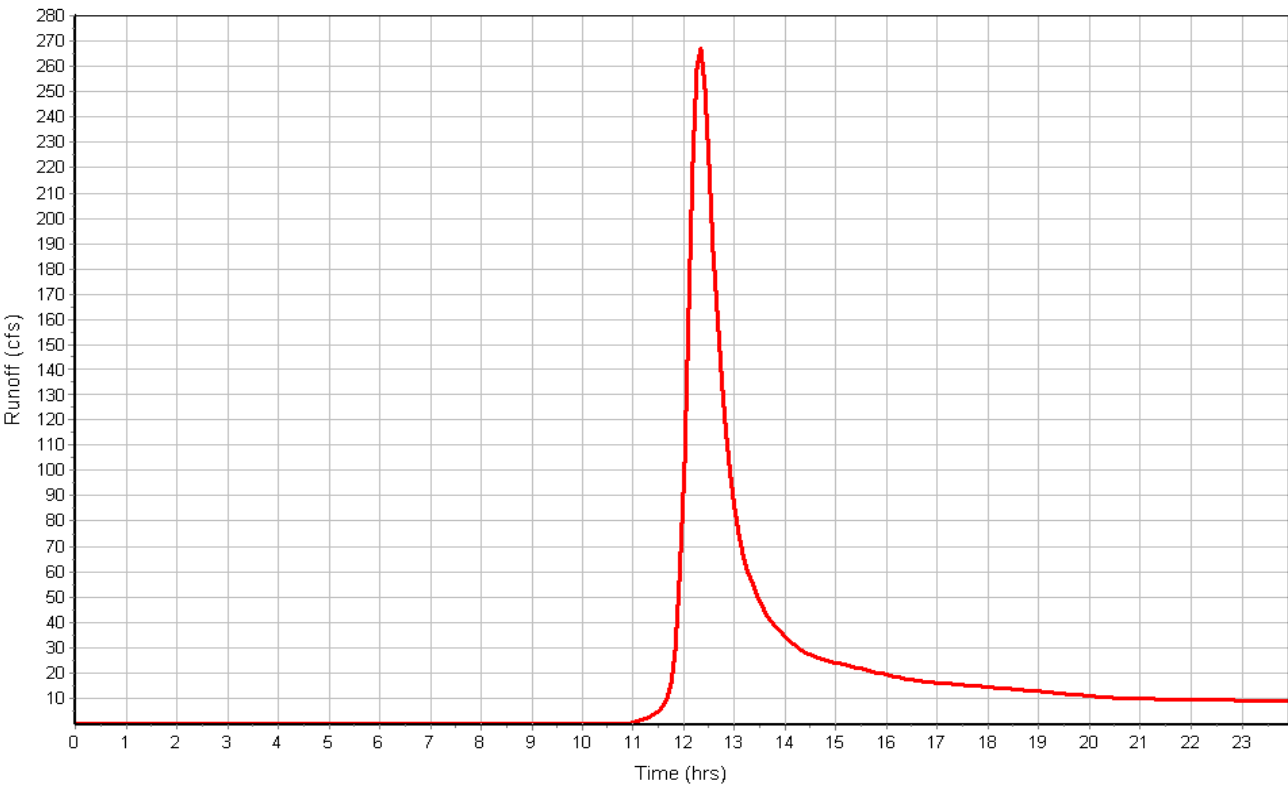


Subbasin : Dc

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Ea

### Input Data

Area (ac) ..... 37.90  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	37.90	B	60.00
Composite Area & Weighted CN	37.90		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	4.9	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.11	0.00	0.00
Computed Flow Time (min) :	7.51	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1227	0.00	0.00
Channel Slope (%) :	4.9	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.59	0.00	0.00
Computed Flow Time (min) :	1.93	0.00	0.00
Total TOC (min) .....	30.50		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 30.18  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:30:30

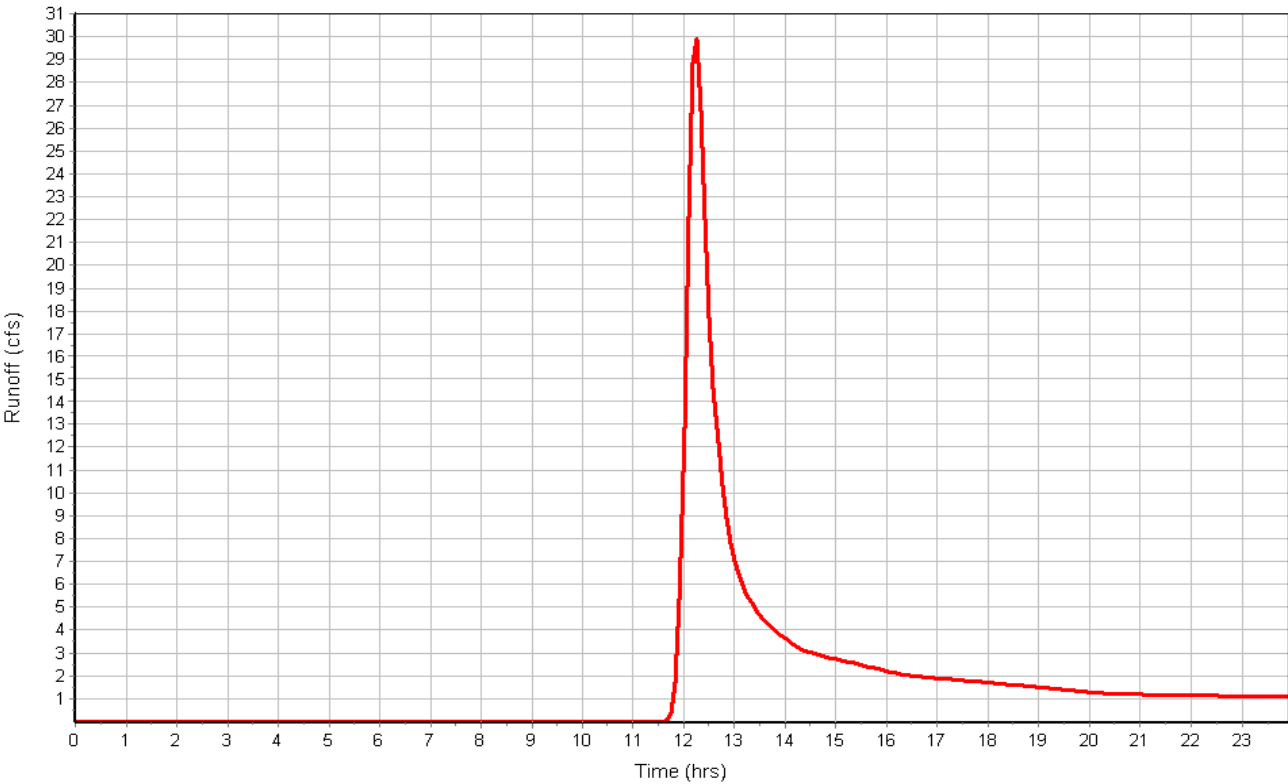


Subbasin : Ea

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : Eb

### Input Data

Area (ac) ..... 74.60  
Weighted Curve Number ..... 67.20  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	91.84	B	69.00
5 Acre Lots, 7% Impervious	22.96	B	60.00
Composite Area & Weighted CN	114.80		67.20

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	12.25	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	2766	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	4.94	0.00	0.00
Total TOC (min) .....	38.26		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.54  
Peak Runoff (cfs) ..... 81.57  
Weighted Curve Number ..... 67.20  
Time of Concentration (days hh:mm:ss) ..... 0 00:38:16

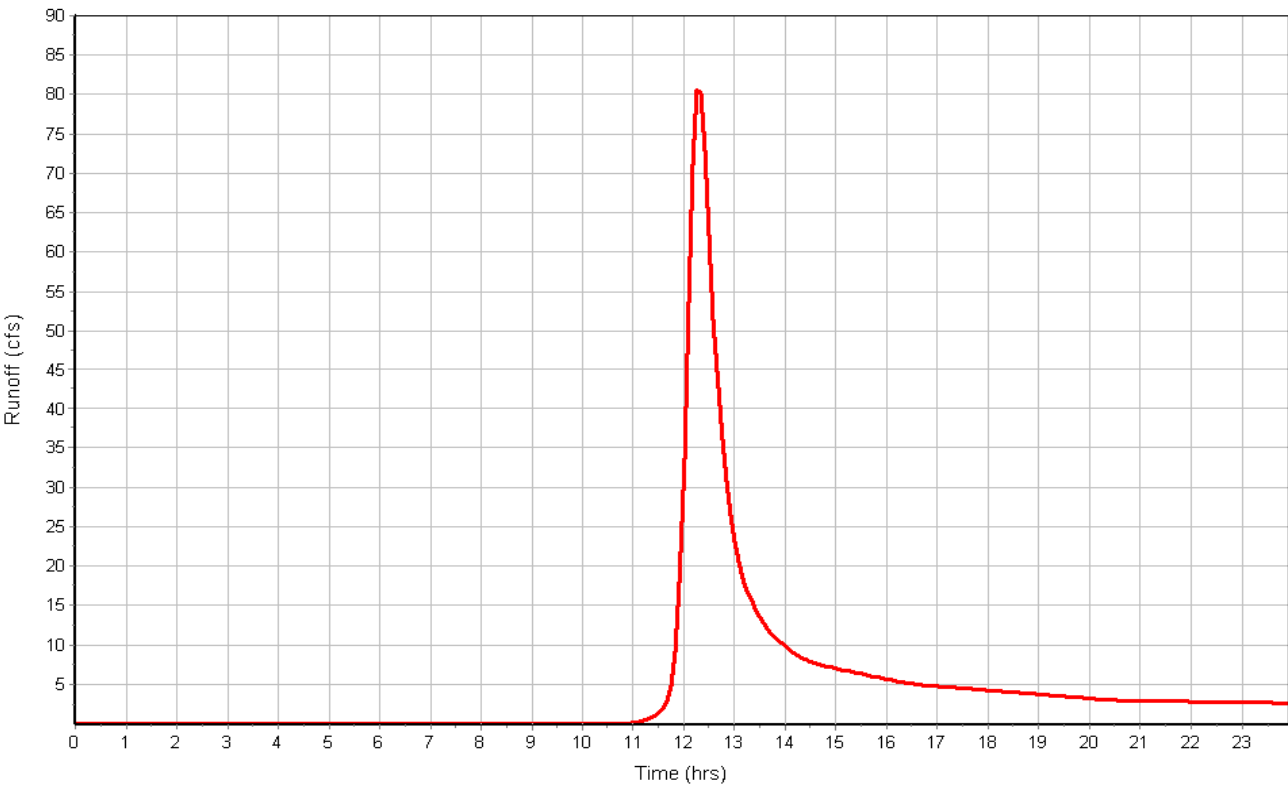


Subbasin : Eb

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : F

### Input Data

Area (ac) ..... 44.50  
Weighted Curve Number ..... 69.00  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	44.50	B	69.00
Composite Area & Weighted CN	44.50		69.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.25	0.00	0.00
Computed Flow Time (min) :	13.33	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1707	0.00	0.00
Channel Slope (%) :	3.2	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.56	0.00	0.00
Computed Flow Time (min) :	3.32	0.00	0.00
Total TOC (min) .....	37.72		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.67  
Peak Runoff (cfs) ..... 54.18  
Weighted Curve Number ..... 69.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:37:43

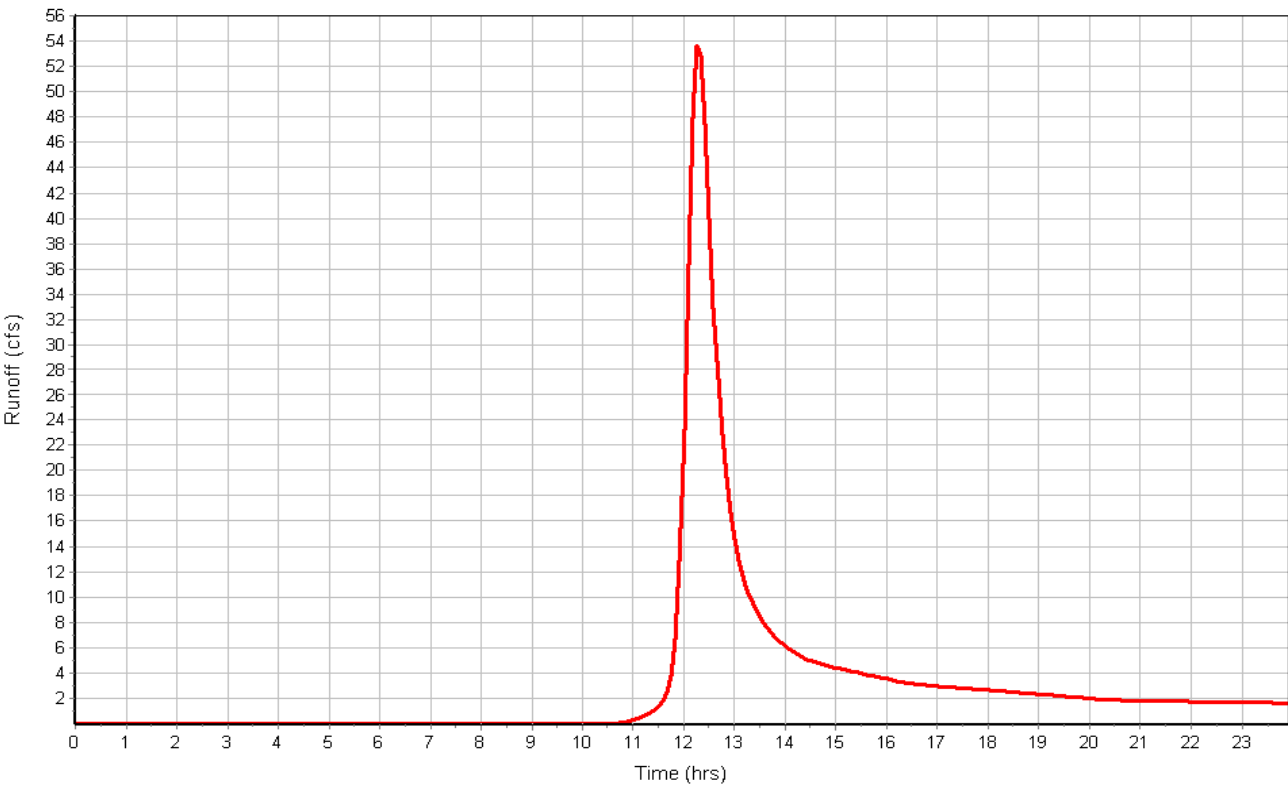


Subbasin : F

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : G

### Input Data

Area (ac) ..... 107.60  
Weighted Curve Number ..... 74.50  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	59.18	C	79.00
Pasture, grassland, or range, Fair	48.42	B	69.00
Composite Area & Weighted CN	107.60		74.50

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.7	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	10.96	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1441	0.00	0.00
Channel Slope (%) :	4.7	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	12.56	0.00	0.00
Computed Flow Time (min) :	1.91	0.00	0.00
Total TOC (min) .....	33.93		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.09  
Peak Runoff (cfs) ..... 181.44  
Weighted Curve Number ..... 74.50  
Time of Concentration (days hh:mm:ss) ..... 0 00:33:56

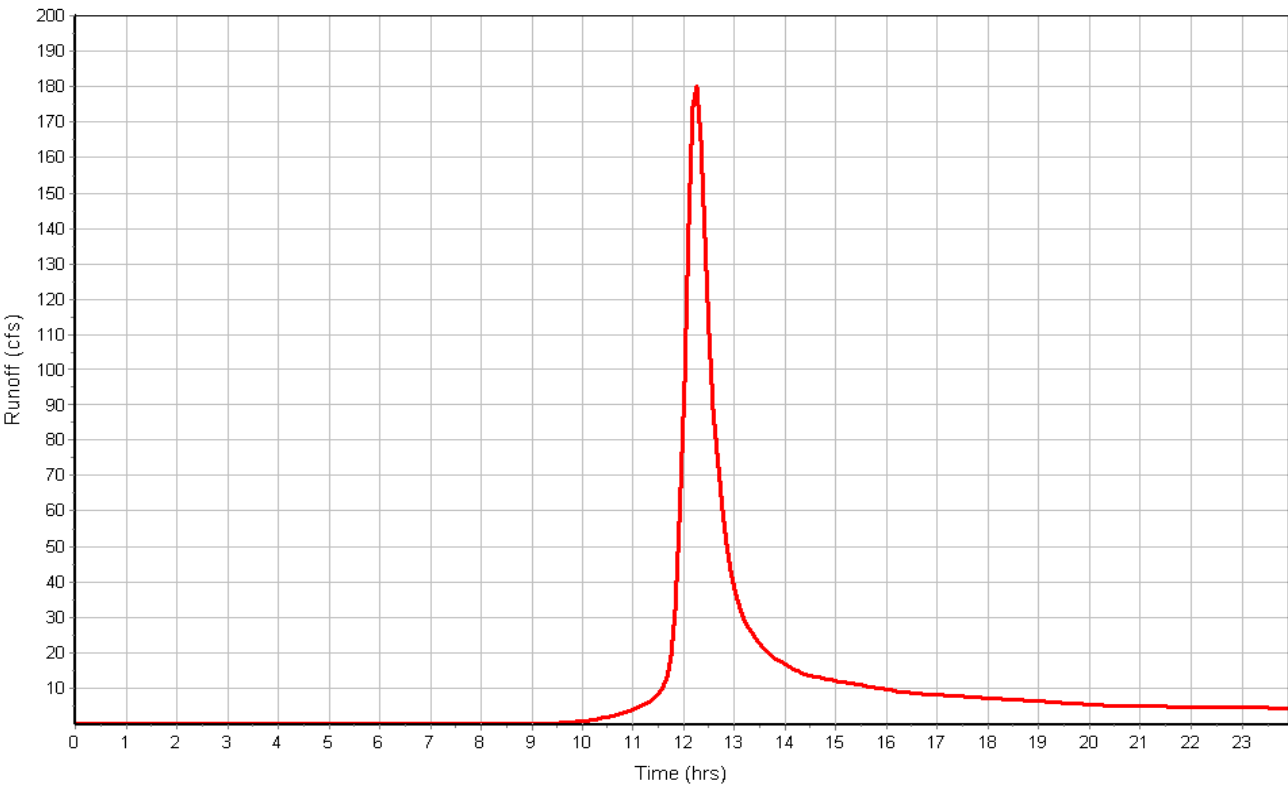


Subbasin : G

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H

### Input Data

Area (ac) ..... 121.80  
Weighted Curve Number ..... 71.76  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	54.81	C	79.00
Woods, Fair	31.67	B	60.00
Pasture, grassland, or range, Fair	30.45	B	69.00
Pasture, grassland, or range, Fair	4.87	D	84.00
Composite Area & Weighted CN	121.80		71.76

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2.00	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.43	0.00	0.00
Computed Flow Time (min) :	11.66	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	676	0.00	0.00
Channel Slope (%) :	4.2	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	11.88	0.00	0.00
Computed Flow Time (min) :	0.95	0.00	0.00
Total TOC (min) .....	33.66		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.88  
Peak Runoff (cfs) ..... 182.91  
Weighted Curve Number ..... 71.76  
Time of Concentration (days hh:mm:ss) ..... 0 00:33:40

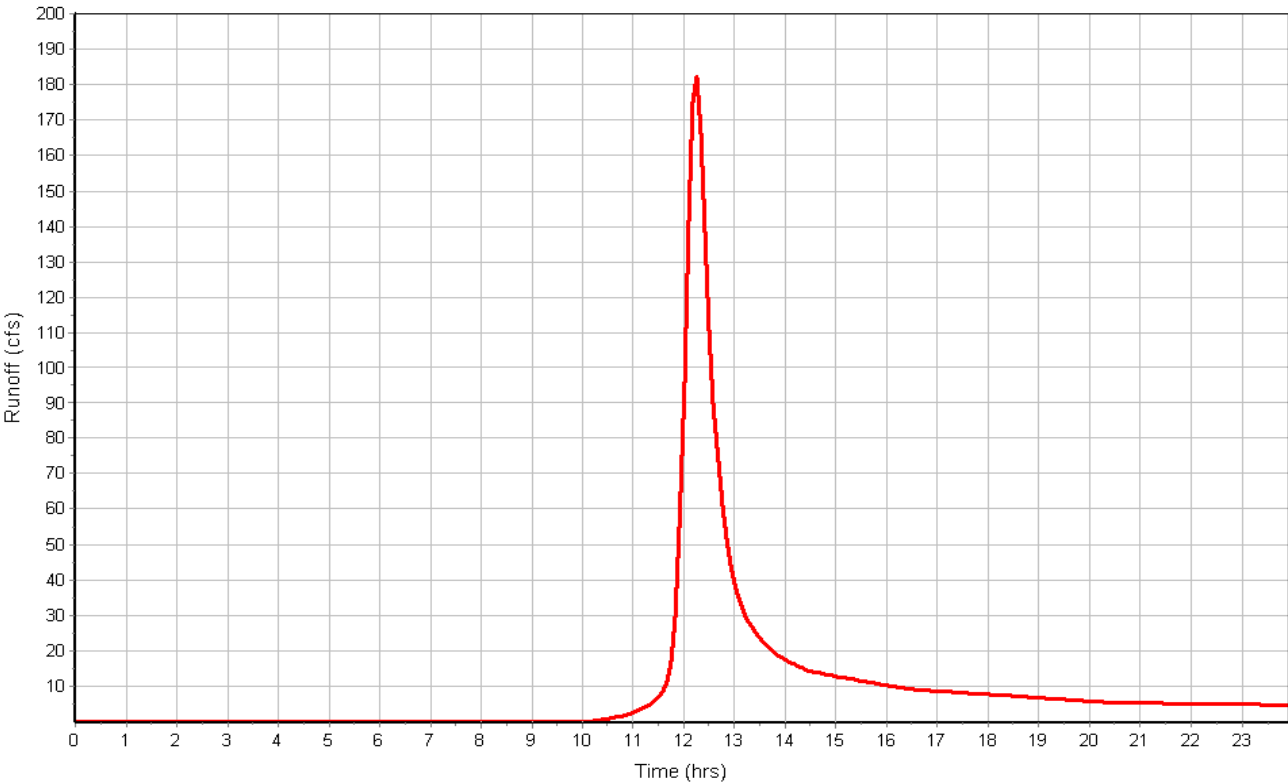


Subbasin : H

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : I

### Input Data

Area (ac) ..... 37.50  
Weighted Curve Number ..... 79.00  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	37.50	C	79.00
Composite Area & Weighted CN	37.50		79.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.58	0.00	0.00
Computed Flow Time (min) :	10.55	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	134	0.00	0.00
Channel Slope (%) :	5.1	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.80	0.00	0.00
Computed Flow Time (min) :	0.21	0.00	0.00
Total TOC (min) .....	31.81		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.46  
Peak Runoff (cfs) ..... 78.32  
Weighted Curve Number ..... 79.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:31:49

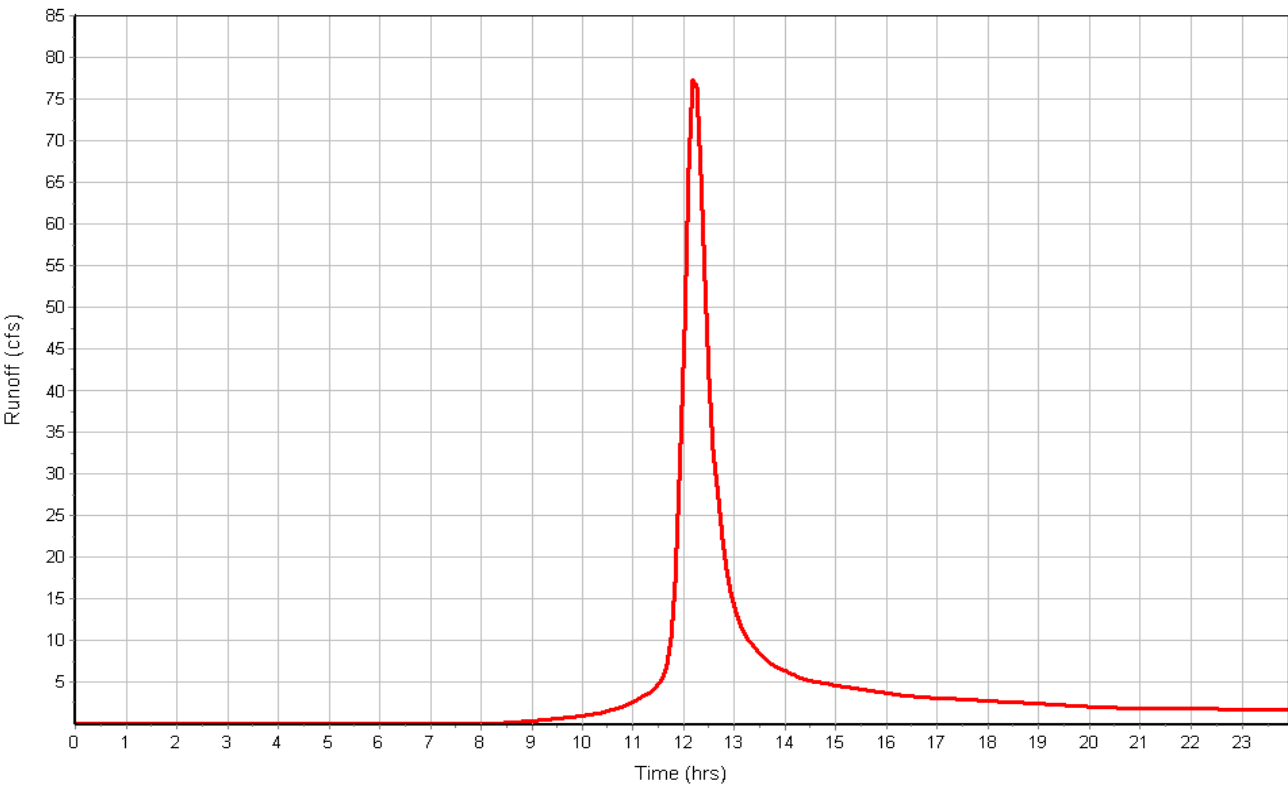


Subbasin : I

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : J

### Input Data

Area (ac) ..... 10.10  
Weighted Curve Number ..... 69.50  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Fair	5.05	B	60.00
Woods, Fair	5.05	D	79.00
Composite Area & Weighted CN	10.10		69.50

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	8.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	2.08	0.00	0.00
Computed Flow Time (min) :	1.60	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	228	0.00	0.00
Channel Slope (%) :	8.8	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	14.19	0.00	0.00
Computed Flow Time (min) :	0.27	0.00	0.00
Total TOC (min) .....	22.93		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.71  
Peak Runoff (cfs) ..... 17.21  
Weighted Curve Number ..... 69.50  
Time of Concentration (days hh:mm:ss) ..... 0 00:22:56

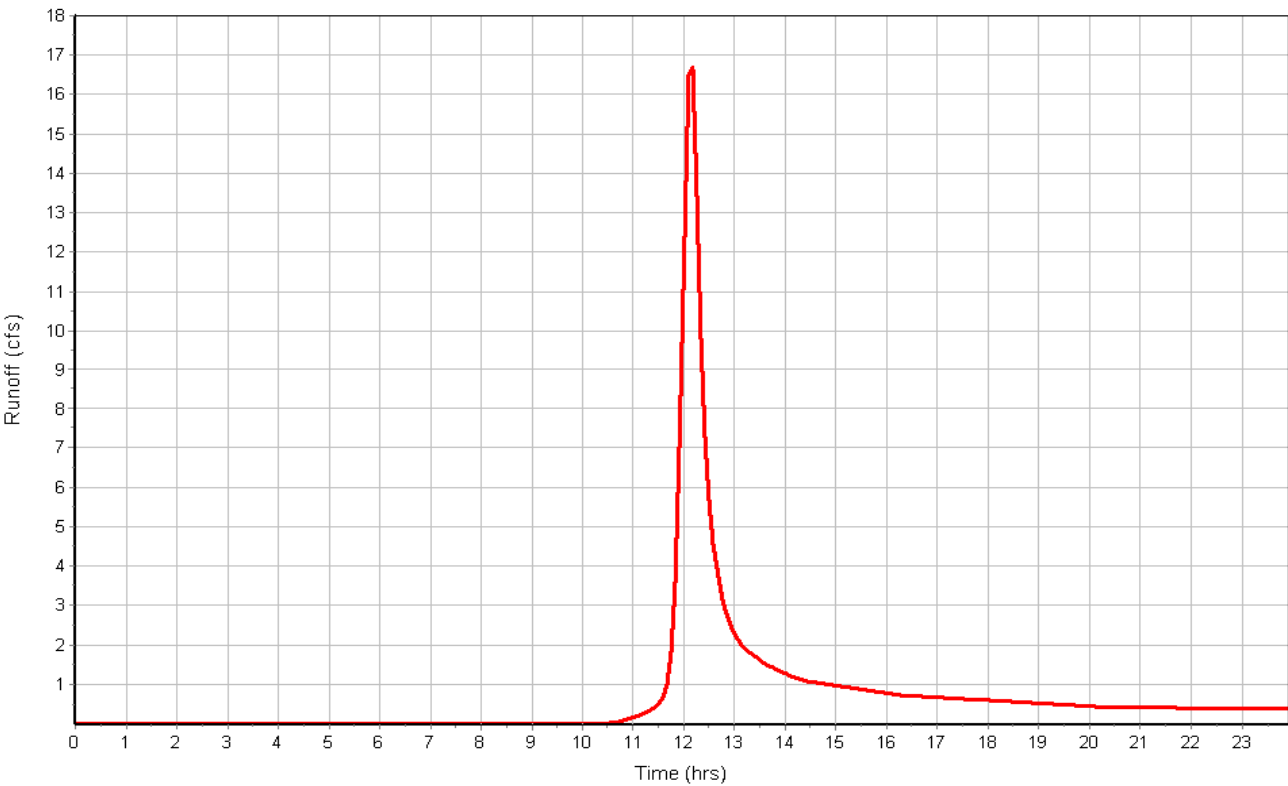


Subbasin : J

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : K

### Input Data

Area (ac) ..... 17.80  
Weighted Curve Number ..... 76.00  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	17.80	C	76.00
Composite Area & Weighted CN	17.80		76.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	3.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.38	0.00	0.00
Computed Flow Time (min) :	2.42	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	354	0.00	0.00
Channel Slope (%) :	3.9	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.45	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00
Total TOC (min) .....	24.10		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.21  
Peak Runoff (cfs) ..... 39.26  
Weighted Curve Number ..... 76.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:24:06

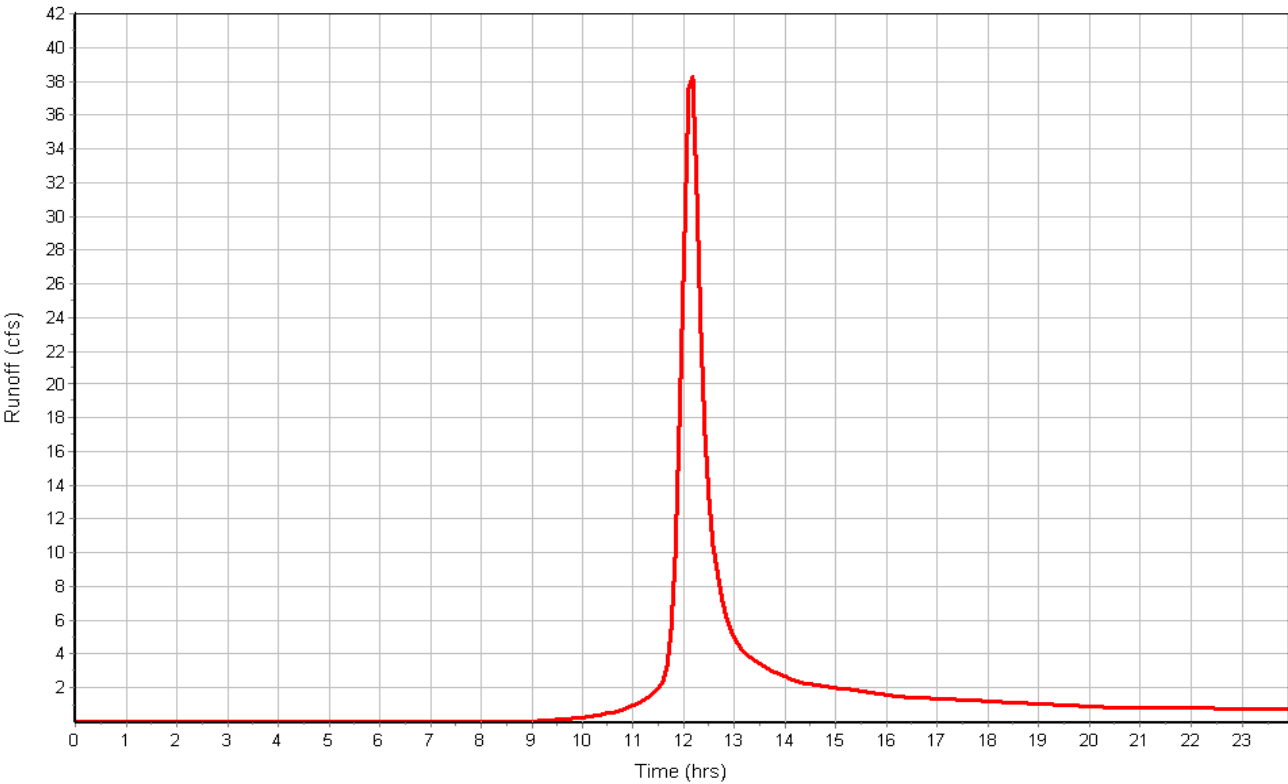


Subbasin : K

Rainfall Intensity Graph



Runoff Hydrograph





# Subbasin Hydrology

## Subbasin : A1

### Input Data

Area (ac) ..... 865.90  
Weighted Curve Number ..... 60.36  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	839.92	B	60.00
Pasture, grassland, or range, Fair	8.66	D	84.00
5 Acre Lots, 7% Impervious	8.66	C	72.00
Composite Area & Weighted CN	857.24		60.36

### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

$T_c$  = Time of Concentration (hr)  
 $n$  = Manning's roughness  
 $L_f$  = Flow Length (ft)  
 $P$  = 2 yr, 24 hr Rainfall (inches)  
 $S_f$  = Slope (ft/ft)

Shallow Concentrated Flow Equation :

$V = 16.1345 * (S_f^{0.5})$  (unpaved surface)  
 $V = 20.3282 * (S_f^{0.5})$  (paved surface)  
 $V = 15.0 * (S_f^{0.5})$  (grassed waterway surface)  
 $V = 10.0 * (S_f^{0.5})$  (nearly bare & untilled surface)  
 $V = 9.0 * (S_f^{0.5})$  (cultivated straight rows surface)  
 $V = 7.0 * (S_f^{0.5})$  (short grass pasture surface)  
 $V = 5.0 * (S_f^{0.5})$  (woodland surface)  
 $V = 2.5 * (S_f^{0.5})$  (forest w/heavy litter surface)  
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where:

$T_c$  = Time of Concentration (hr)  
 $L_f$  = Flow Length (ft)  
 $V$  = Velocity (ft/sec)  
 $S_f$  = Slope (ft/ft)

Channel Flow Equation :

$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$   
 $R = A_q / W_p$   
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where :

$T_c$  = Time of Concentration (hr)  
 $L_f$  = Flow Length (ft)  
 $R$  = Hydraulic Radius (ft)  
 $A_q$  = Flow Area (ft<sup>2</sup>)  
 $W_p$  = Wetted Perimeter (ft)  
 $V$  = Velocity (ft/sec)  
 $S_f$  = Slope (ft/ft)  
 $n$  = Manning's roughness



Sheet Flow Computations	Flowpath	Flowpath	Flowpath
	A	B	C
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations	Flowpath	Flowpath	Flowpath
	A	B	C
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	10.62	0.00	0.00
Channel Flow Computations	Flowpath	Flowpath	Flowpath
	A	B	C
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	12115	0.00	0.00
Channel Slope (%) :	1.8	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	7.78	0.00	0.00
Computed Flow Time (min) :	25.97	0.00	0.00
Total TOC (min) .....	57.64		

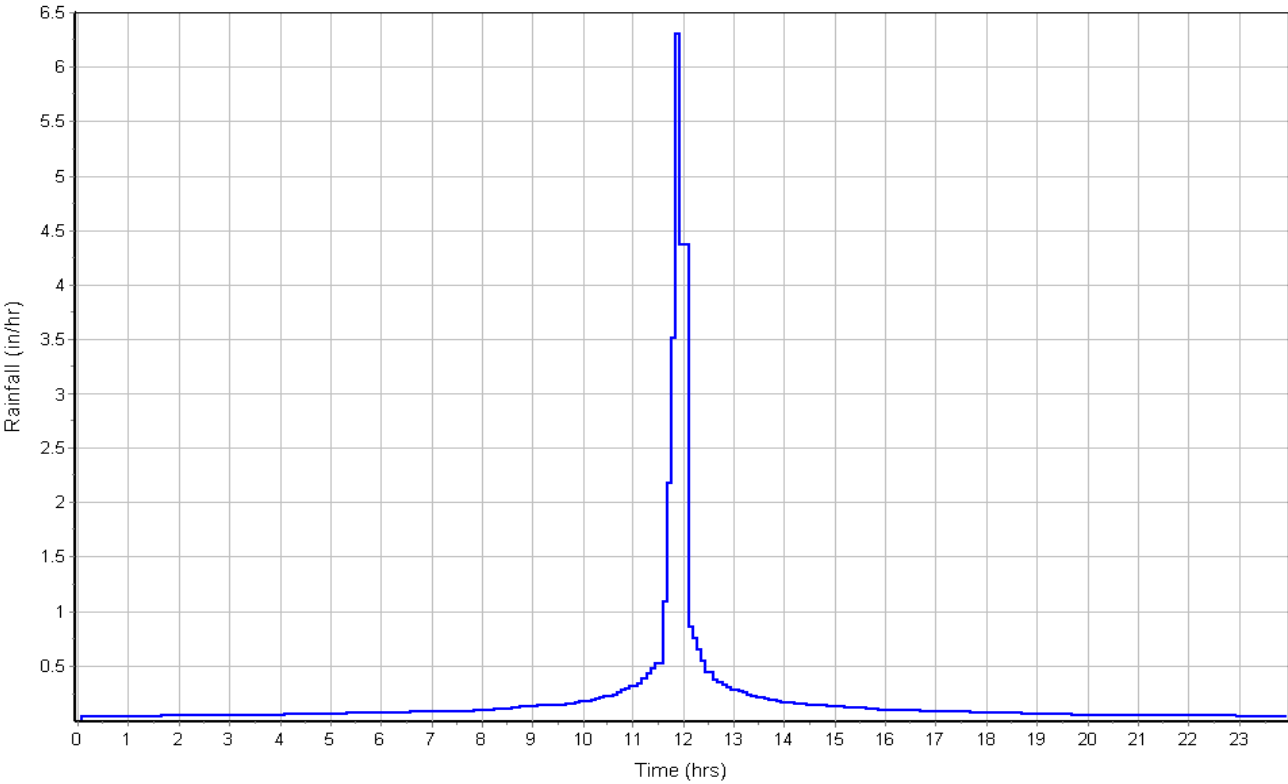
### Subbasin Runoff Results

Total Rainfall (in) .....	4.60
Total Runoff (in) .....	1.10
Peak Runoff (cfs) .....	451.68
Weighted Curve Number .....	60.36
Time of Concentration (days hh:mm:ss) .....	0 00:57:38

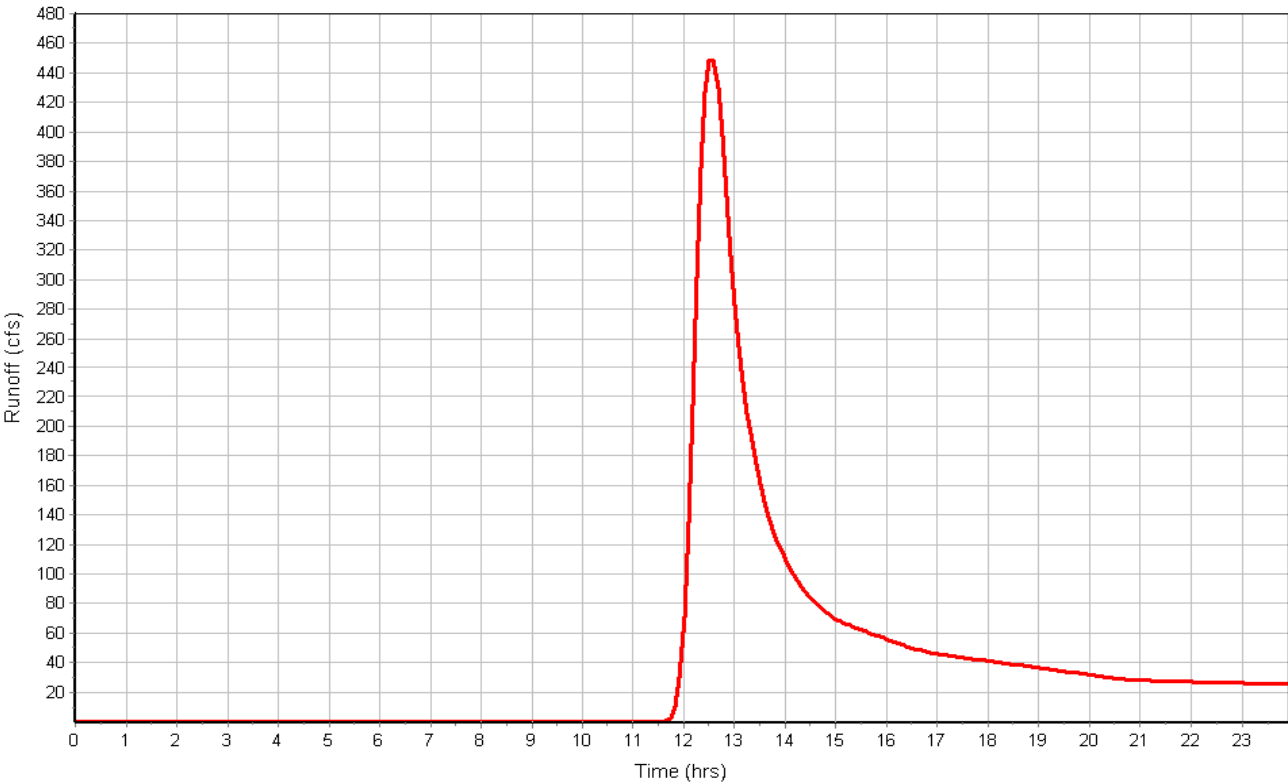


Subbasin : A1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : A2

### Input Data

Area (ac) ..... 37.00  
Weighted Curve Number ..... 66.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	18.50	C	72.00
5 Acre Lots, 7% Impervious	18.50	B	60.00
Composite Area & Weighted CN	37.00		66.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0.00	0.00
Computed Flow Time (min) :	14.01	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1157	0.00	0.00
Channel Slope (%) :	2.9	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.15	0.00	0.00
Computed Flow Time (min) :	2.37	0.00	0.00
Total TOC (min) .....	37.43		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.46  
Peak Runoff (cfs) ..... 38.33  
Weighted Curve Number ..... 66.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:37:26

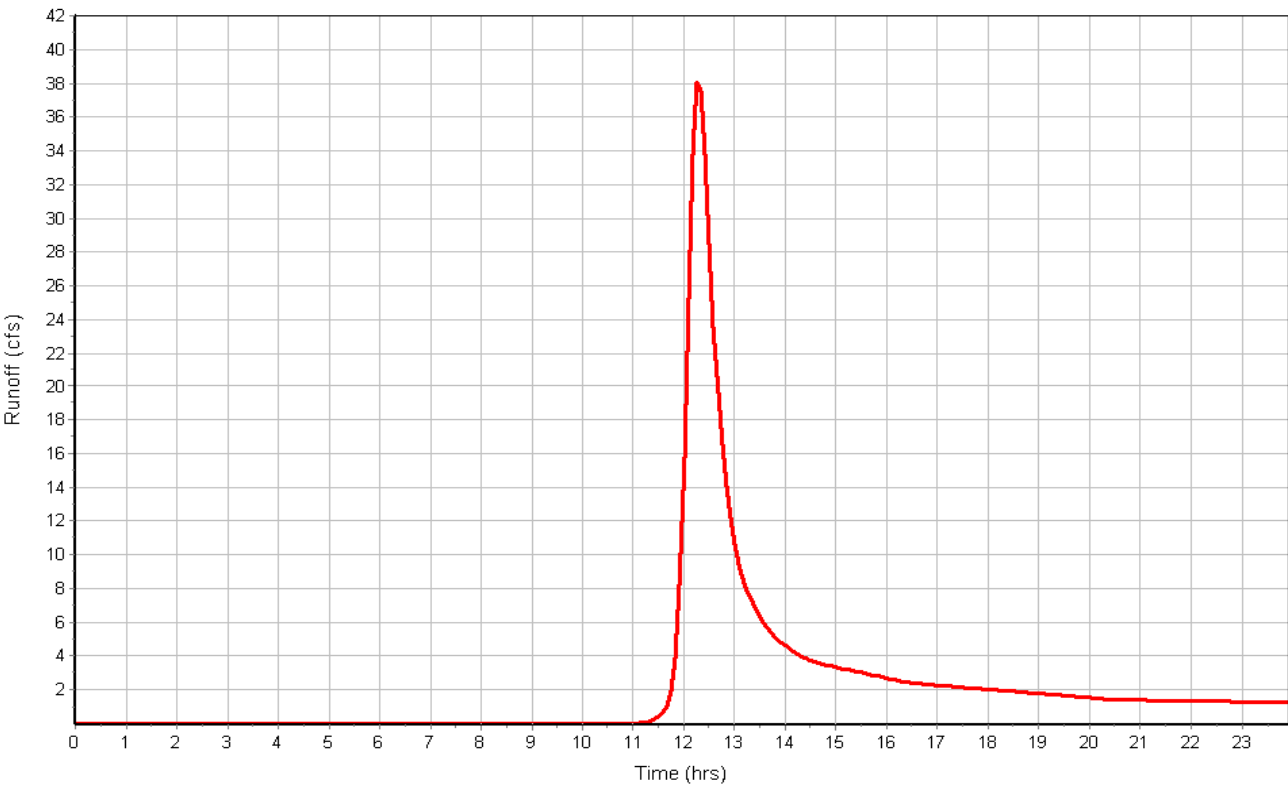


Subbasin : A2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : A3

### Input Data

Area (ac) ..... 41.48  
Weighted Curve Number ..... 76.50  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	20.74	C	72.00
Pasture, grassland, or range, Fair	8.30	D	84.00
Pasture, grassland, or range, Fair	12.44	C	79.00
Composite Area & Weighted CN	41.48		76.50

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.53	0.00	0.00
Computed Flow Time (min) :	10.89	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1188	0.00	0.00
Channel Slope (%) :	4.8	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.48	0.00	0.00
Computed Flow Time (min) :	1.89	0.00	0.00
Total TOC (min) .....	33.84		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.25  
Peak Runoff (cfs) ..... 76.08  
Weighted Curve Number ..... 76.50  
Time of Concentration (days hh:mm:ss) ..... 0 00:33:50

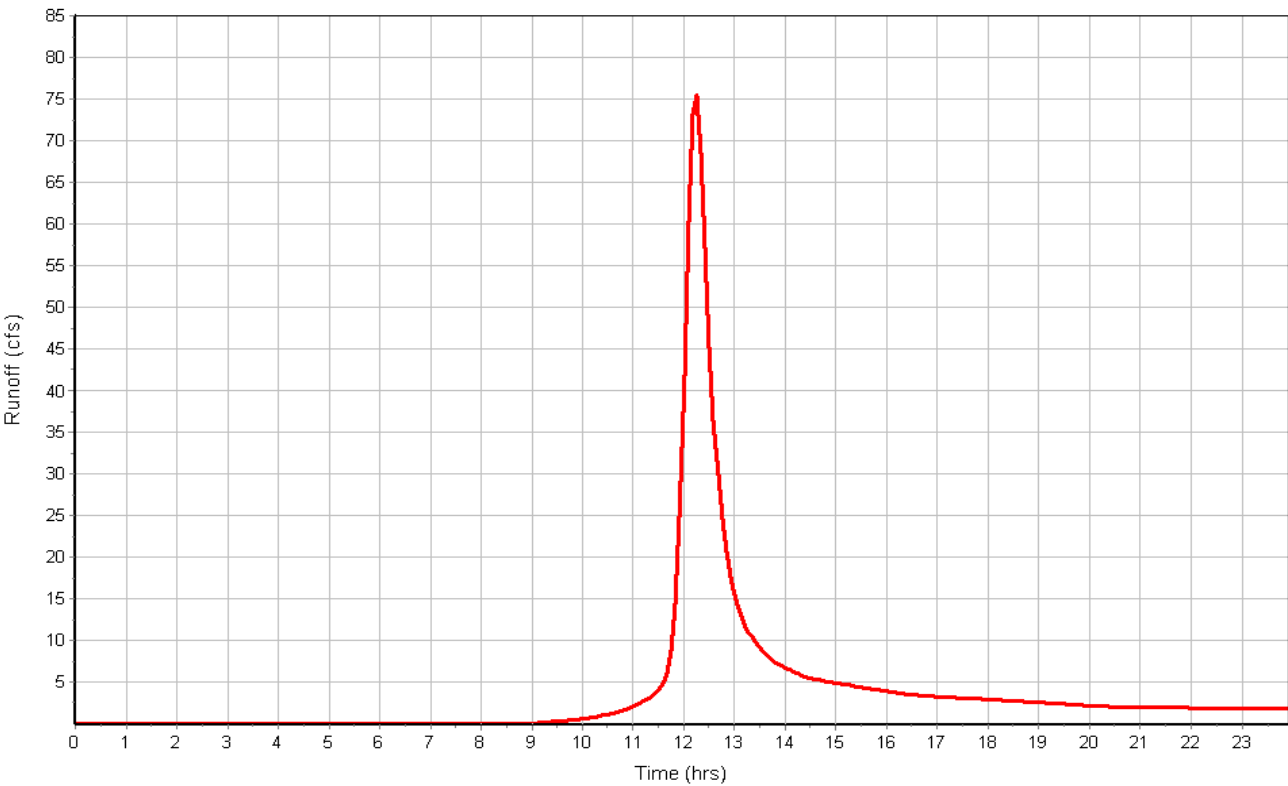


Subbasin : A3

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : B1

### Input Data

Area (ac) ..... 3836.70  
Weighted Curve Number ..... 60.34  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	3759.97	B	60.00
5 Acre Lots, 7% Impervious	76.73	D	77.00
Composite Area & Weighted CN	3836.70		60.34

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	11.90	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	20154	0.00	0.00
Channel Slope (%) :	1.3	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	6.61	0.00	0.00
Computed Flow Time (min) :	50.83	0.00	0.00
Total TOC (min) .....	83.80		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.10  
Peak Runoff (cfs) ..... 1515.68  
Weighted Curve Number ..... 60.34  
Time of Concentration (days hh:mm:ss) ..... 0 01:23:48

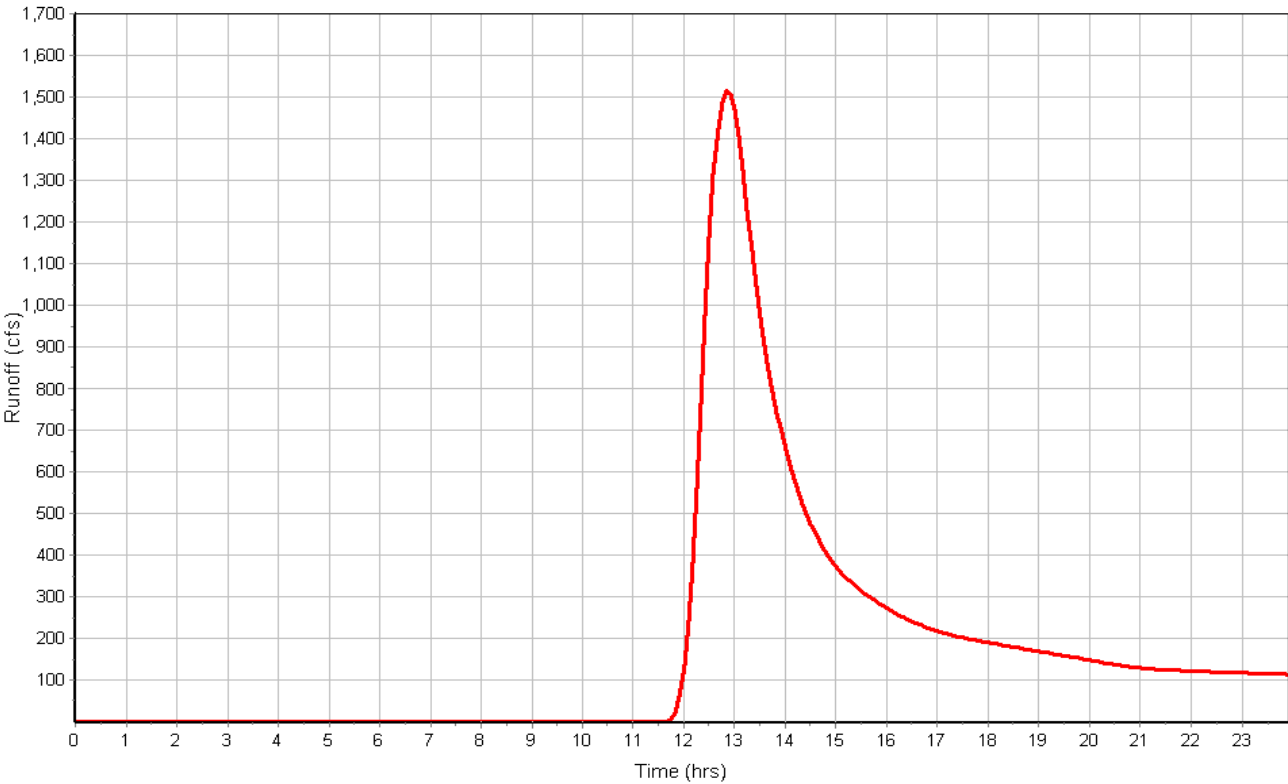


Subbasin : B1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : B2

### Input Data

Area (ac) ..... 13.10  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	13.10	B	64.00
Composite Area & Weighted CN	13.10		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	5.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.60	0.00	0.00
Computed Flow Time (min) :	3.13	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	177	0.00	0.00
Channel Slope (%) :	5.2	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.91	0.00	0.00
Computed Flow Time (min) :	0.27	0.00	0.00
Total TOC (min) .....	24.45		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 15.92  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:24:27

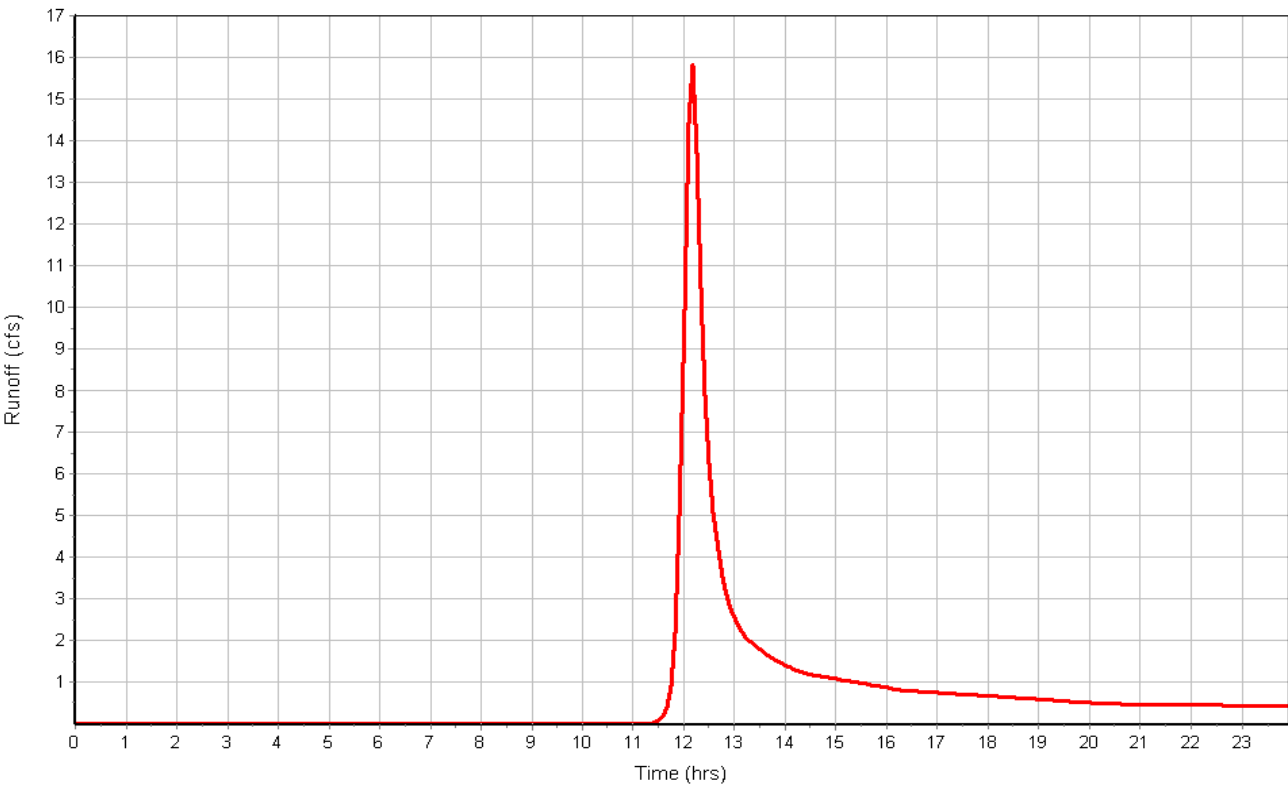


Subbasin : B2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : B3

### Input Data

Area (ac) ..... 54.90  
Weighted Curve Number ..... 65.10  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	38.43	B	60.00
5 Acre Lots, 7% Impervious	16.47	D	77.00
Composite Area & Weighted CN	54.90		65.10

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.27	0.00	0.00
Computed Flow Time (min) :	13.12	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	2693	0.00	0.00
Channel Slope (%) :	3.3	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.69	0.00	0.00
Computed Flow Time (min) :	5.17	0.00	0.00
Total TOC (min) .....	39.35		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.40  
Peak Runoff (cfs) ..... 52.19  
Weighted Curve Number ..... 65.10  
Time of Concentration (days hh:mm:ss) ..... 0 00:39:21

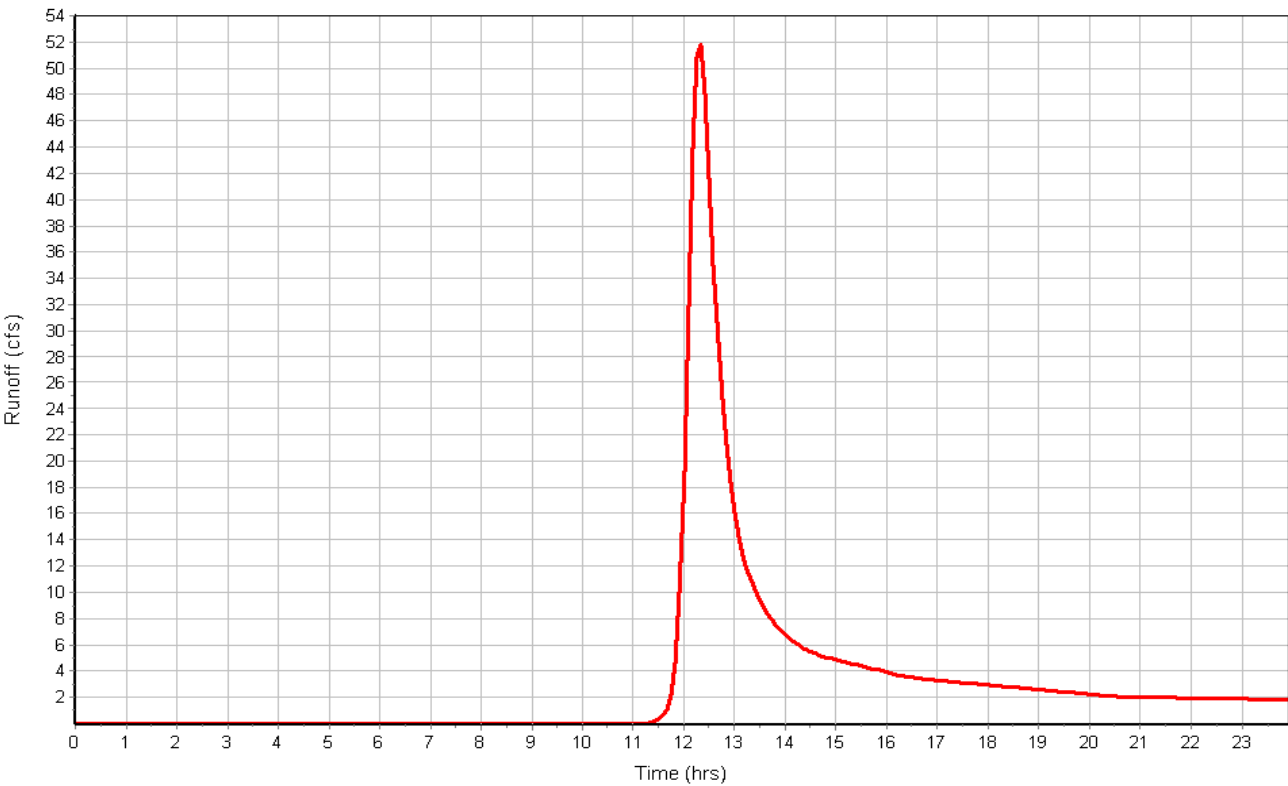


Subbasin : B3

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : B4

### Input Data

Area (ac) ..... 41.48  
Weighted Curve Number ..... 68.50  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	22.81	B	64.00
Pasture, grassland, or range, Fair	12.44	B	69.00
Pasture, grassland, or range, Fair	6.22	D	84.00
Composite Area & Weighted CN	41.47		68.50

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.06	0.00	0.00
Computed Flow Time (min) :	15.72	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1188	0.00	0.00
Channel Slope (%) :	2.3	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.25	0.00	0.00
Computed Flow Time (min) :	2.73	0.00	0.00
Total TOC (min) .....	39.51		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.64  
Peak Runoff (cfs) ..... 47.71  
Weighted Curve Number ..... 68.50  
Time of Concentration (days hh:mm:ss) ..... 0 00:39:31

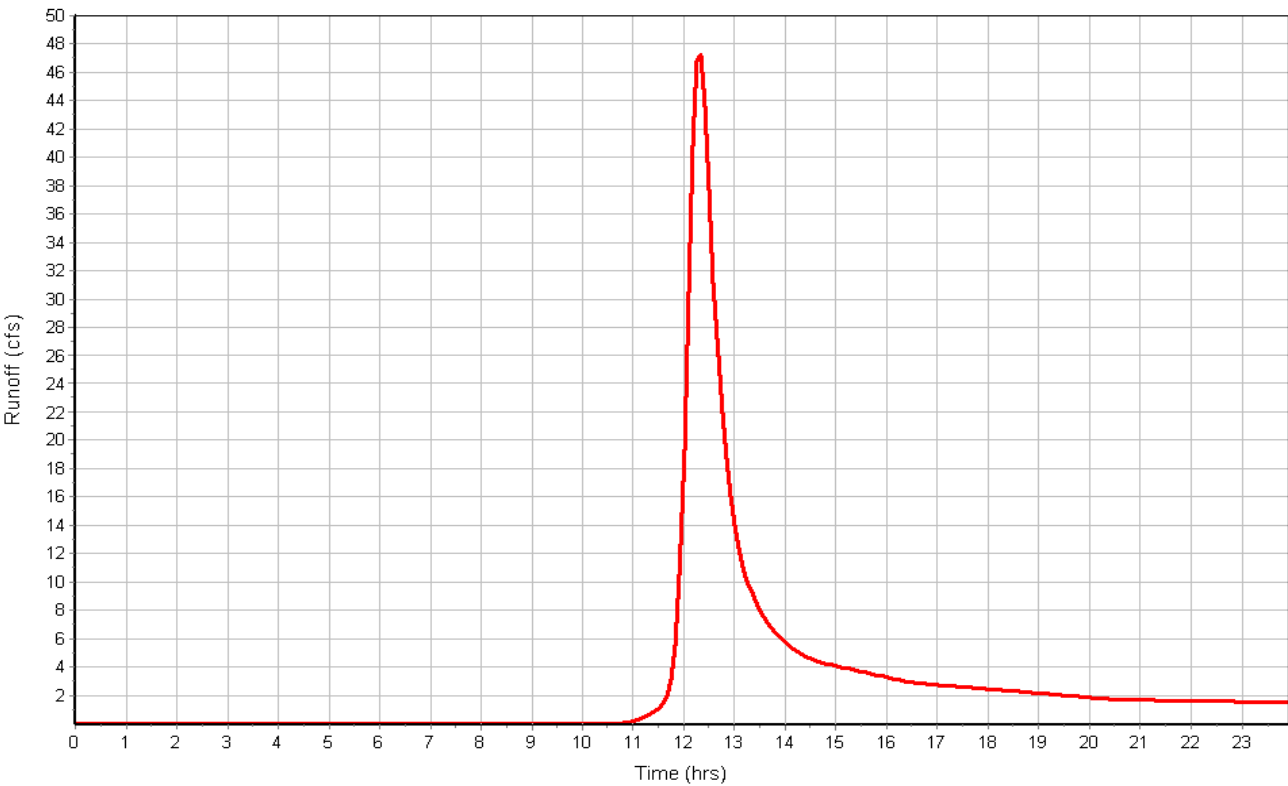


Subbasin : B4

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : C1

### Input Data

Area (ac) ..... 162.70  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	162.70	B	60.00
Composite Area & Weighted CN	162.70		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0.00	0.00
Computed Flow Time (min) :	11.74	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	3099	0.00	0.00
Channel Slope (%) :	4.1	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	11.73	0.00	0.00
Computed Flow Time (min) :	4.40	0.00	0.00
Total TOC (min) .....	37.20		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 113.04  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:37:12

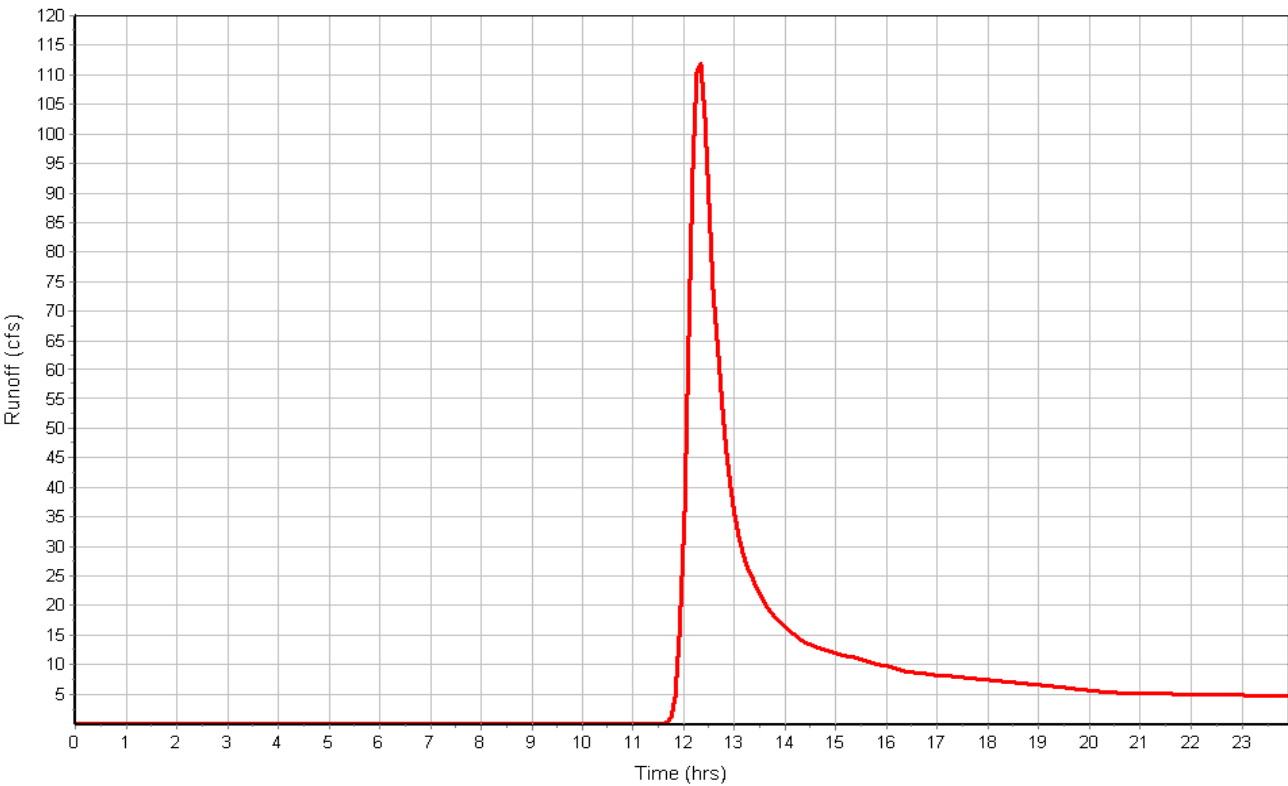


Subbasin : C1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : C2

### Input Data

Area (ac) ..... 22.40  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	22.40	B	64.00
Composite Area & Weighted CN	22.40		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	5.31	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	401	0.00	0.00
Channel Slope (%) :	.05	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	1.07	0.00	0.00
Computed Flow Time (min) :	6.25	0.00	0.00
Total TOC (min) .....	32.61		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 22.55  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:32:37

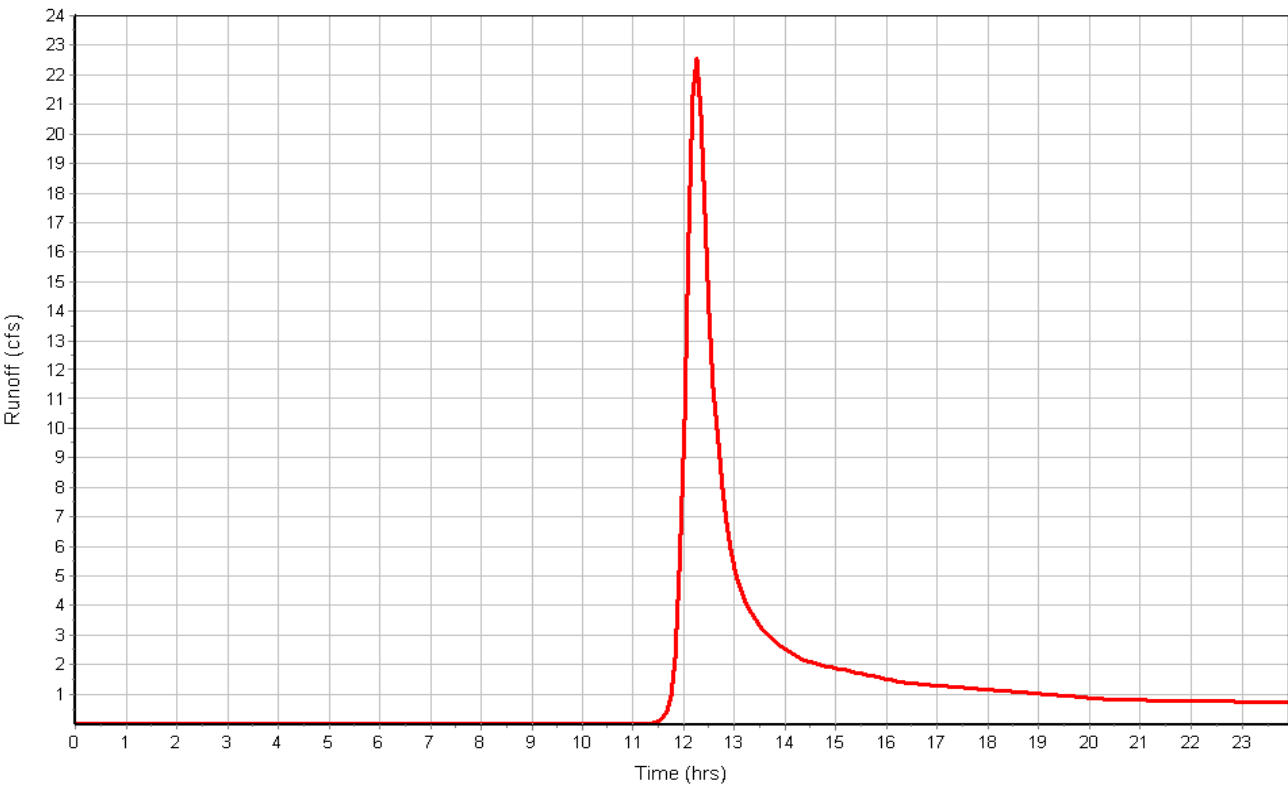


Subbasin : C2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : C3

### Input Data

Area (ac) ..... 16.10  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	16.10	B	64.00
Composite Area & Weighted CN	16.10		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	6.13	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	666	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	1.19	0.00	0.00
Total TOC (min) .....	28.38		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 17.80  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:28:23

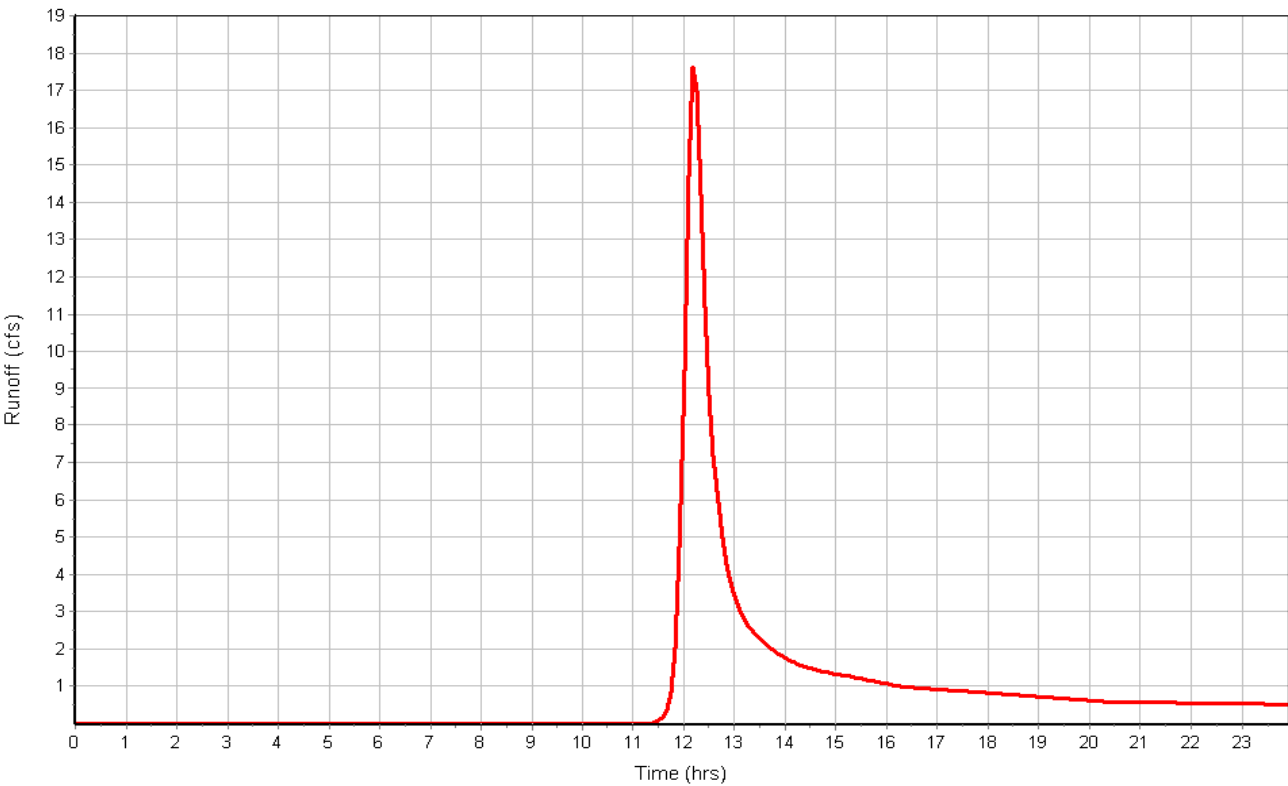


Subbasin : C3

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : C4

### Input Data

Area (ac) ..... 23.80  
Weighted Curve Number ..... 65.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	11.90	B	60.00
Pasture, grassland, or range, Fair	1.19	C	79.00
Pasture, grassland, or range, Fair	10.71	B	69.00
Composite Area & Weighted CN	23.80		65.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	1.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.96	0.00	0.00
Computed Flow Time (min) :	17.36	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1074	0.00	0.00
Channel Slope (%) :	1.9	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	6.59	0.00	0.00
Computed Flow Time (min) :	2.71	0.00	0.00
Total TOC (min) .....	41.13		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.39  
Peak Runoff (cfs) ..... 21.79  
Weighted Curve Number ..... 65.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:41:08

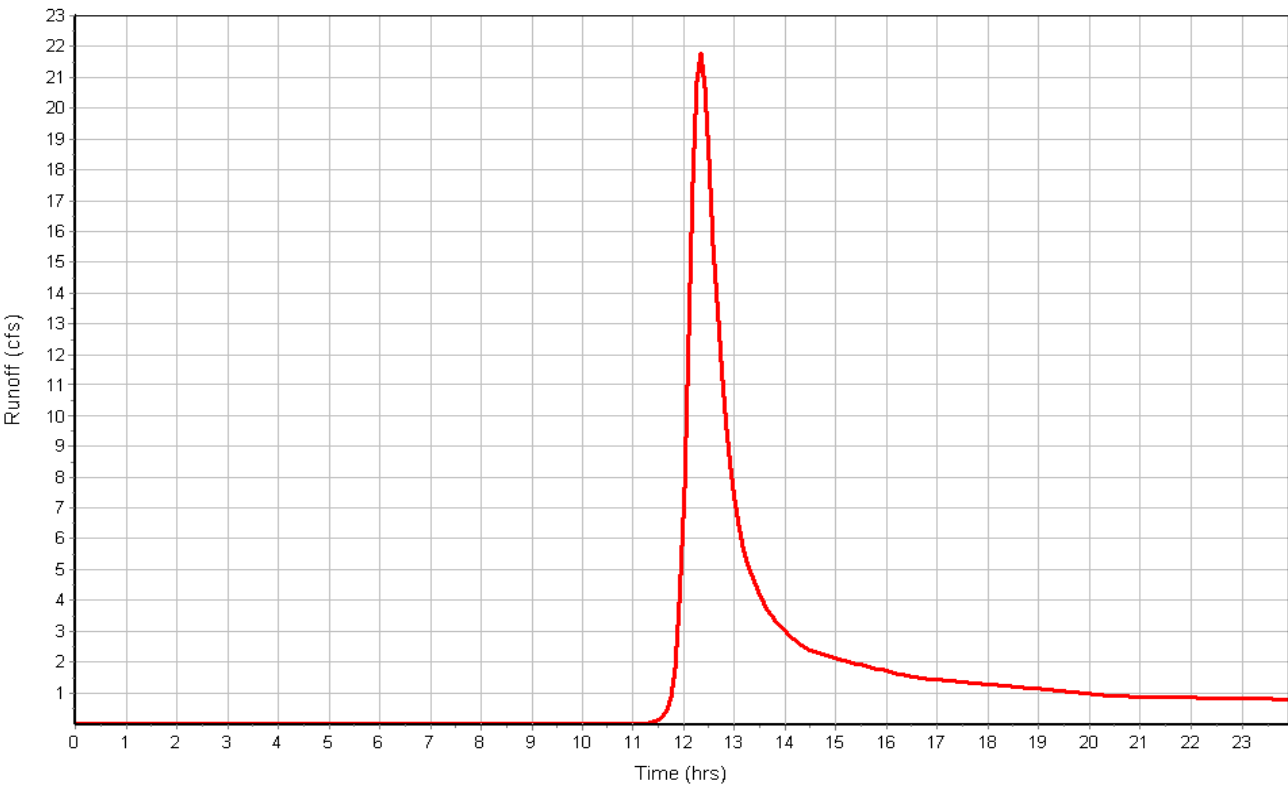


Subbasin : C4

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : D1.1

### Input Data

Area (ac) ..... 161.30  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	161.30	B	60.00
Composite Area & Weighted CN	161.30		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.7	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0.00	0.00
Computed Flow Time (min) :	14.01	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1601	0.00	0.00
Channel Slope (%) :	5.7	0.00	0.00
Cross Section Area (ft²) :	64	0.00	0.00
Wetted Perimeter (ft) :	32.98	0.00	0.00
Velocity (ft/sec) :	13.84	0.00	0.00
Computed Flow Time (min) :	1.93	0.00	0.00
Total TOC (min) .....	36.99		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 112.52  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:36:59

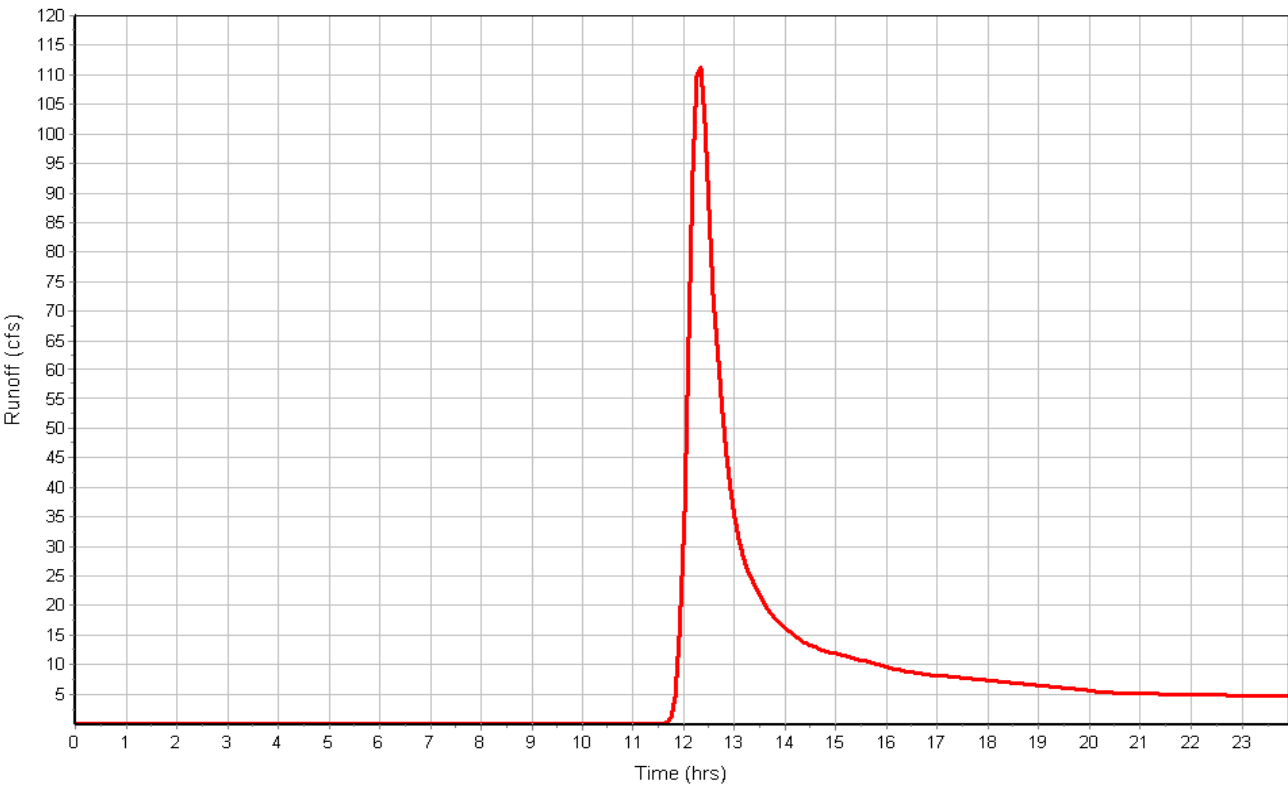


Subbasin : D1.1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : D1.2

### Input Data

Area (ac) ..... 49.90  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	49.90	B	60.00
Composite Area & Weighted CN	49.90		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.48	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	0.79	0.00	0.00
Computed Flow Time (min) :	21.10	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	922	0.00	0.00
Channel Slope (%) :	2.48	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.53	0.00	0.00
Computed Flow Time (min) :	2.04	0.00	0.00
Total TOC (min) .....	44.20		

### Subbasin Runoff Results

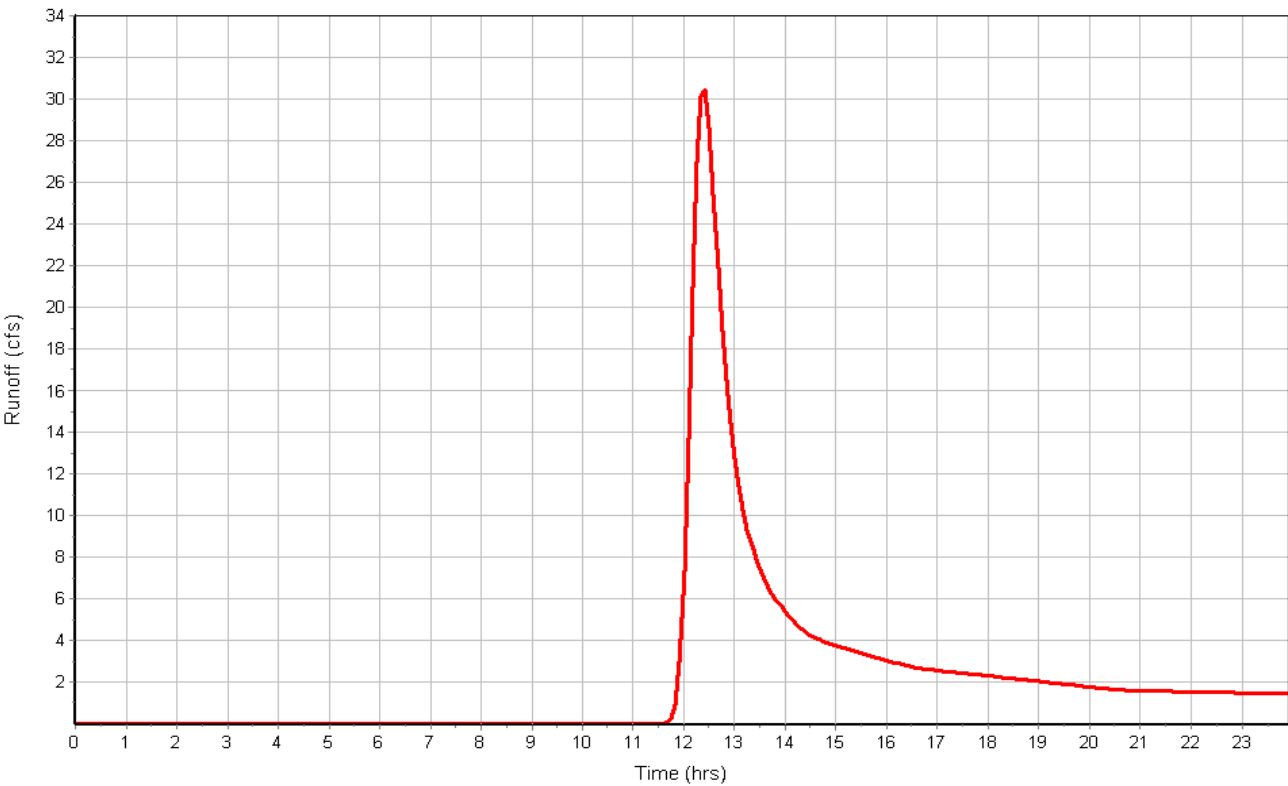
Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 30.63  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:44:12



Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : D2

### Input Data

Area (ac) ..... 68.70  
Weighted Curve Number ..... 64.75  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	10.31	B	69.00
2.5 Acre Lots, 11% Impervious	58.40	B	64.00
Composite Area & Weighted CN	68.71		64.75

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	12.25	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	848	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	1.52	0.00	0.00
Total TOC (min) .....	34.83		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.38  
Peak Runoff (cfs) ..... 69.43  
Weighted Curve Number ..... 64.75  
Time of Concentration (days hh:mm:ss) ..... 0 00:34:50

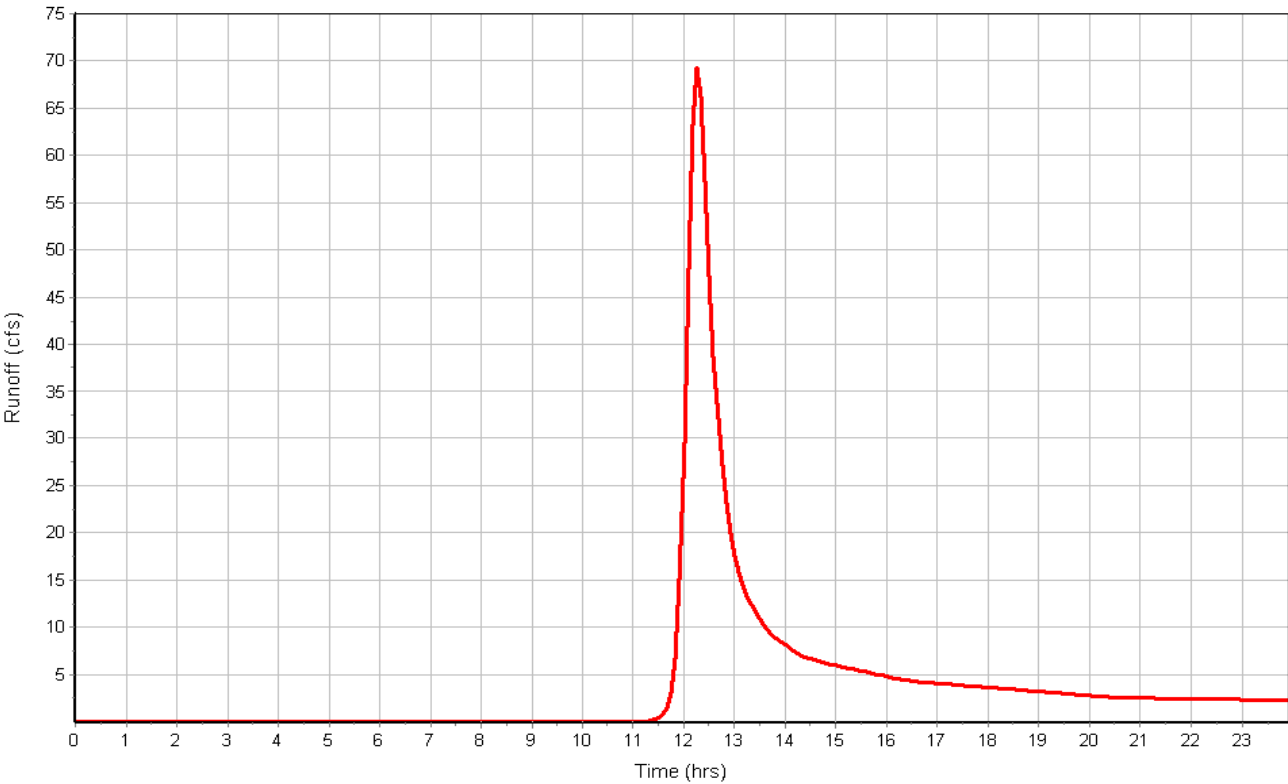


Subbasin : D2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : D3

### Input Data

Area (ac) ..... 41.20  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	41.20	B	64.00
Composite Area & Weighted CN	41.20		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.06	0.00	0.00
Computed Flow Time (min) :	15.72	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1128	0.00	0.00
Channel Slope (%) :	2.3	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.25	0.00	0.00
Computed Flow Time (min) :	2.59	0.00	0.00
Total TOC (min) .....	39.37		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 36.49  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:39:22

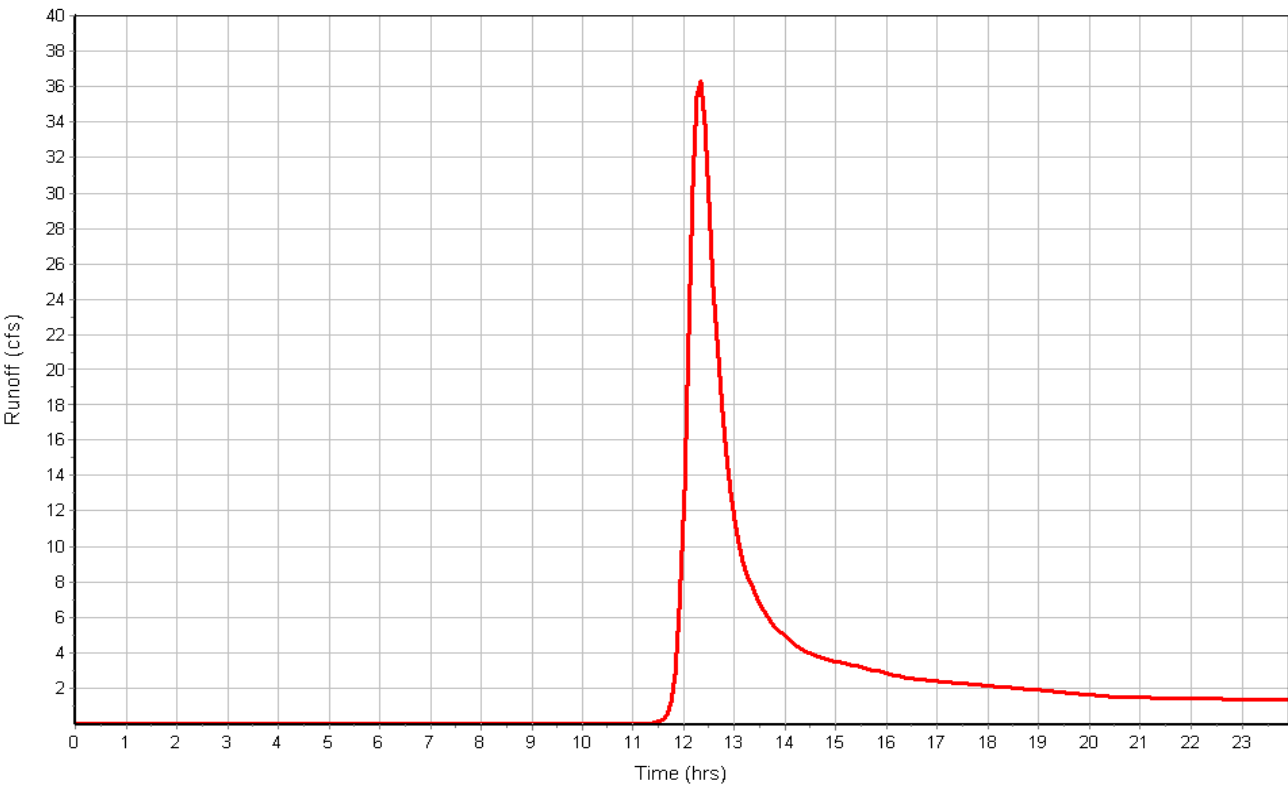


Subbasin : D3

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : D4

### Input Data

Area (ac) ..... 34.30  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	34.30	B	64.00
Composite Area & Weighted CN	34.30		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.06	0.00	0.00
Computed Flow Time (min) :	7.86	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	658	0.00	0.00
Channel Slope (%) :	2.3	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.25	0.00	0.00
Computed Flow Time (min) :	1.51	0.00	0.00
Total TOC (min) .....	30.43		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 36.25  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:30:26

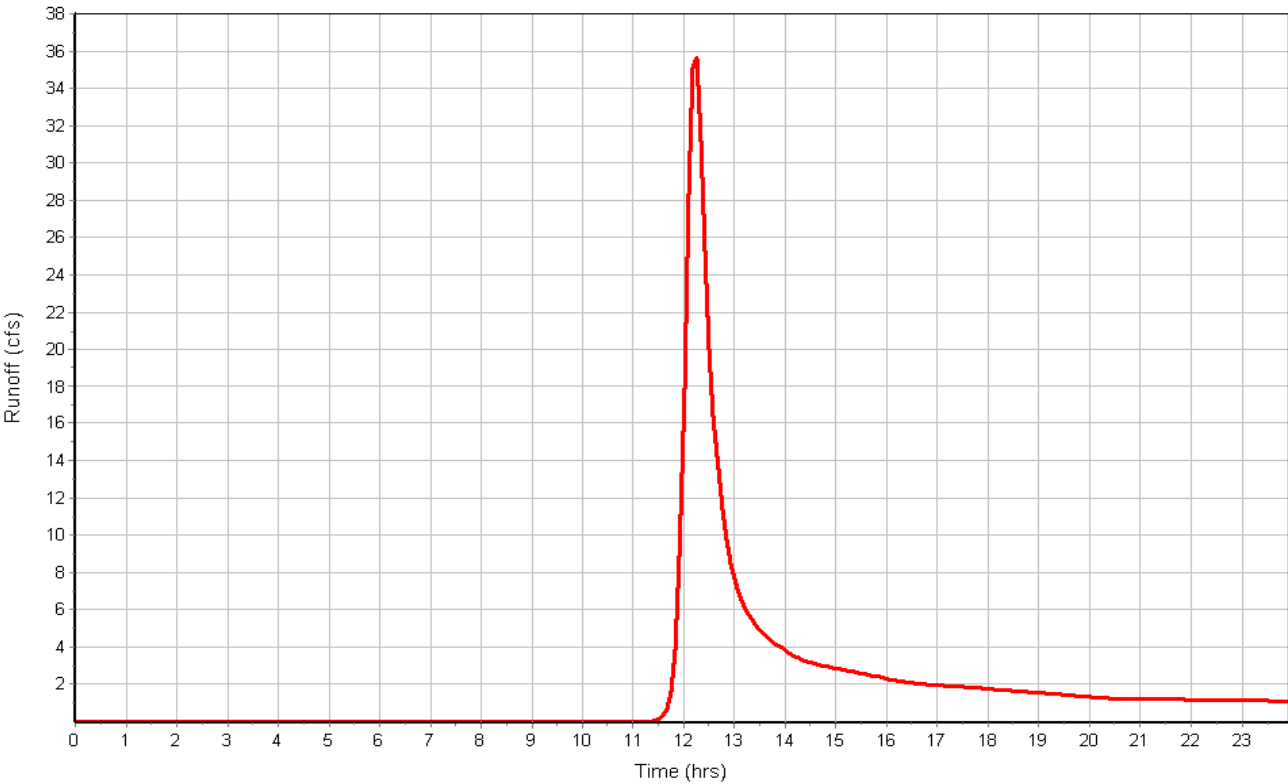


Subbasin : D4

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : D5

### Input Data

Area (ac) ..... 12.80  
Weighted Curve Number ..... 67.20  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	2.56	B	60.00
Pasture, grassland, or range, Fair	10.24	B	69.00
Composite Area & Weighted CN	12.80		67.20

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	2.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.01	0.00	0.00
Computed Flow Time (min) :	8.25	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	506	0.00	0.00
Channel Slope (%) :	2.1	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	6.93	0.00	0.00
Computed Flow Time (min) :	1.22	0.00	0.00
Total TOC (min) .....	30.53		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.54  
Peak Runoff (cfs) ..... 16.27  
Weighted Curve Number ..... 67.20  
Time of Concentration (days hh:mm:ss) ..... 0 00:30:32

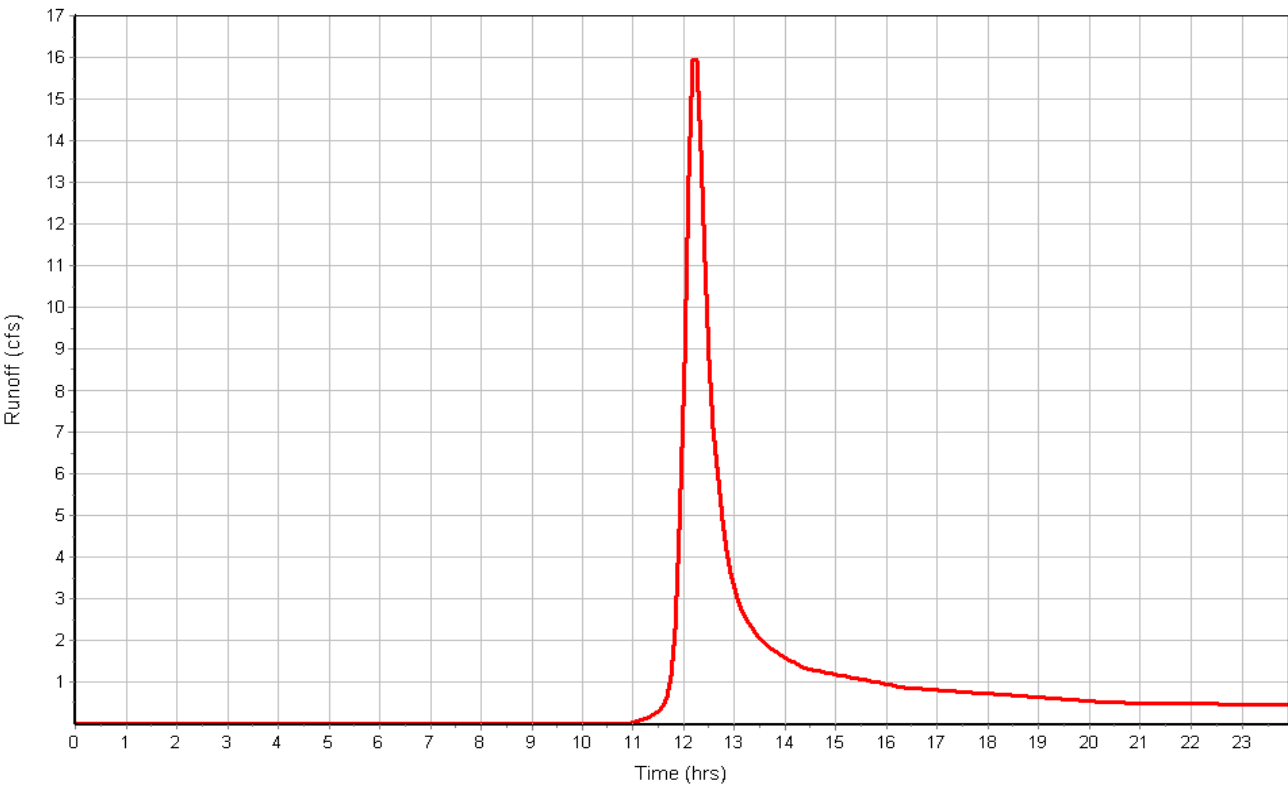


Subbasin : D5

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : D6

### Input Data

Area (ac) ..... 41.80  
Weighted Curve Number ..... 61.65  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	37.62	B	60.00
Pasture, grassland, or range, Fair	2.09	D	84.00
Pasture, grassland, or range, Fair	2.09	B	69.00
Composite Area & Weighted CN	41.80		61.65

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.06	0.00	0.00
Computed Flow Time (min) :	15.72	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1255	0.00	0.00
Channel Slope (%) :	2.3	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.25	0.00	0.00
Computed Flow Time (min) :	2.88	0.00	0.00
Total TOC (min) .....	39.67		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.18  
Peak Runoff (cfs) ..... 31.38  
Weighted Curve Number ..... 61.65  
Time of Concentration (days hh:mm:ss) ..... 0 00:39:40

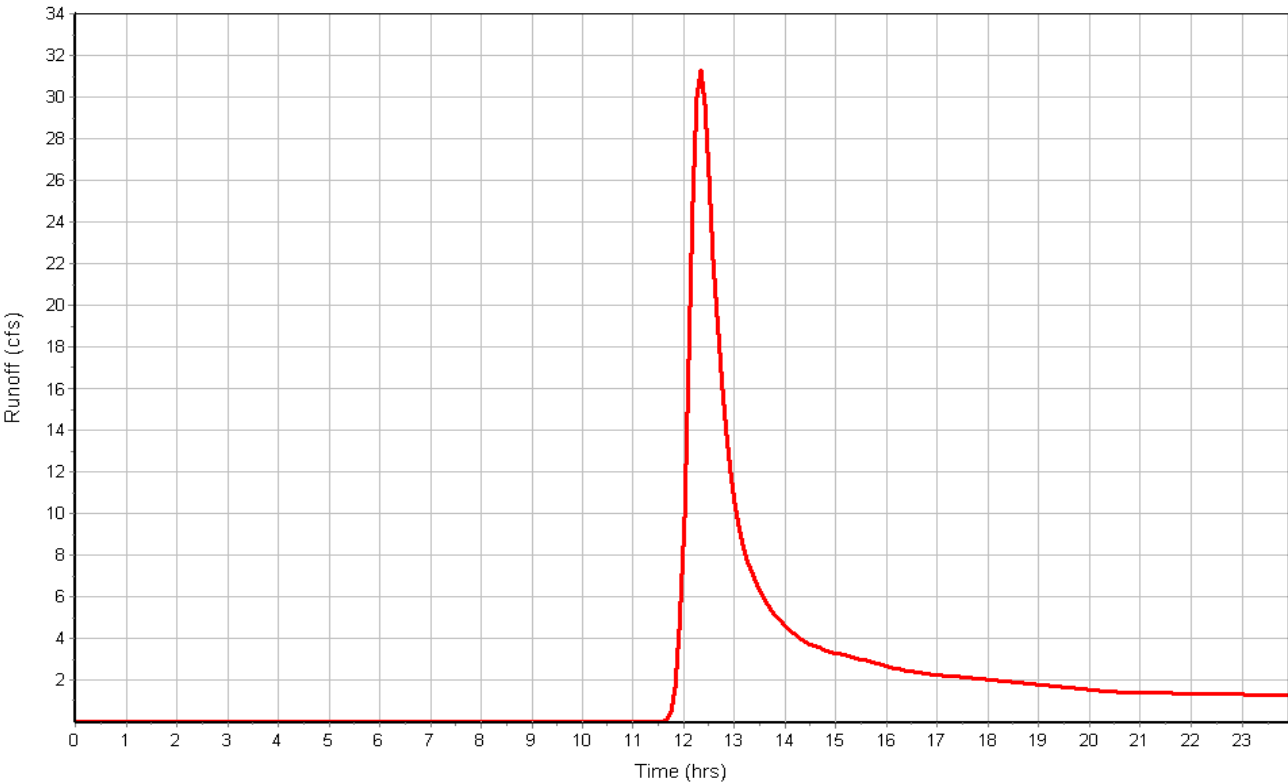


Subbasin : D6

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E0

### Input Data

Area (ac) ..... 37.90  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	37.90	B	60.00
Composite Area & Weighted CN	37.90		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.9	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.11	0.00	0.00
Computed Flow Time (min) :	15.02	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	748	0.00	0.00
Channel Slope (%) :	4.9	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.59	0.00	0.00
Computed Flow Time (min) :	1.18	0.00	0.00
Total TOC (min) .....	37.25		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 26.31  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:37:15

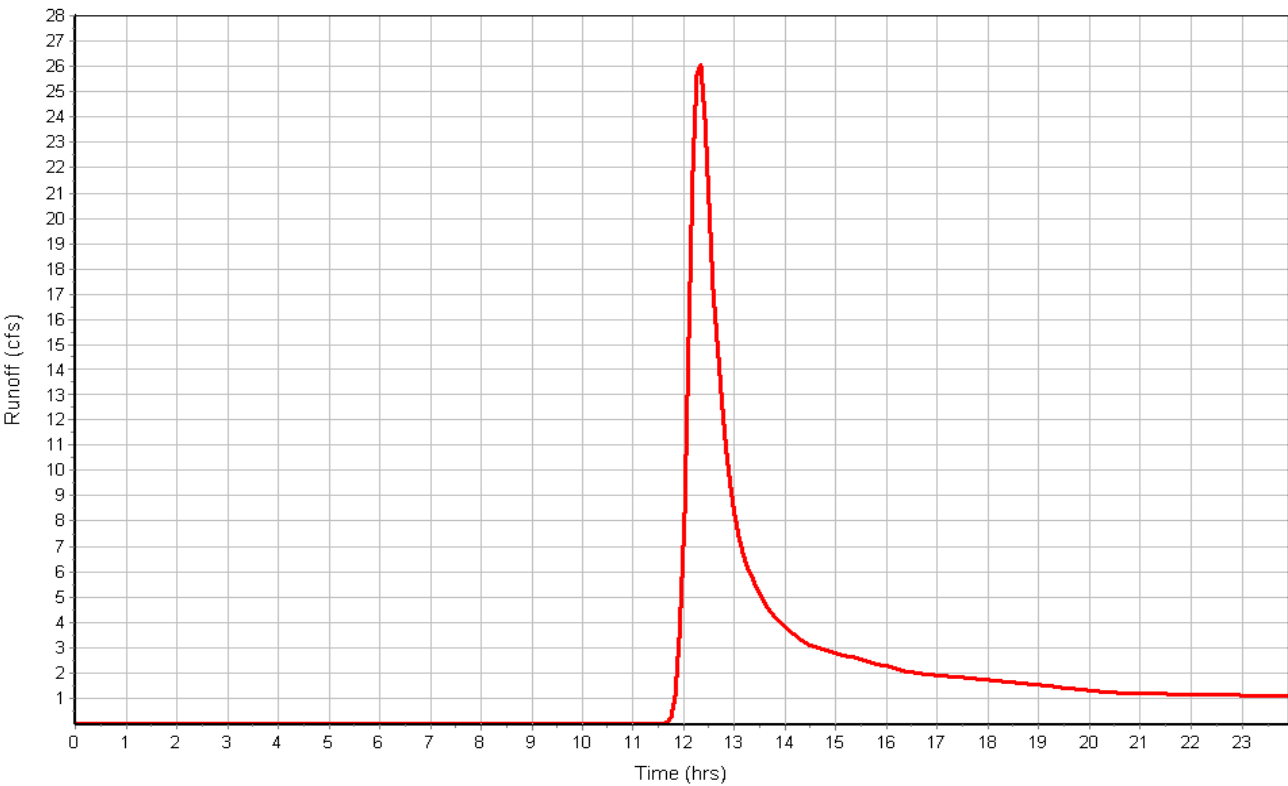


Subbasin : E0

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E1.1

### Input Data

Area (ac) ..... 7.90  
Weighted Curve Number ..... 76.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Fair	3.95	B	60.00
Urban commercial, 85% imp	3.95	B	92.00
Composite Area & Weighted CN	7.90		76.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.1	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	583	0.00	0.00
Slope (%) :	3.17	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	0.89	0.00	0.00
Computed Flow Time (min) :	10.92	0.00	0.00
Total TOC (min) .....	31.98		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.21  
Peak Runoff (cfs) ..... 14.70  
Weighted Curve Number ..... 76.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:31:59

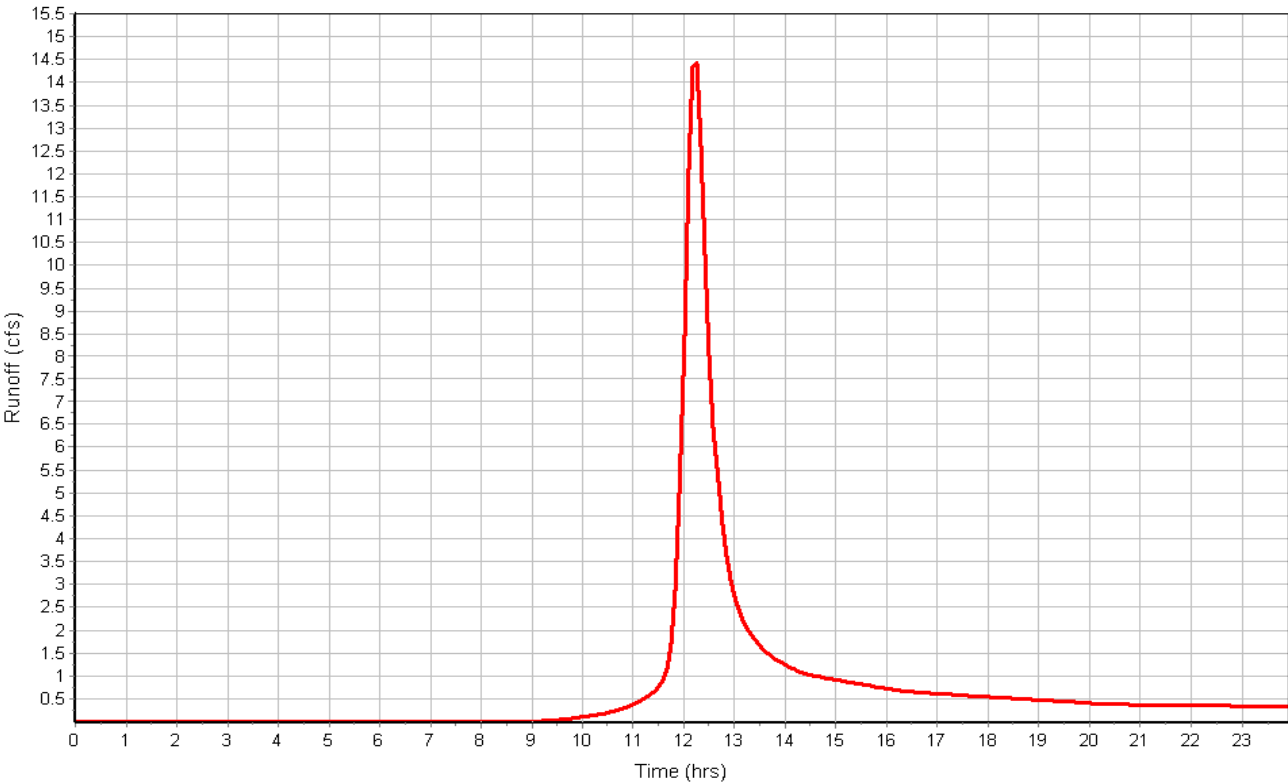


Subbasin : E1.1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E1.2

### Input Data

Area (ac) ..... 16.30  
Weighted Curve Number ..... 62.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	8.15	B	60.00
2.5 Acre Lots, 11% Impervious	8.15	B	64.00
Composite Area & Weighted CN	16.30		62.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	2.7	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.15	0.00	0.00
Computed Flow Time (min) :	14.49	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	228	0.00	0.00
Channel Slope (%) :	2.7	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	7.86	0.00	0.00
Computed Flow Time (min) :	0.48	0.00	0.00
Total TOC (min) .....	36.03		

### Subbasin Runoff Results

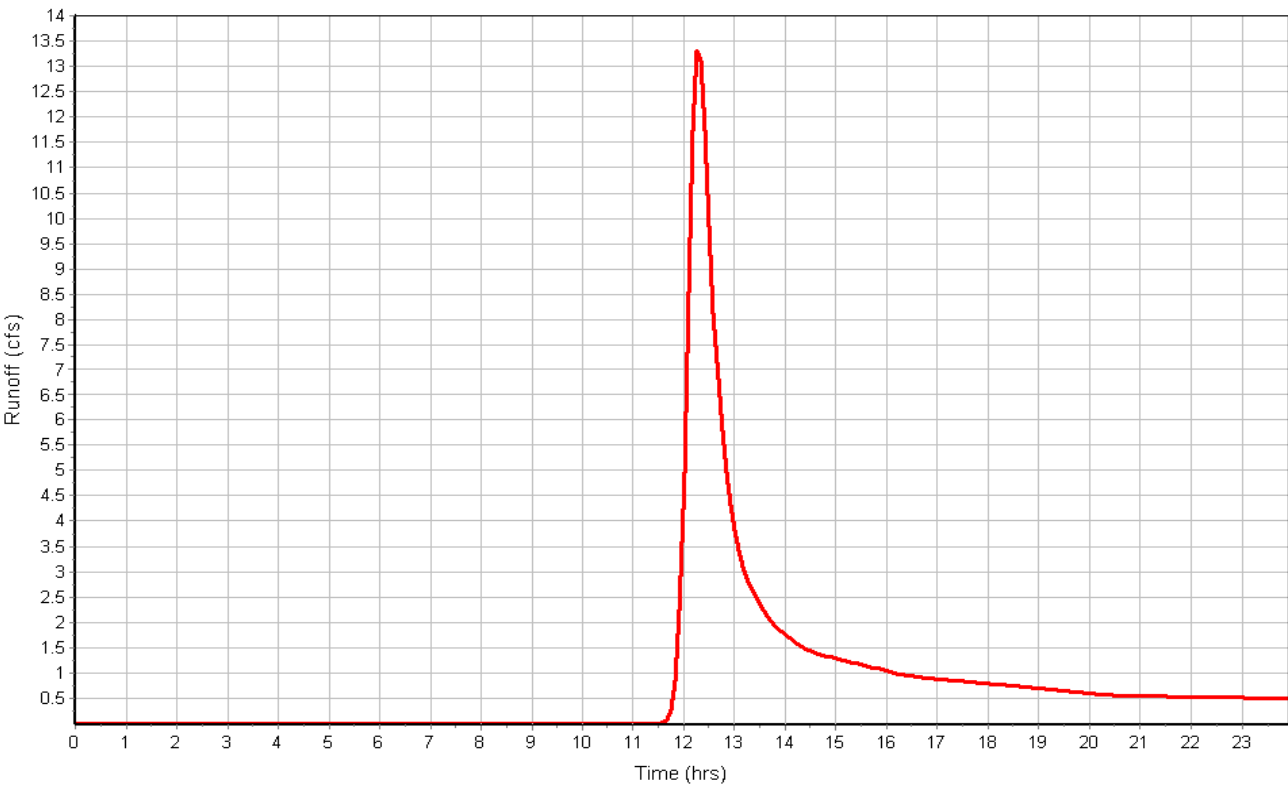
Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.20  
Peak Runoff (cfs) ..... 13.42  
Weighted Curve Number ..... 62.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:36:02



Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E2

### Input Data

Area (ac) ..... 2.60  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	2.60	B	64.00
Composite Area & Weighted CN	2.60		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	5.4	0.00	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.16	0.00	0.00
Computed Flow Time (min) :	1.44	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	101	0.00	0.00
Channel Slope (%) :	5.4	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	11.12	0.00	0.00
Computed Flow Time (min) :	0.15	0.00	0.00
Total TOC (min) .....	22.65		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 3.30  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:22:39

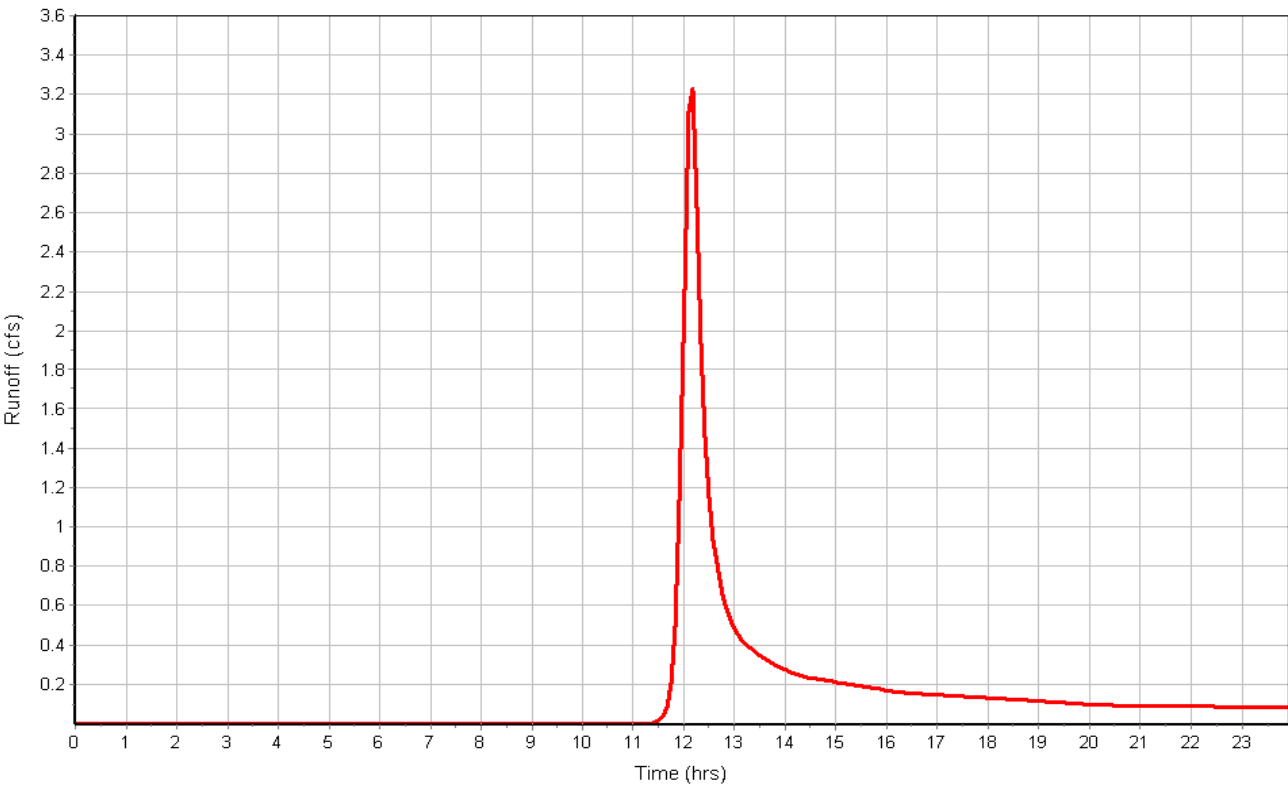


Subbasin : E2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E3

### Input Data

Area (ac) ..... 19.80  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	19.80	B	64.00
Composite Area & Weighted CN	19.80		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	4.6	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.50	0.00	0.00
Computed Flow Time (min) :	5.56	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	453	0.00	0.00
Channel Slope (%) :	4.6	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.26	0.00	0.00
Computed Flow Time (min) :	0.74	0.00	0.00
Total TOC (min) .....	27.35		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 22.41  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:27:21

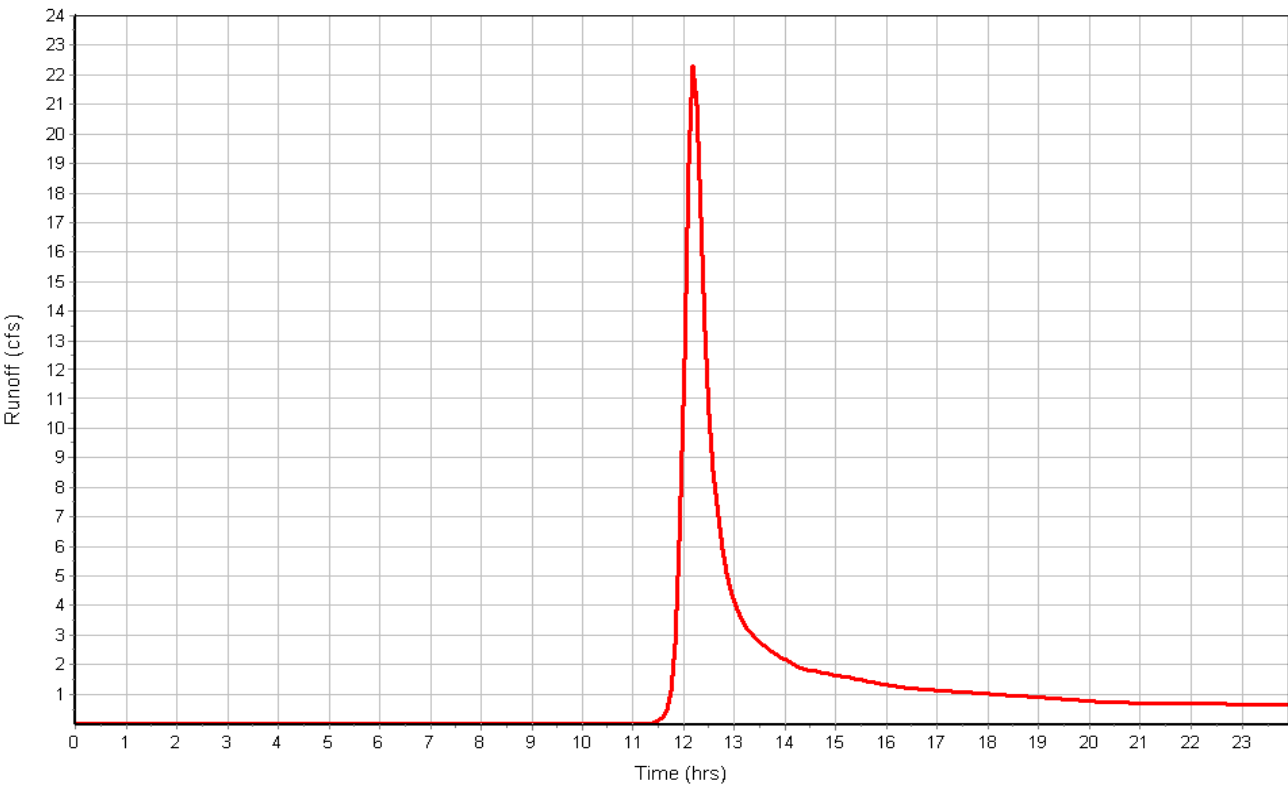


Subbasin : E3

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E4

### Input Data

Area (ac) ..... 18.20  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	18.20	B	64.00
Composite Area & Weighted CN	18.20		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	6.13	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	528	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	0.94	0.00	0.00
Total TOC (min) .....	28.13		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 20.25  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:28:08

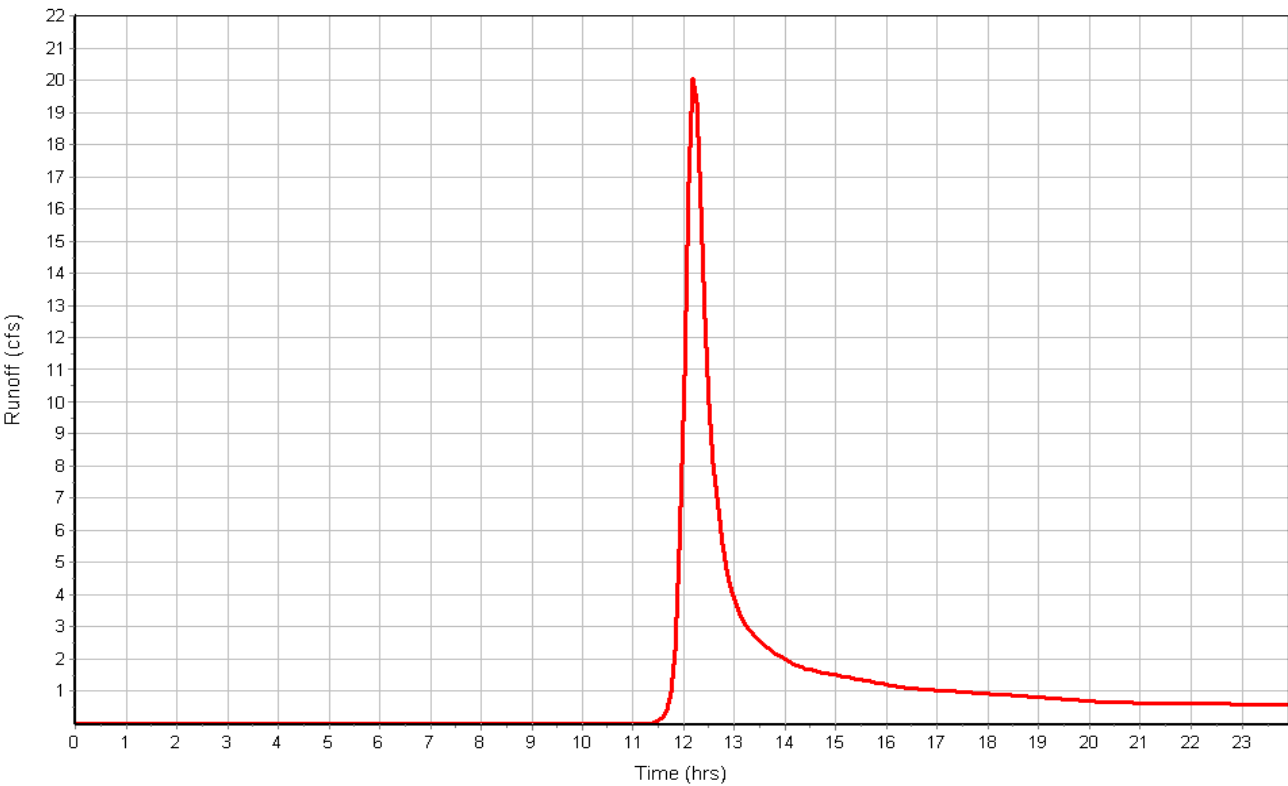


Subbasin : E4

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E5

### Input Data

Area (ac) ..... 13.50  
Weighted Curve Number ..... 64.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	13.50	B	64.00
Composite Area & Weighted CN	13.50		64.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	4.7	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	5.48	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	335	0.00	0.00
Channel Slope (%) :	4.7	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.37	0.00	0.00
Computed Flow Time (min) :	0.54	0.00	0.00
Total TOC (min) .....	27.08		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.33  
Peak Runoff (cfs) ..... 15.39  
Weighted Curve Number ..... 64.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:27:05

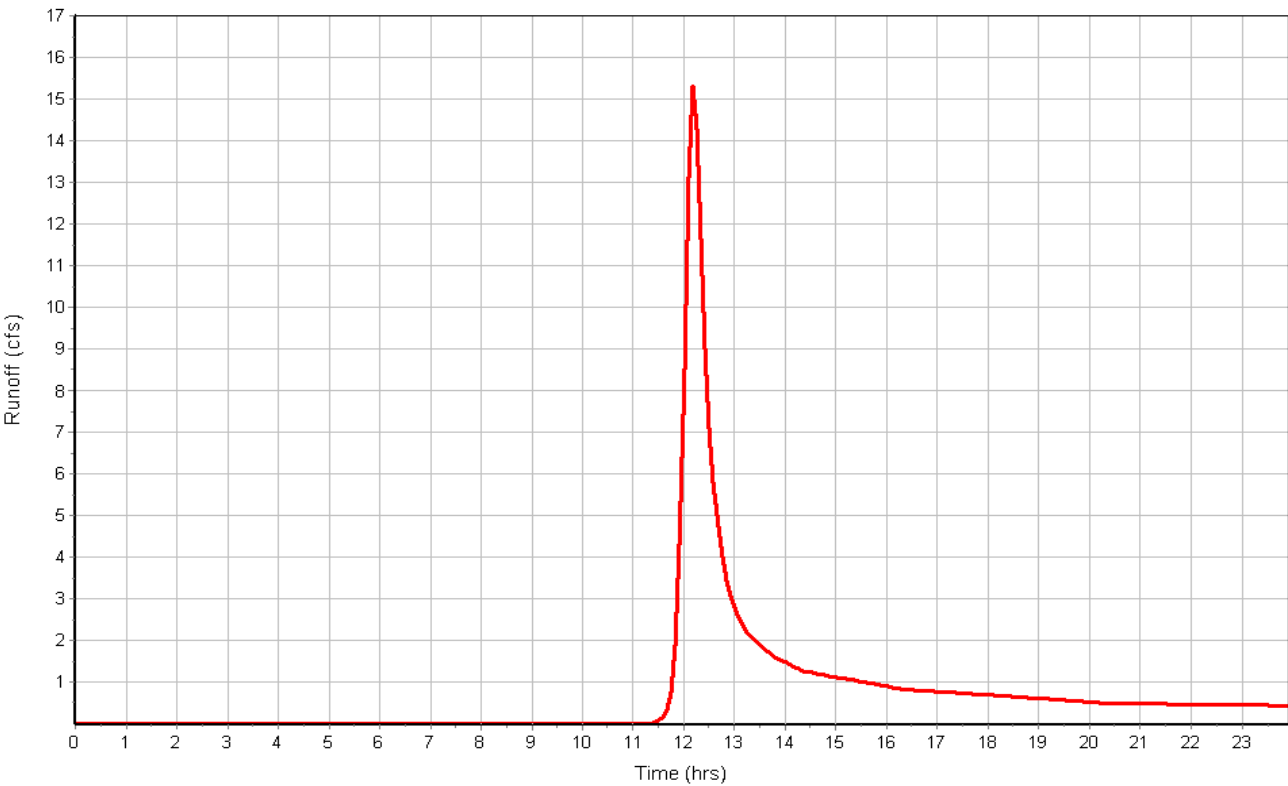


Subbasin : E5

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E6

### Input Data

Area (ac) ..... 28.90  
Weighted Curve Number ..... 62.40  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
2.5 Acre Lots, 11% Impervious	8.67	B	64.00
5 Acre Lots, 7% Impervious	18.79	B	60.00
Pasture, grassland, or range, Fair	1.45	D	84.00
Composite Area & Weighted CN	28.91		62.40

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	4.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.43	0.00	0.00
Computed Flow Time (min) :	5.83	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	859	0.00	0.00
Channel Slope (%) :	4.2	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.80	0.00	0.00
Computed Flow Time (min) :	1.46	0.00	0.00
Total TOC (min) .....	28.35		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.22  
Peak Runoff (cfs) ..... 28.79  
Weighted Curve Number ..... 62.40  
Time of Concentration (days hh:mm:ss) ..... 0 00:28:21

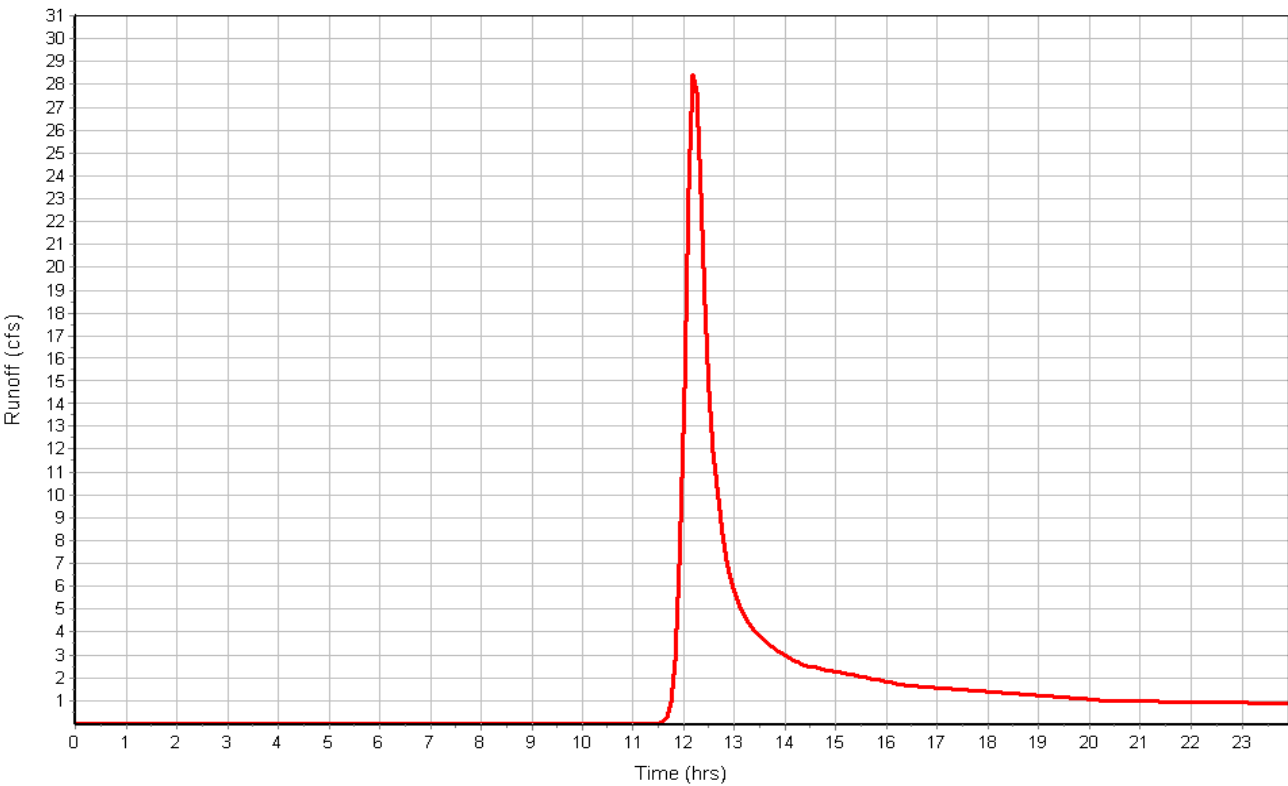


Subbasin : E6

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : E7

### Input Data

Area (ac) ..... 9.80  
Weighted Curve Number ..... 62.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	4.90	B	60.00
2.5 Acre Lots, 11% Impervious	4.90	B	64.00
Composite Area & Weighted CN	9.80		62.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	3.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.31	0.00	0.00
Computed Flow Time (min) :	2.54	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	474	0.00	0.00
Channel Slope (%) :	3.5	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.95	0.00	0.00
Computed Flow Time (min) :	0.88	0.00	0.00
Total TOC (min) .....	24.49		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.20  
Peak Runoff (cfs) ..... 10.44  
Weighted Curve Number ..... 62.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:24:29

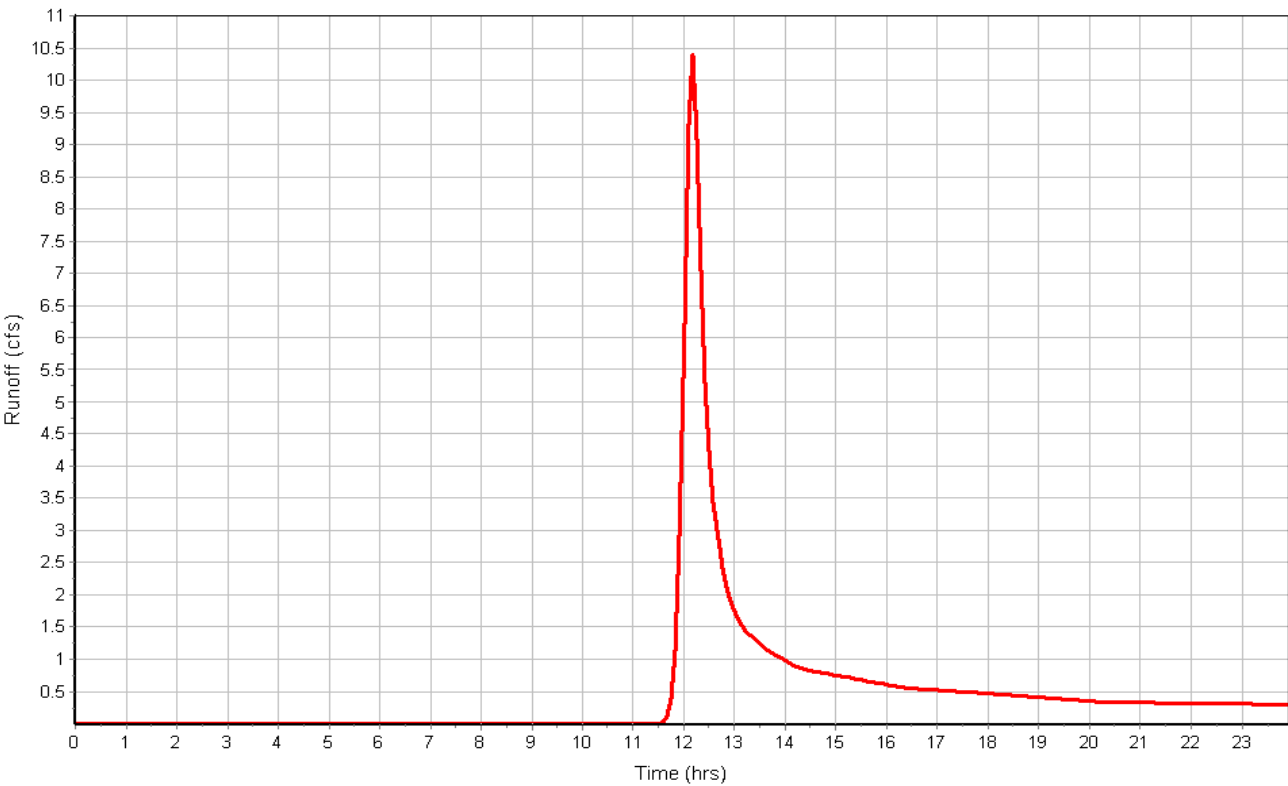


Subbasin : E7

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : F1

### Input Data

Area (ac) ..... 42.90  
Weighted Curve Number ..... 60.40  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	38.61	B	60.00
2.5 Acre Lots, 11% Impervious	4.29	B	64.00
Composite Area & Weighted CN	42.90		60.40

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.25	0.00	0.00
Computed Flow Time (min) :	13.33	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	745	0.00	0.00
Channel Slope (%) :	3.2	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.56	0.00	0.00
Computed Flow Time (min) :	1.45	0.00	0.00
Total TOC (min) .....	35.84		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.10  
Peak Runoff (cfs) ..... 31.50  
Weighted Curve Number ..... 60.40  
Time of Concentration (days hh:mm:ss) ..... 0 00:35:50

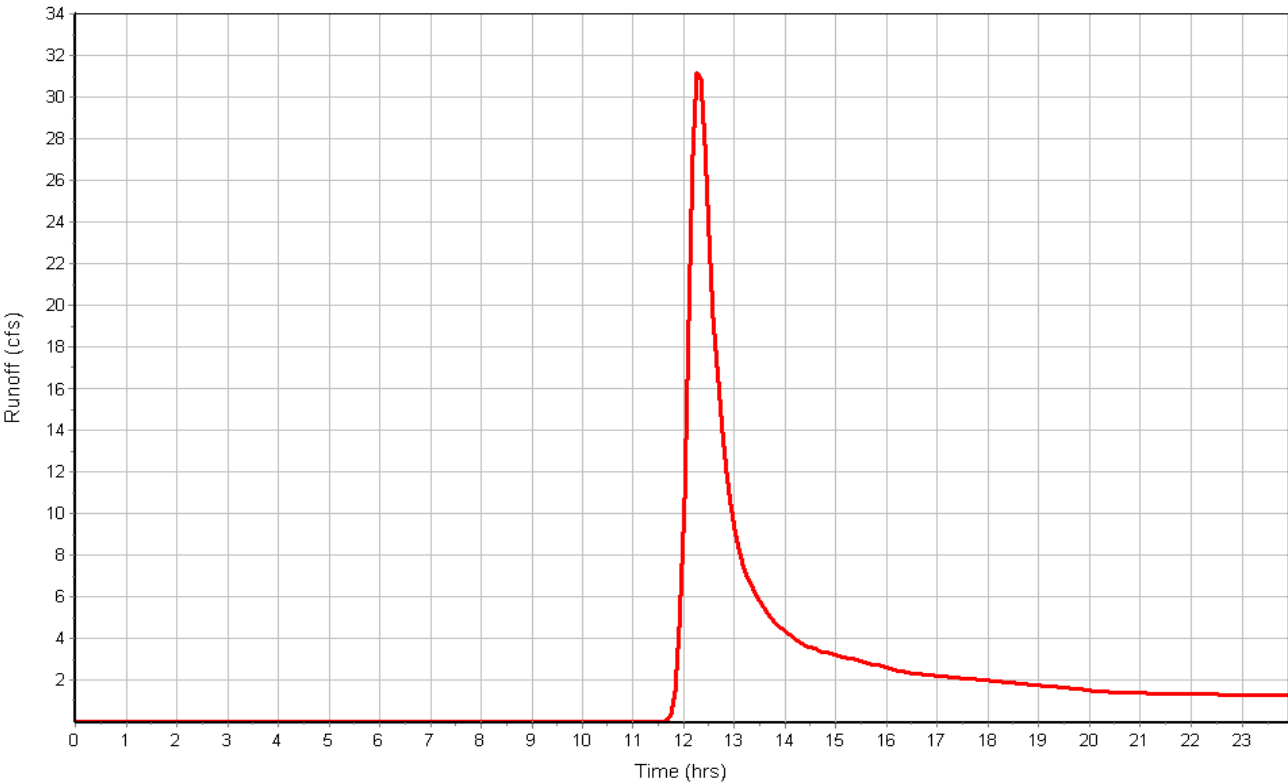


Subbasin : F1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : G1

### Input Data

Area (ac) ..... 25.20  
Weighted Curve Number ..... 66.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	12.60	C	72.00
Woods, Fair	12.60	B	60.00
Composite Area & Weighted CN	25.20		66.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	6.1	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.73	0.00	0.00
Computed Flow Time (min) :	4.82	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	658	0.00	0.00
Channel Slope (%) :	6.1	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	11.81	0.00	0.00
Computed Flow Time (min) :	0.93	0.00	0.00
Total TOC (min) .....	26.80		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.46  
Peak Runoff (cfs) ..... 32.59  
Weighted Curve Number ..... 66.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:26:48

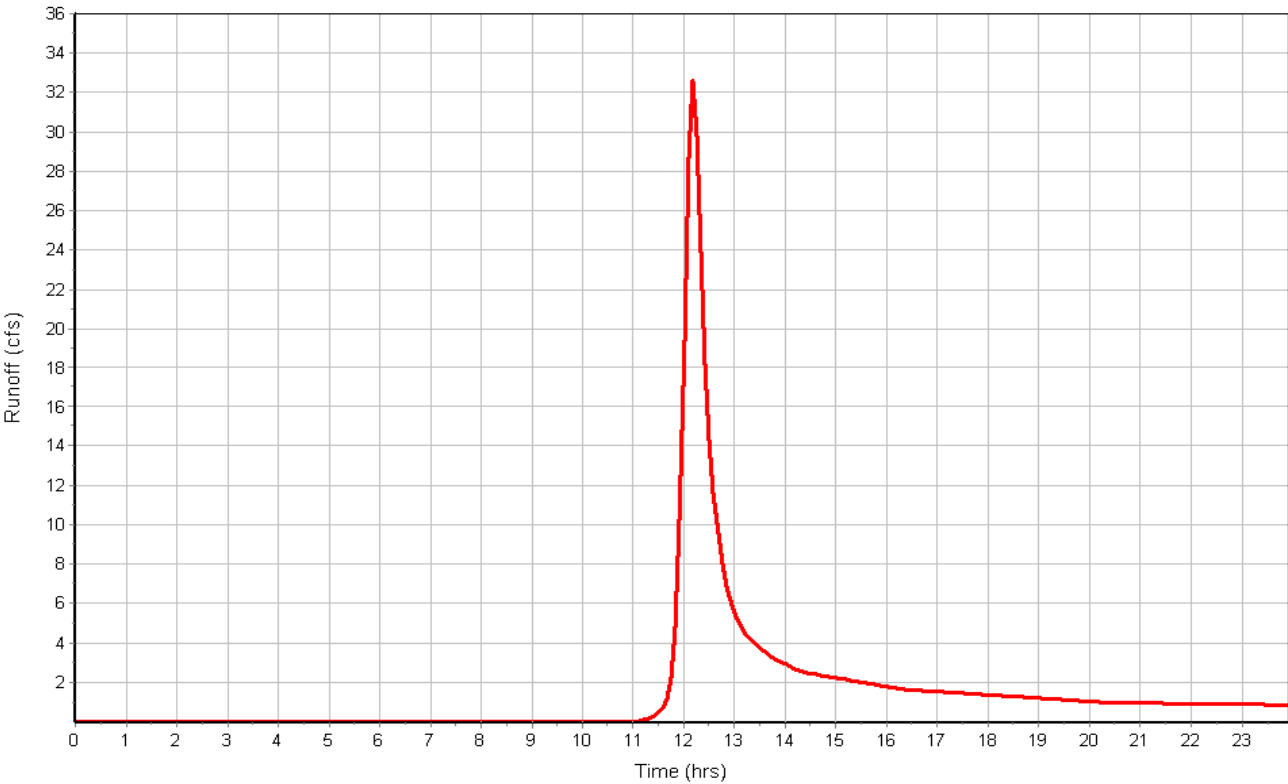


Subbasin : G1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : G2

### Input Data

Area (ac) ..... 21.20  
Weighted Curve Number ..... 72.70  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	19.08	C	72.00
Pasture, grassland, or range, Fair	2.12	C	79.00
Composite Area & Weighted CN	21.20		72.70

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.38	0.00	0.00
Computed Flow Time (min) :	12.08	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	695	0.00	0.00
Channel Slope (%) :	3.9	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.45	0.00	0.00
Computed Flow Time (min) :	1.23	0.00	0.00
Total TOC (min) .....	34.36		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.95  
Peak Runoff (cfs) ..... 32.77  
Weighted Curve Number ..... 72.70  
Time of Concentration (days hh:mm:ss) ..... 0 00:34:22

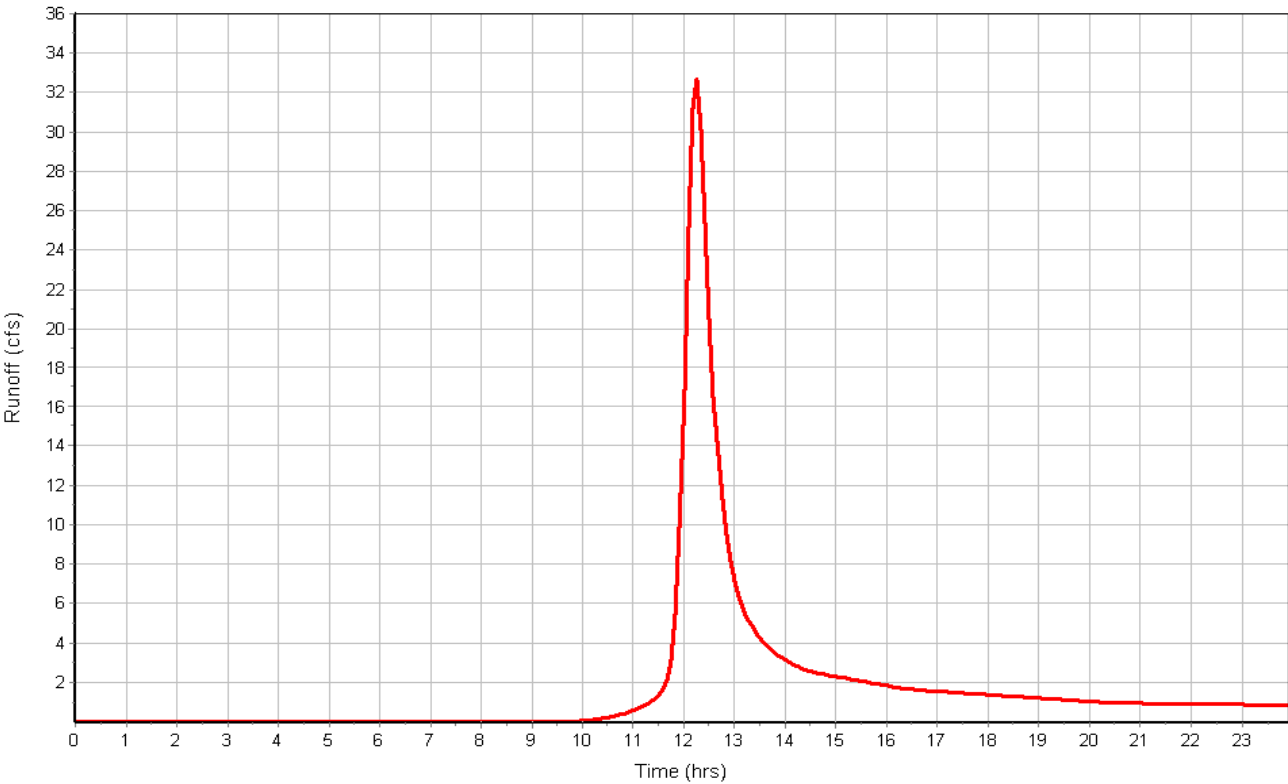


Subbasin : G2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H1

### Input Data

Area (ac) ..... 13.90  
Weighted Curve Number ..... 70.80  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	1.39	B	60.00
5 Acre Lots, 7% Impervious	12.51	C	72.00
Composite Area & Weighted CN	13.90		70.80

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	4.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.55	0.00	0.00
Computed Flow Time (min) :	5.38	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	328	0.00	0.00
Channel Slope (%) :	4.9	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.59	0.00	0.00
Computed Flow Time (min) :	0.52	0.00	0.00
Total TOC (min) .....	26.95		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.80  
Peak Runoff (cfs) ..... 23.00  
Weighted Curve Number ..... 70.80  
Time of Concentration (days hh:mm:ss) ..... 0 00:26:57

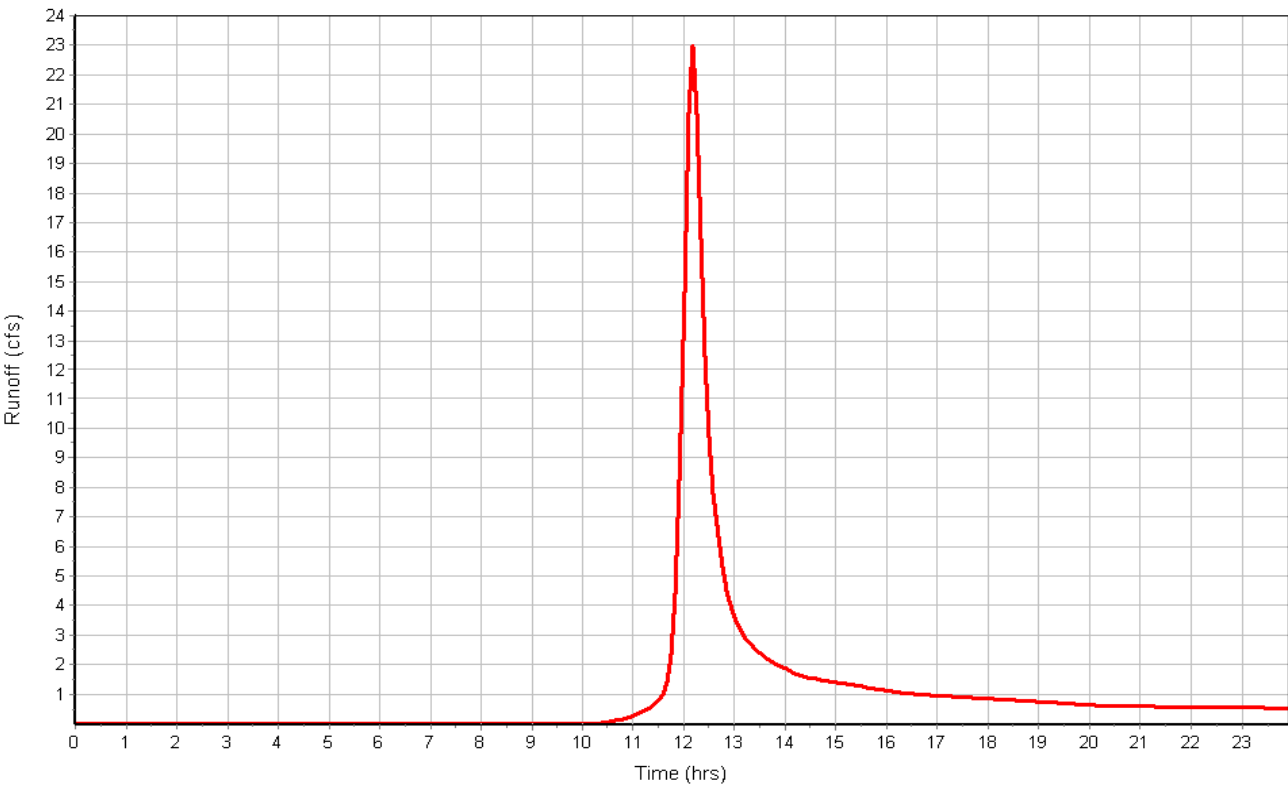


Subbasin : H1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H2

### Input Data

Area (ac) ..... 39.10  
Weighted Curve Number ..... 67.20  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	15.64	B	60.00
5 Acre Lots, 7% Impervious	23.46	C	72.00
Composite Area & Weighted CN	39.10		67.20

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.57	0.00	0.00
Computed Flow Time (min) :	10.62	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	851	0.00	0.00
Channel Slope (%) :	5	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.70	0.00	0.00
Computed Flow Time (min) :	1.33	0.00	0.00
Total TOC (min) .....	33.00		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.54  
Peak Runoff (cfs) ..... 47.25  
Weighted Curve Number ..... 67.20  
Time of Concentration (days hh:mm:ss) ..... 0 00:33:00

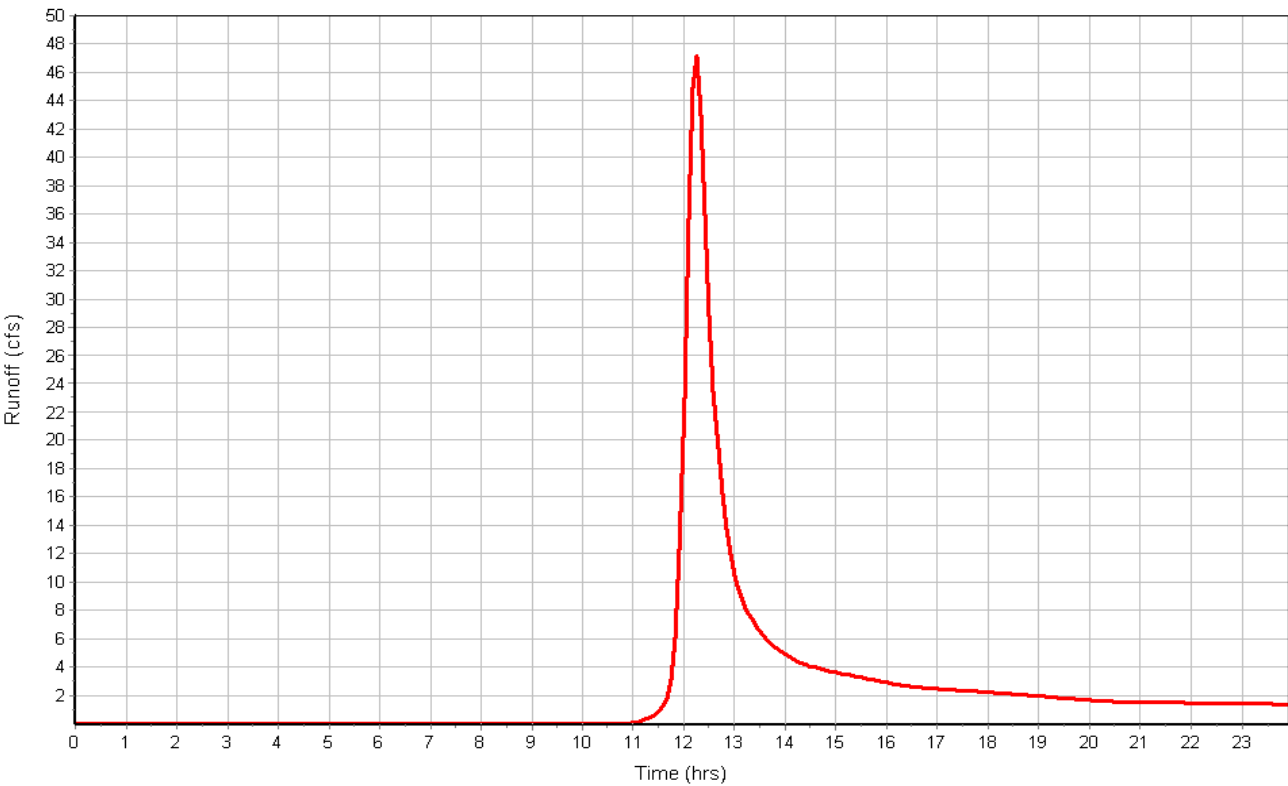


Subbasin : H2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H3

### Input Data

Area (ac) ..... 5.80  
Weighted Curve Number ..... 66.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	2.90	C	72.00
Woods, Fair	2.90	B	60.00
Composite Area & Weighted CN	5.80		66.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	3.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.25	0.00	0.00
Computed Flow Time (min) :	2.67	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	133	0.00	0.00
Channel Slope (%) :	3.2	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	8.56	0.00	0.00
Computed Flow Time (min) :	0.26	0.00	0.00
Total TOC (min) .....	23.98		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.46  
Peak Runoff (cfs) ..... 8.02  
Weighted Curve Number ..... 66.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:23:59

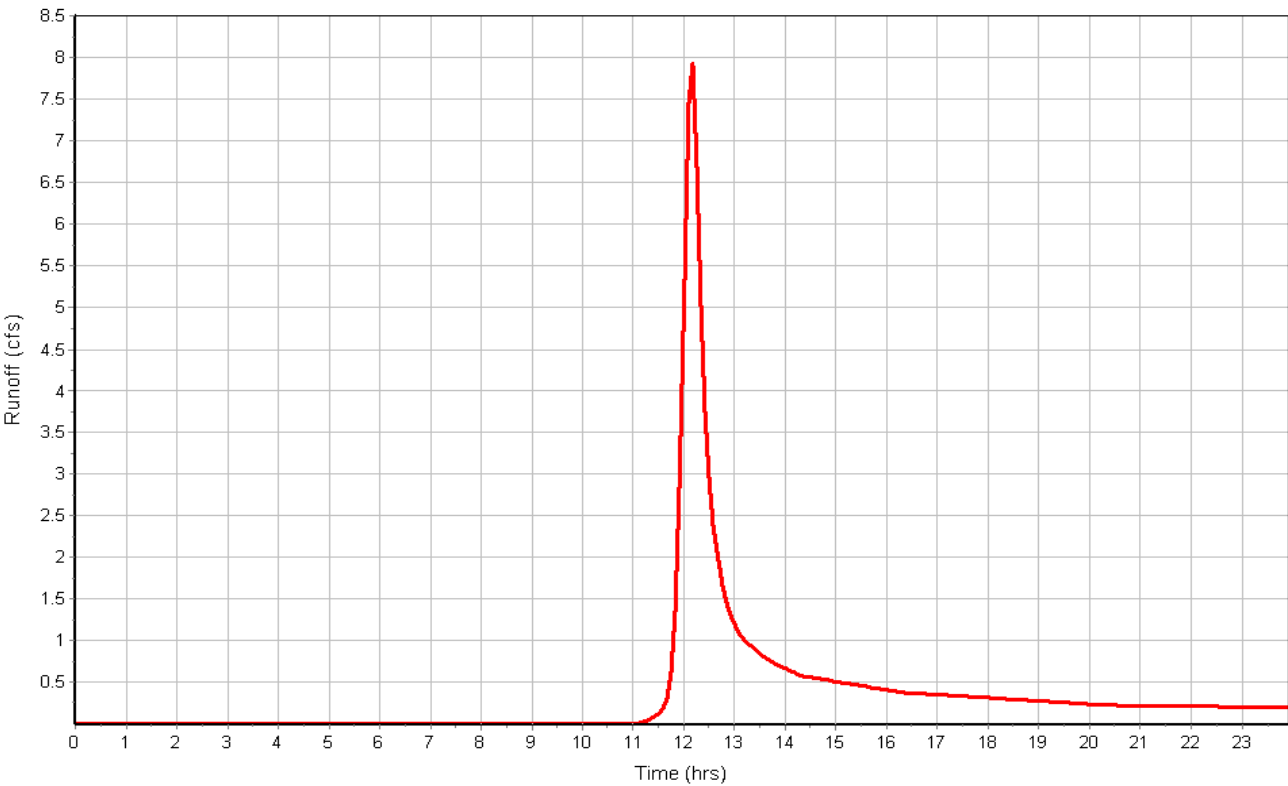


Subbasin : H3

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H4

### Input Data

Area (ac) ..... 27.10  
Weighted Curve Number ..... 73.75  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	20.33	C	72.00
Pasture, grassland, or range, Fair	6.78	C	79.00
Composite Area & Weighted CN	27.11		73.75

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	4.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.48	0.00	0.00
Computed Flow Time (min) :	11.26	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	791	0.00	0.00
Channel Slope (%) :	4.5	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.15	0.00	0.00
Computed Flow Time (min) :	1.30	0.00	0.00
Total TOC (min) .....	33.62		

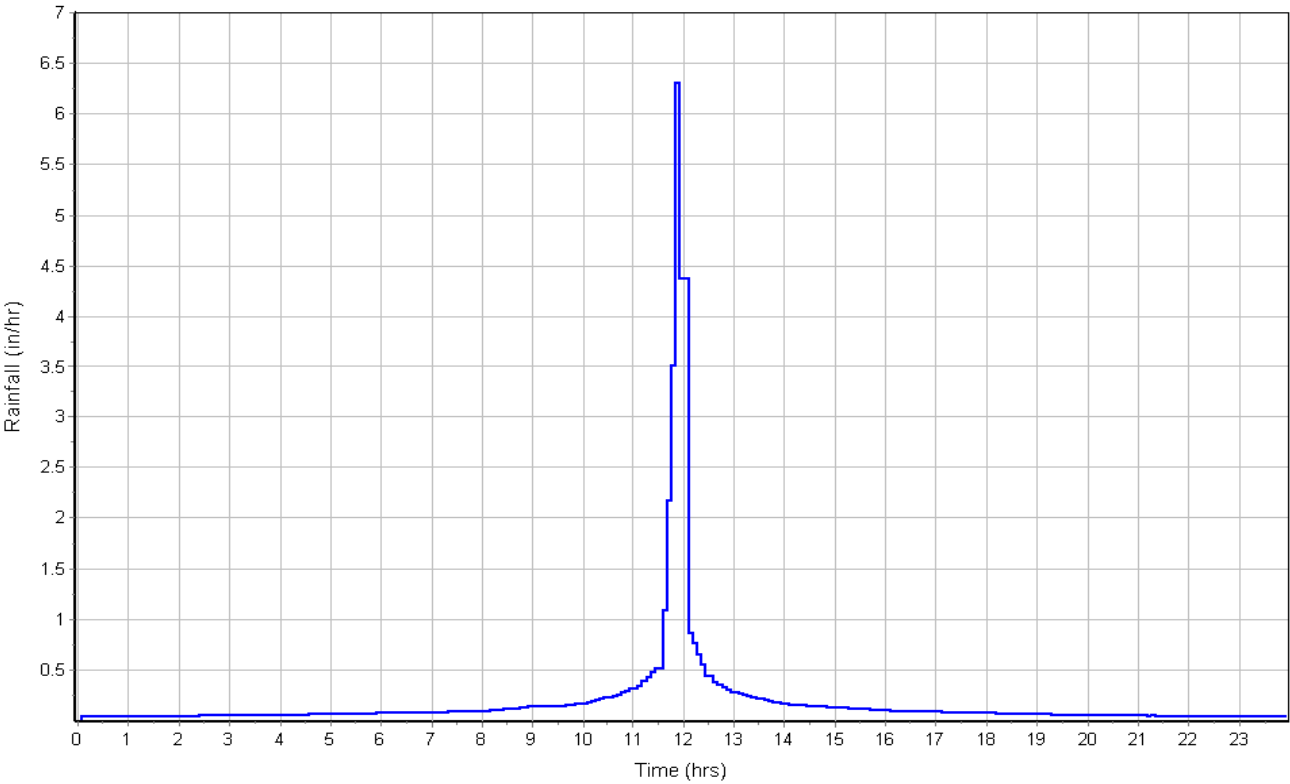
### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.03  
Peak Runoff (cfs) ..... 44.54  
Weighted Curve Number ..... 73.75  
Time of Concentration (days hh:mm:ss) ..... 0 00:33:37

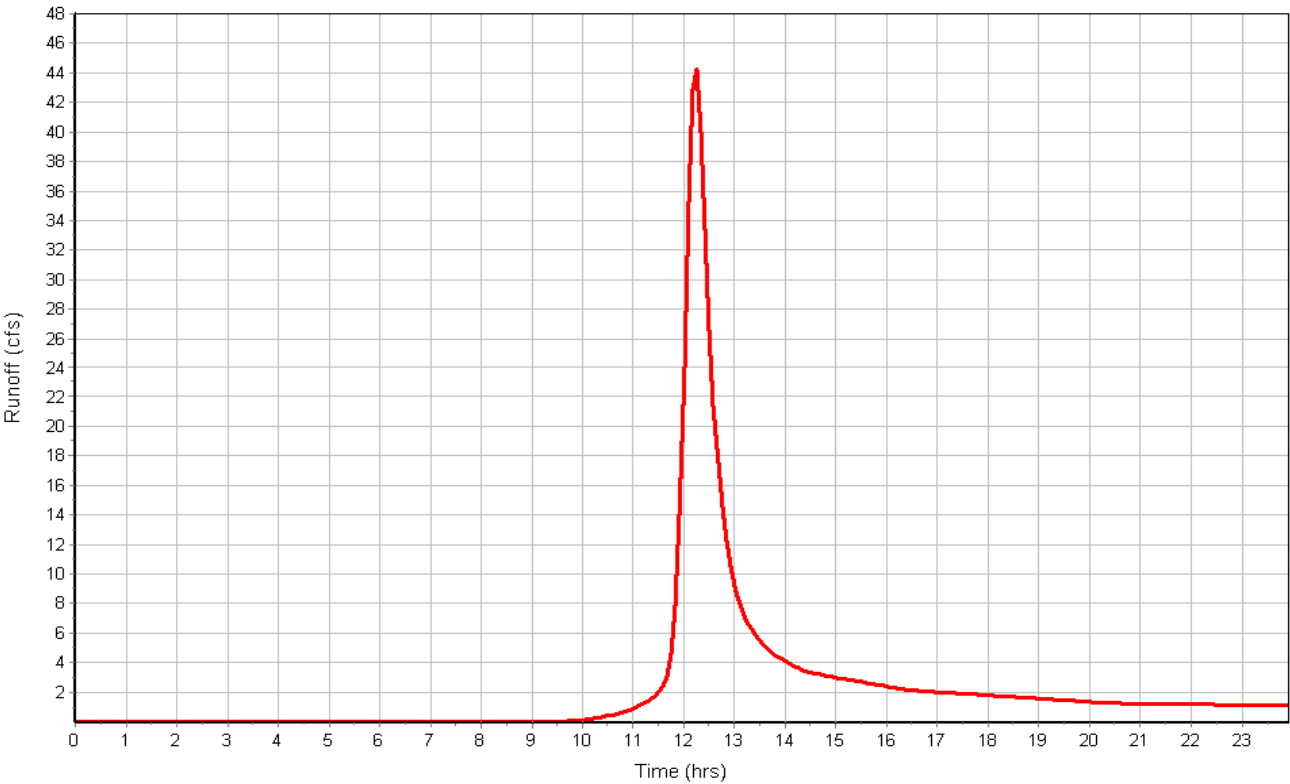


Subbasin : H4

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H5

### Input Data

Area (ac) ..... 20.20  
Weighted Curve Number ..... 74.80  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture, grassland, or range, Fair	8.08	C	79.00
5 Acre Lots, 7% Impervious	12.12	C	72.00
Composite Area & Weighted CN	20.20		74.80

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	5.3	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.61	0.00	0.00
Computed Flow Time (min) :	10.35	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	655	0.00	0.00
Channel Slope (%) :	5.3	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	11.01	0.00	0.00
Computed Flow Time (min) :	0.99	0.00	0.00
Total TOC (min) .....	32.40		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.11  
Peak Runoff (cfs) ..... 35.48  
Weighted Curve Number ..... 74.80  
Time of Concentration (days hh:mm:ss) ..... 0 00:32:24

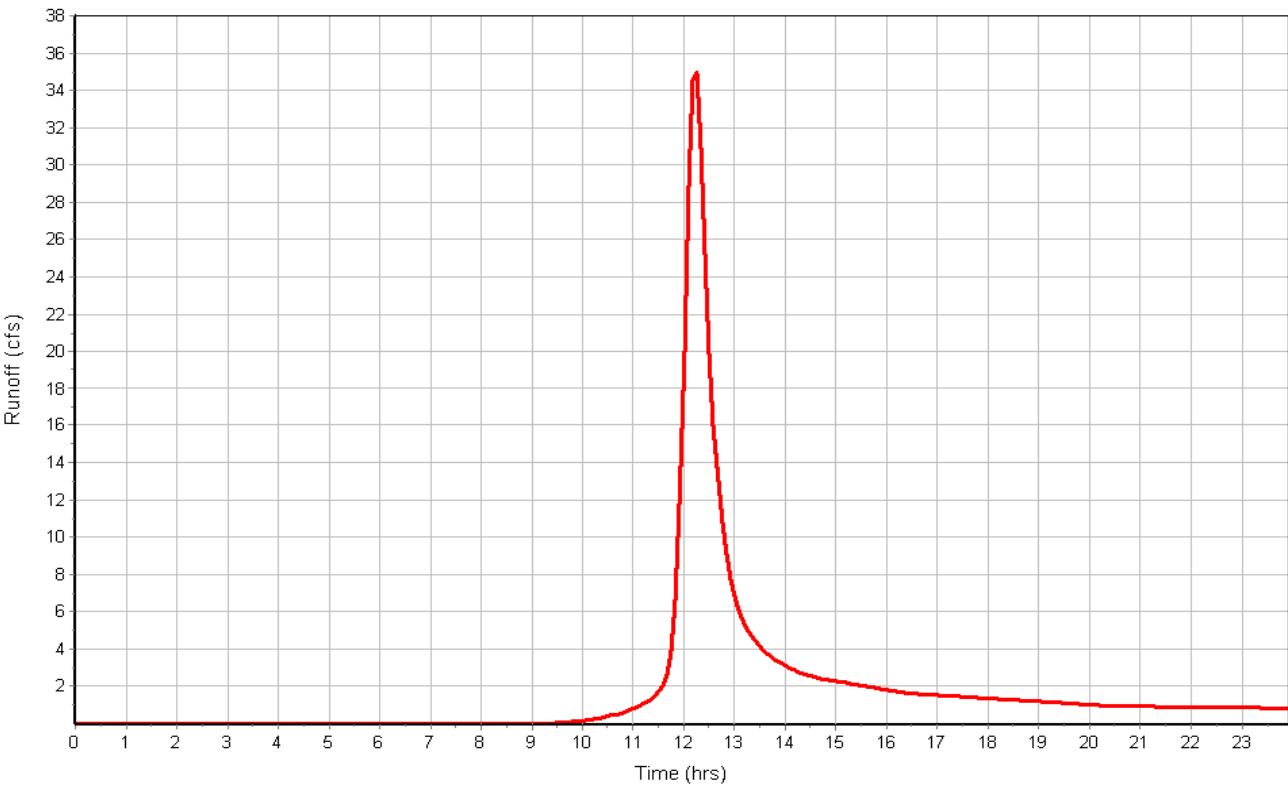


Subbasin : H5

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H6

### Input Data

Area (ac) ..... 31.60  
Weighted Curve Number ..... 66.60  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	11.06	B	60.00
Pasture, grassland, or range, Fair	18.96	B	69.00
Pasture, grassland, or range, Fair	1.58	D	84.00
Composite Area & Weighted CN	31.60		66.60

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	3.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.36	0.00	0.00
Computed Flow Time (min) :	12.25	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	1275	0.00	0.00
Channel Slope (%) :	3.8	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.32	0.00	0.00
Computed Flow Time (min) :	2.28	0.00	0.00
Total TOC (min) .....	35.59		

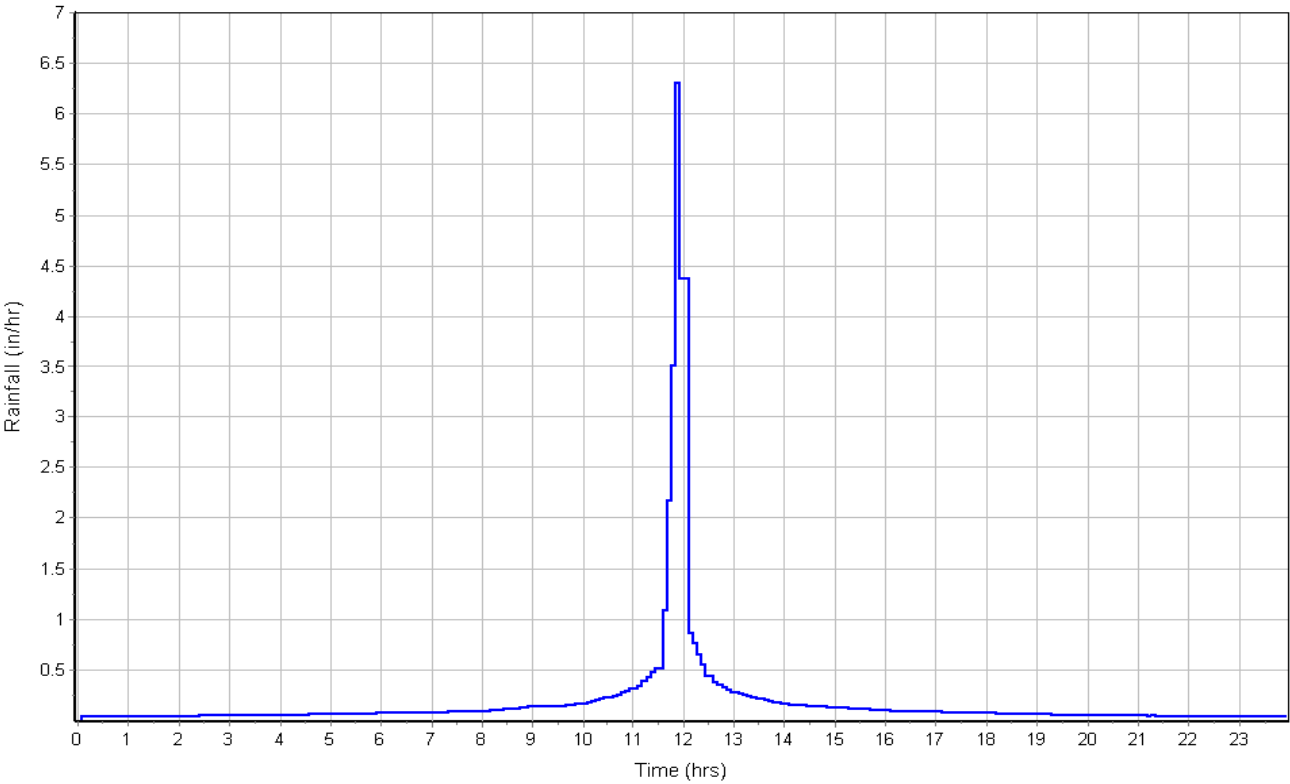
### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.50  
Peak Runoff (cfs) ..... 35.05  
Weighted Curve Number ..... 66.60  
Time of Concentration (days hh:mm:ss) ..... 0 00:35:35

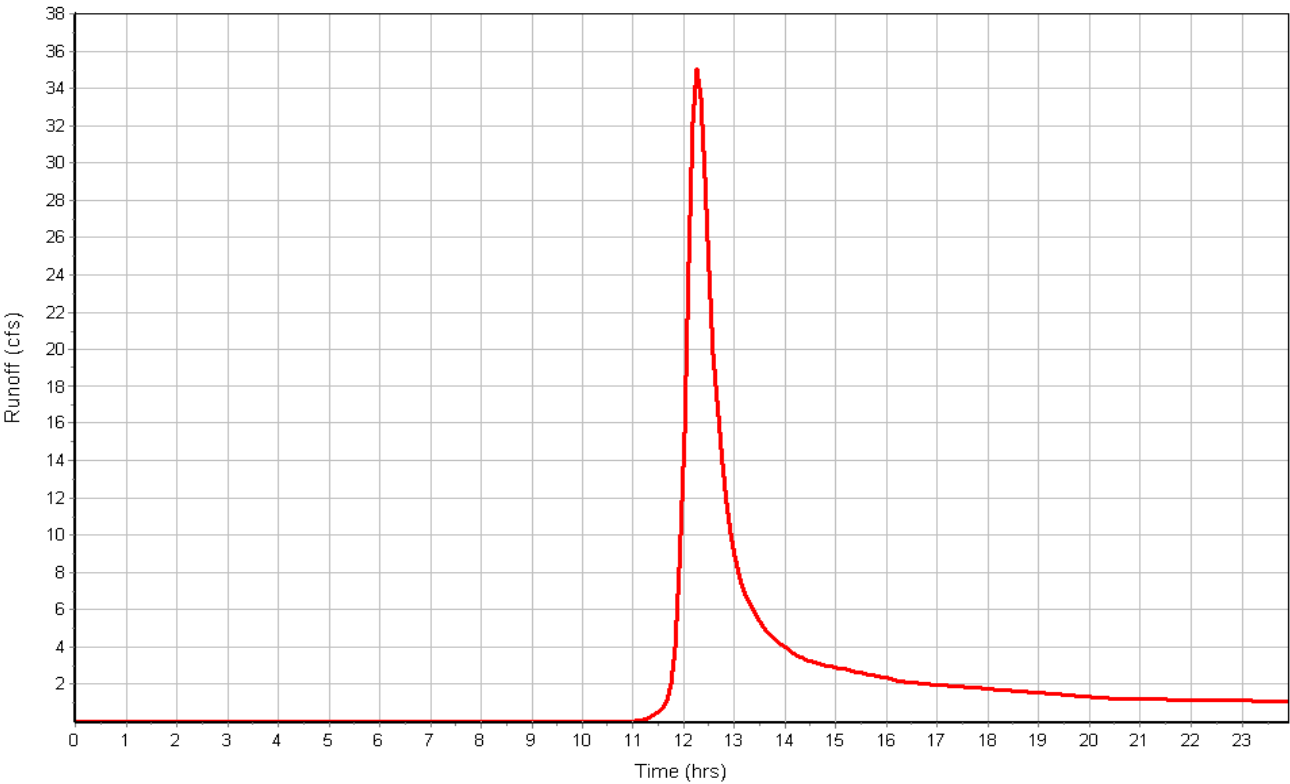


Subbasin : H6

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H7

### Input Data

Area (ac) ..... 25.80  
Weighted Curve Number ..... 70.50  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	10.32	C	72.00
Pasture, grassland, or range, Fair	7.74	C	79.00
5 Acre Lots, 7% Impervious	7.74	B	60.00
Composite Area & Weighted CN	25.80		70.50

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	1000	0.00	0.00
Slope (%) :	6.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.78	0.00	0.00
Computed Flow Time (min) :	9.36	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	343	0.00	0.00
Channel Slope (%) :	6.5	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	12.20	0.00	0.00
Computed Flow Time (min) :	0.47	0.00	0.00
Total TOC (min) .....	30.89		

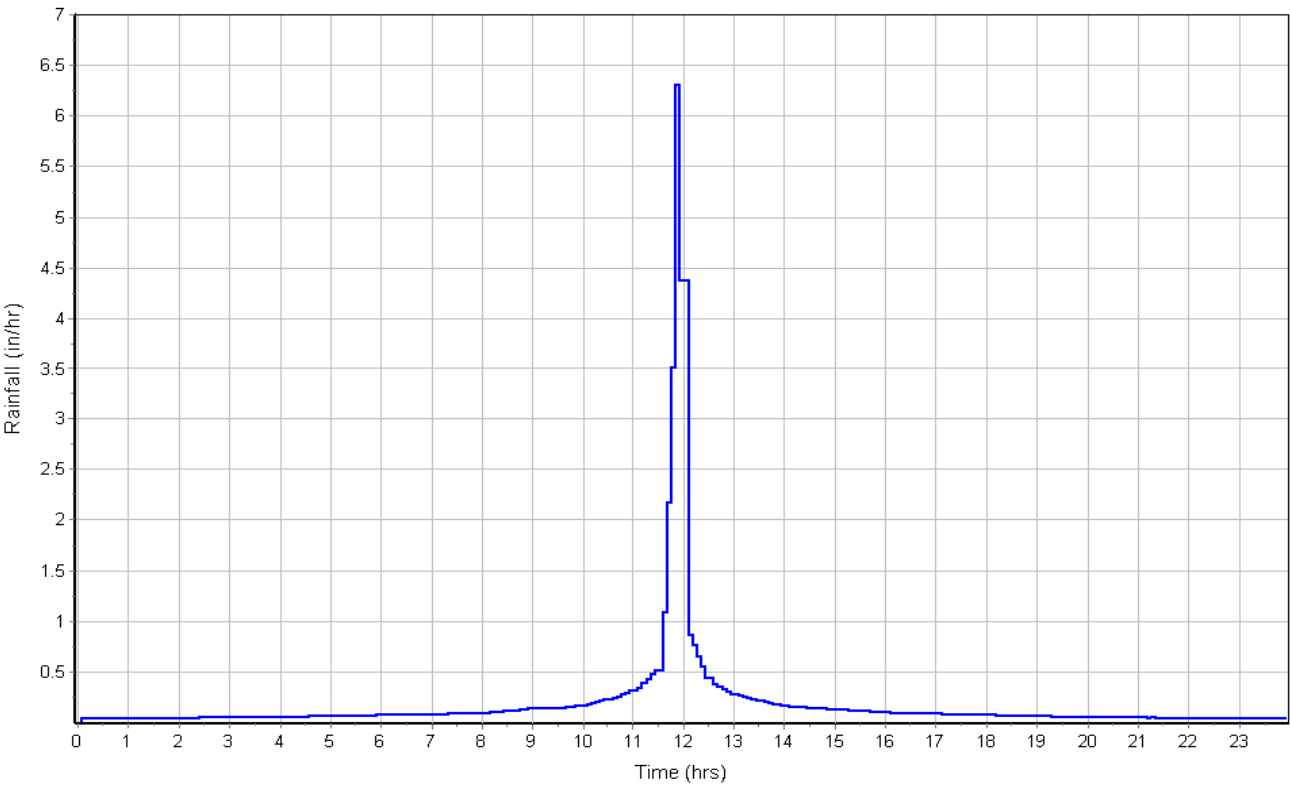
### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.78  
Peak Runoff (cfs) ..... 38.62  
Weighted Curve Number ..... 70.50  
Time of Concentration (days hh:mm:ss) ..... 0 00:30:53

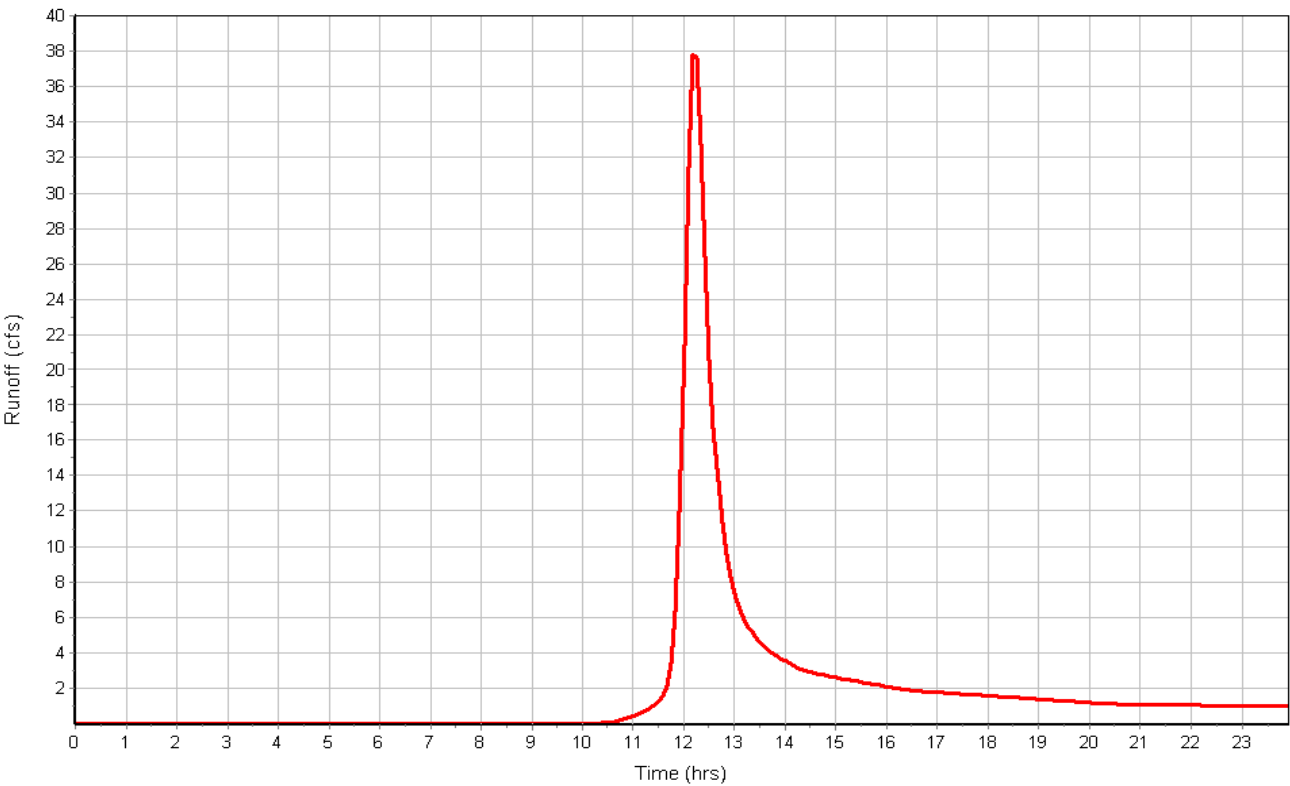


Subbasin : H7

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H8

### Input Data

Area (ac) ..... 8.50  
Weighted Curve Number ..... 74.55  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	2.55	B	60.00
Pasture, grassland, or range, Fair	2.13	D	84.00
Pasture, grassland, or range, Fair	3.83	C	79.00
Composite Area & Weighted CN	8.51		74.55

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	7.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.97	0.00	0.00
Computed Flow Time (min) :	4.23	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	159	0.00	0.00
Channel Slope (%) :	7.9	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	13.44	0.00	0.00
Computed Flow Time (min) :	0.20	0.00	0.00
Total TOC (min) .....	25.49		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 2.09  
Peak Runoff (cfs) ..... 17.10  
Weighted Curve Number ..... 74.55  
Time of Concentration (days hh:mm:ss) ..... 0 00:25:29

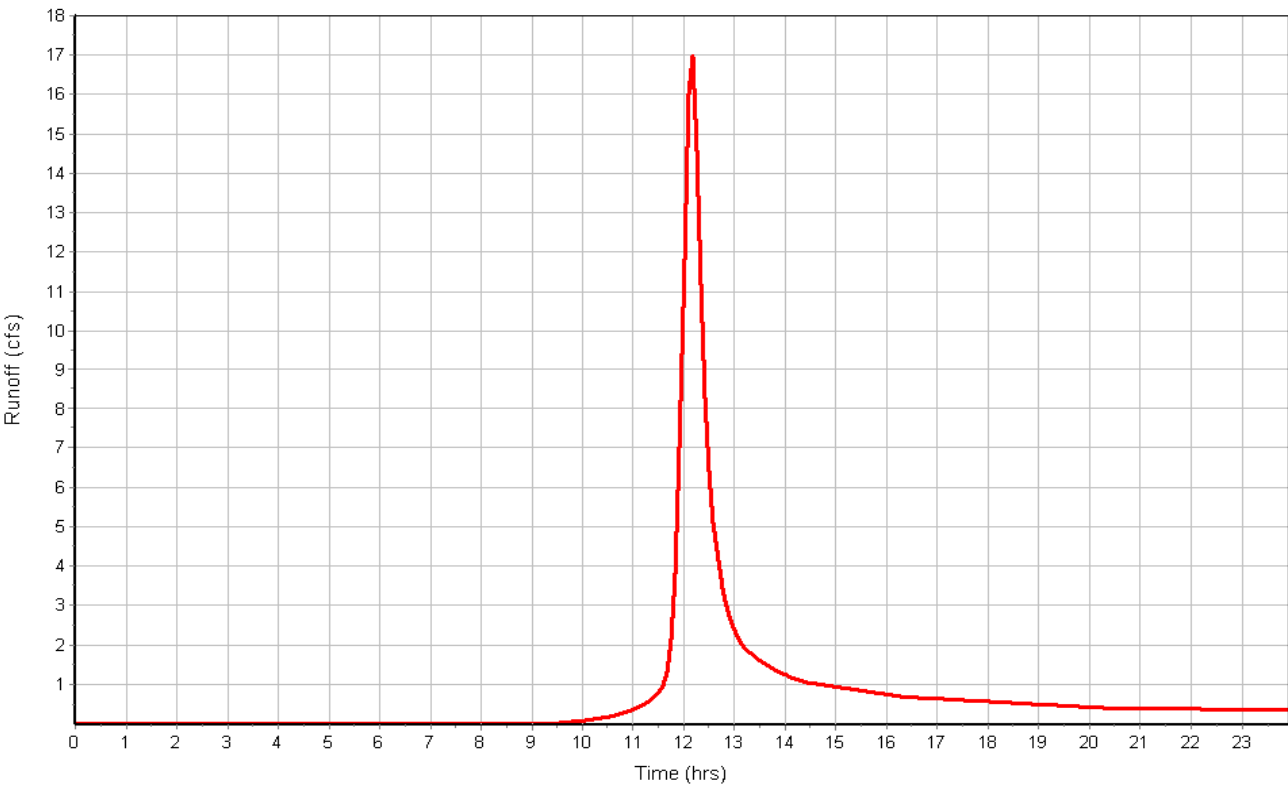


Subbasin : H8

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : H9

### Input Data

Area (ac) ..... 6.90  
Weighted Curve Number ..... 70.80  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	0.69	B	60.00
5 Acre Lots, 7% Impervious	6.21	C	72.00
Composite Area & Weighted CN	6.90		70.80

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	6.7	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.81	0.00	0.00
Computed Flow Time (min) :	2.76	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	171	0.00	0.00
Channel Slope (%) :	6.7	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	12.38	0.00	0.00
Computed Flow Time (min) :	0.23	0.00	0.00
Total TOC (min) .....	24.05		

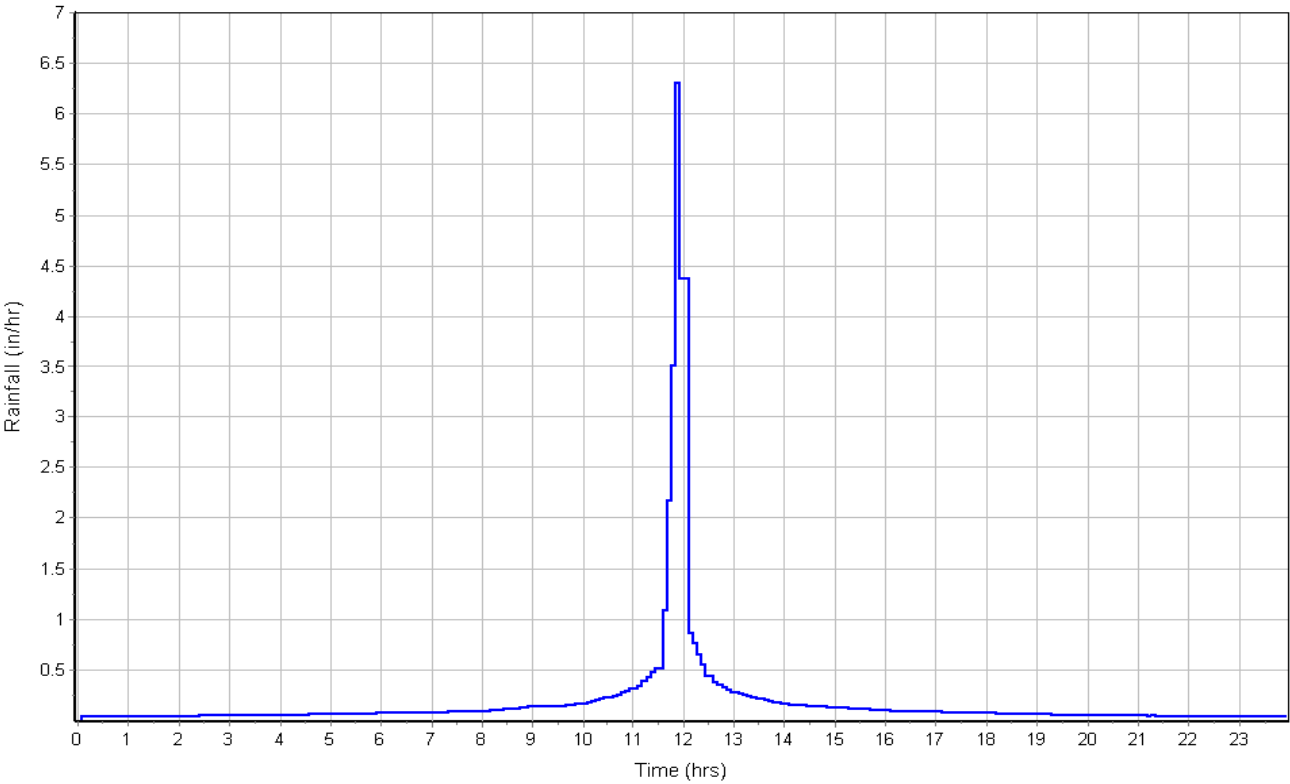
### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.80  
Peak Runoff (cfs) ..... 12.19  
Weighted Curve Number ..... 70.80  
Time of Concentration (days hh:mm:ss) ..... 0 00:24:03

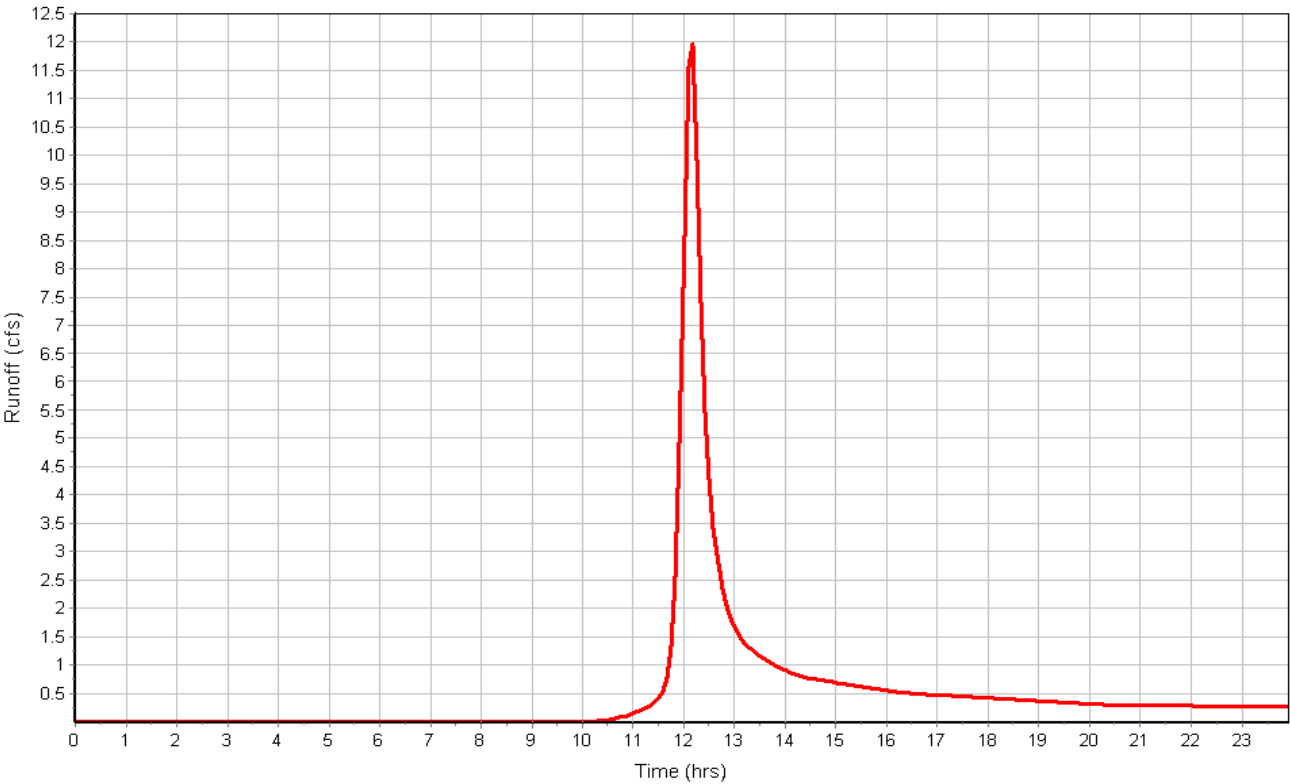


Subbasin : H9

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : I1

### Input Data

Area (ac) ..... 6.80  
Weighted Curve Number ..... 72.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	6.80	C	72.00
Composite Area & Weighted CN	6.80		72.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	4	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.40	0.00	0.00
Computed Flow Time (min) :	2.38	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	268	0.00	0.00
Channel Slope (%) :	4	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.57	0.00	0.00
Computed Flow Time (min) :	0.47	0.00	0.00
Total TOC (min) .....	23.91		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.90  
Peak Runoff (cfs) ..... 12.72  
Weighted Curve Number ..... 72.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:23:55

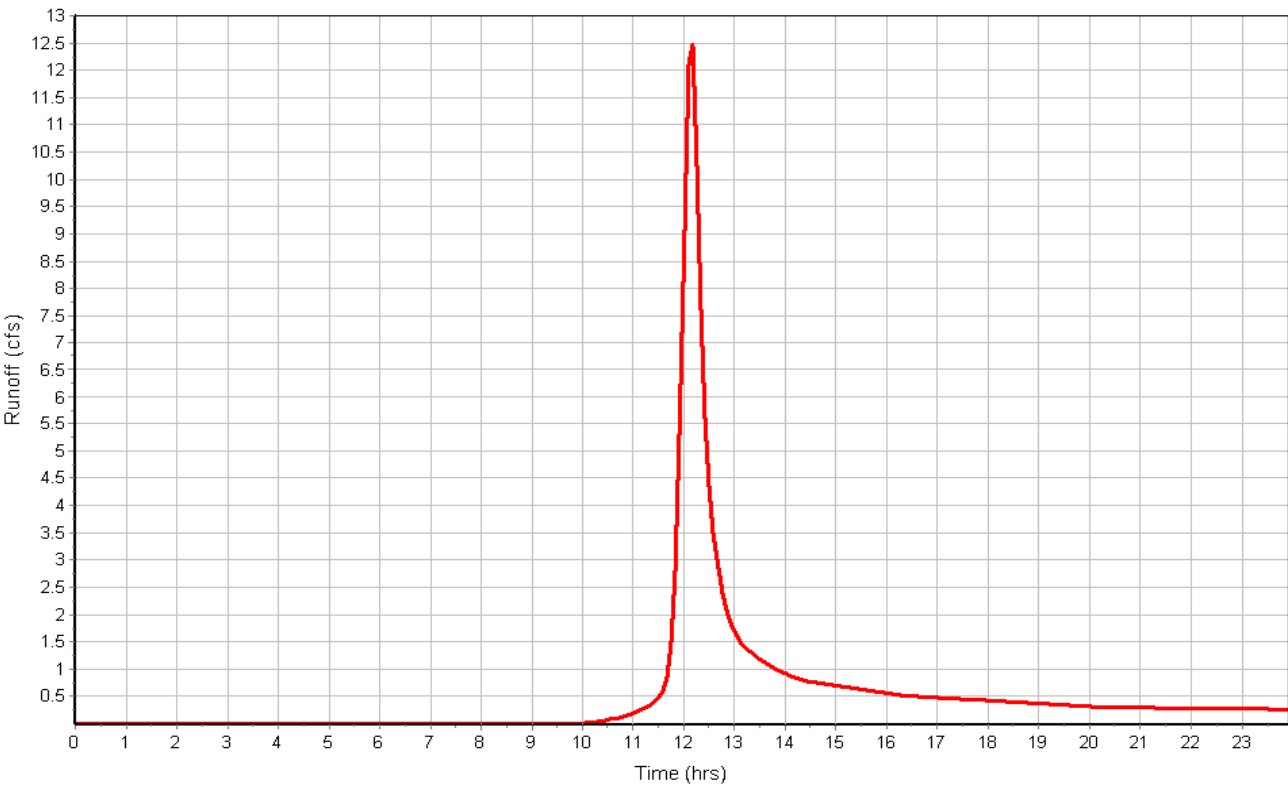


Subbasin : I1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : I2

### Input Data

Area (ac) ..... 14.80  
Weighted Curve Number ..... 72.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	14.80	C	72.00
Composite Area & Weighted CN	14.80		72.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	5.2	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.60	0.00	0.00
Computed Flow Time (min) :	2.08	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	285	0.00	0.00
Channel Slope (%) :	5.2	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	10.91	0.00	0.00
Computed Flow Time (min) :	0.44	0.00	0.00
Total TOC (min) .....	23.58		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.90  
Peak Runoff (cfs) ..... 27.89  
Weighted Curve Number ..... 72.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:23:35

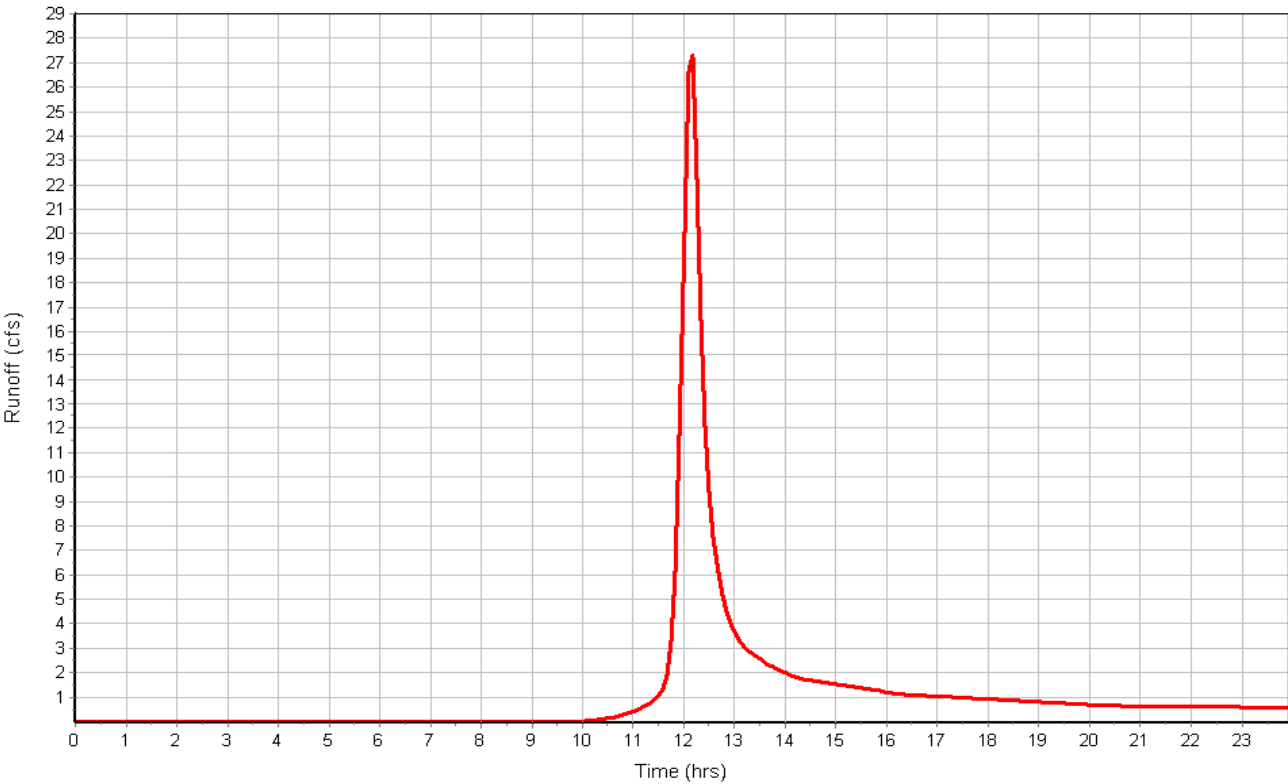


Subbasin : I2

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : J1

### Input Data

Area (ac) ..... 10.10  
Weighted Curve Number ..... 60.00  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	10.10	B	60.00
Composite Area & Weighted CN	10.10		60.00

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	8.8	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	2.08	0.00	0.00
Computed Flow Time (min) :	1.60	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	228	0.00	0.00
Channel Slope (%) :	8.8	0.00	0.00
Cross Section Area (ft²) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	14.19	0.00	0.00
Computed Flow Time (min) :	0.27	0.00	0.00
Total TOC (min) .....	22.93		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.07  
Peak Runoff (cfs) ..... 9.67  
Weighted Curve Number ..... 60.00  
Time of Concentration (days hh:mm:ss) ..... 0 00:22:56

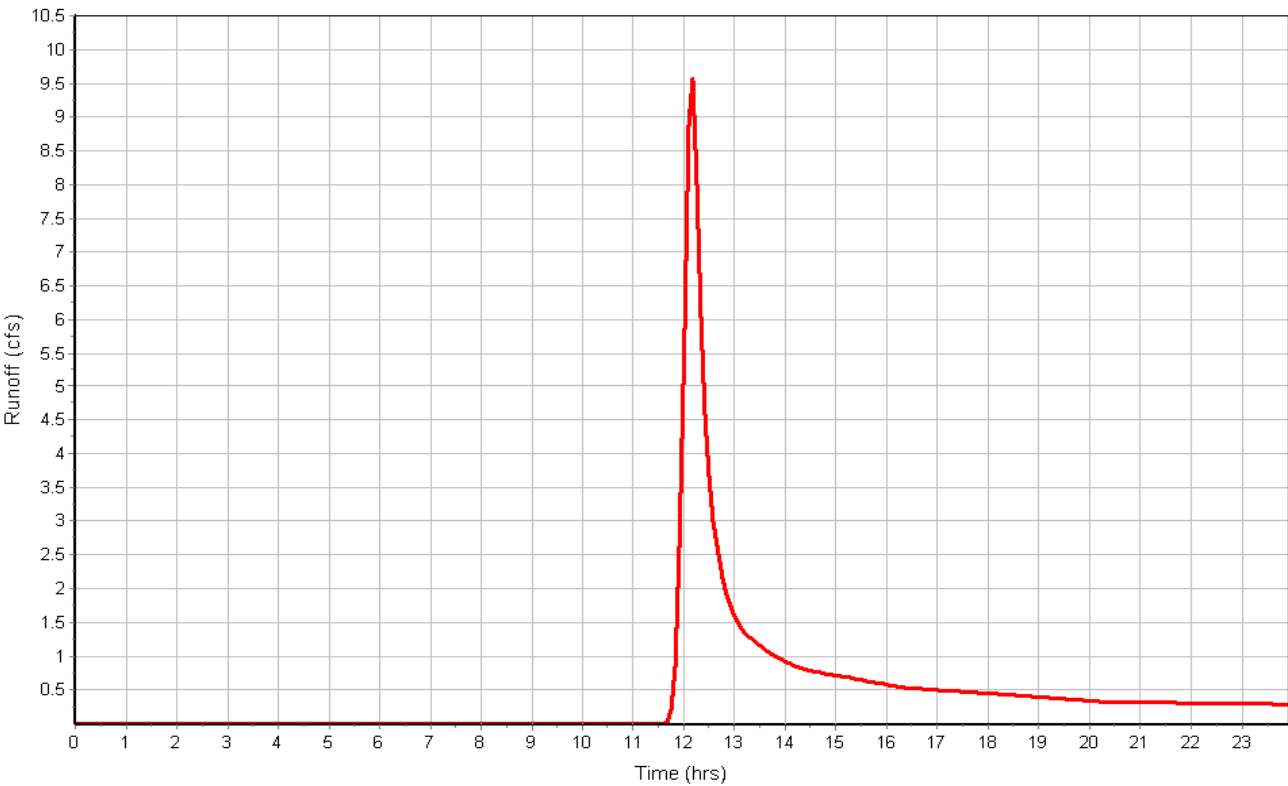


Subbasin : J1

Rainfall Intensity Graph



Runoff Hydrograph





## Subbasin : K1

### Input Data

Area (ac) ..... 17.80  
Weighted Curve Number ..... 69.60  
Rain Gage ID ..... Rain Gage-1

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
5 Acre Lots, 7% Impervious	3.56	B	60.00
5 Acre Lots, 7% Impervious	14.24	C	72.00
Composite Area & Weighted CN	17.80		69.60

### Time of Concentration

	Flowpath A	Flowpath B	Flowpath C
Sheet Flow Computations			
Manning's Roughness :	.1	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.10	0.00	0.00
Velocity (ft/sec) :	0.24	0.00	0.00
Computed Flow Time (min) :	21.06	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	3.9	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.38	0.00	0.00
Computed Flow Time (min) :	2.42	0.00	0.00

	Flowpath A	Flowpath B	Flowpath C
Channel Flow Computations			
Manning's Roughness :	.04	0.00	0.00
Flow Length (ft) :	354	0.00	0.00
Channel Slope (%) :	3.9	0.00	0.00
Cross Section Area (ft <sup>2</sup> ) :	36	0.00	0.00
Wetted Perimeter (ft) :	24.74	0.00	0.00
Velocity (ft/sec) :	9.45	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00
Total TOC (min) .....	24.10		

### Subbasin Runoff Results

Total Rainfall (in) ..... 4.60  
Total Runoff (in) ..... 1.72  
Peak Runoff (cfs) ..... 29.64  
Weighted Curve Number ..... 69.60  
Time of Concentration (days hh:mm:ss) ..... 0 00:24:06

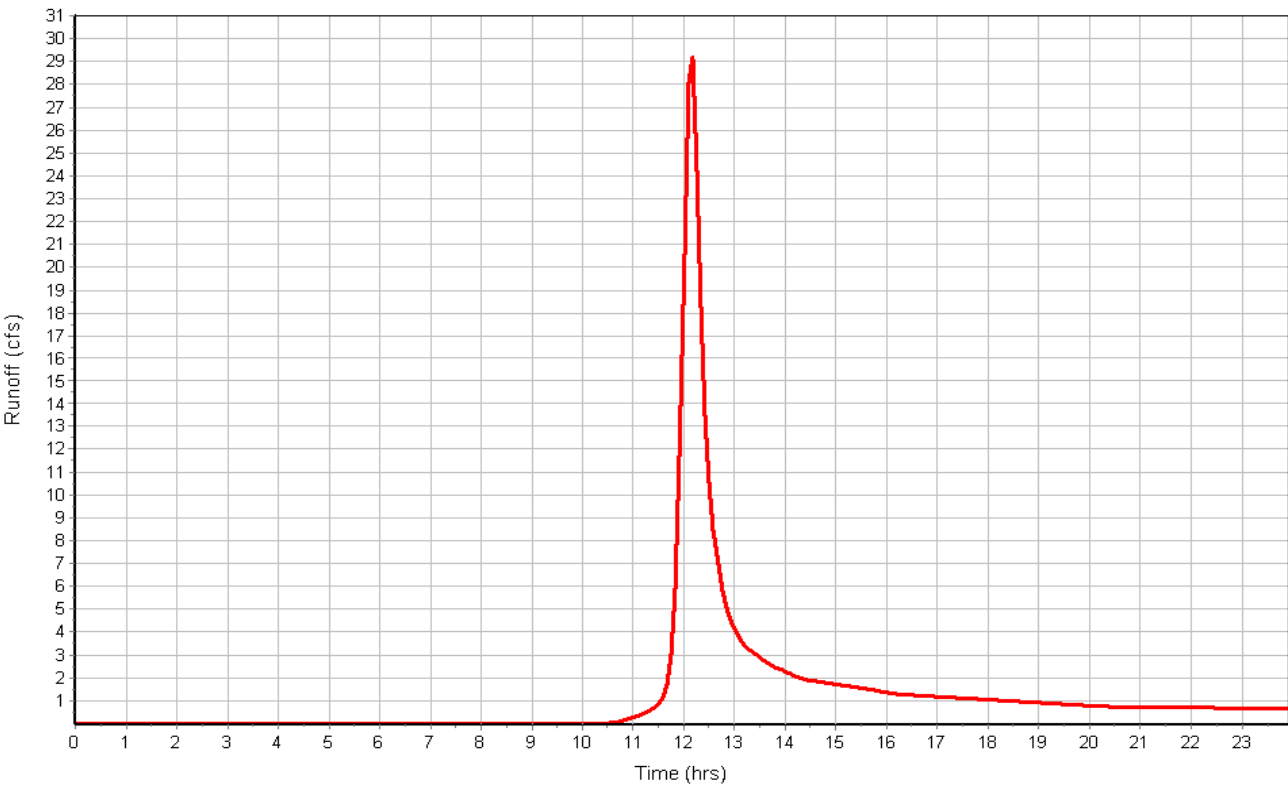


Subbasin : K1

Rainfall Intensity Graph



Runoff Hydrograph





## **4.6 BASIN INPUT DETAILS**



HEC - HMS Existing Sub-Basin Input Summary								
Sub-Basin	Area (sq. mi.)	Initial Storage (%)	Max. Storage (in)	Initial Abstraction	Curve Number	Impervious (%)	Time of Conc. (hr)	Storage Coeff. (hr)
A	1.4303125	5	0.035	0.617	61.83	6.55	0.883333	0.7968
Ba	5.9948	5	0.035	0.657	60.34	7	1.4925	1.2239
Bb	0.157188	5	0.035	0.433	69.79	2	0.666667	0.7623
Ca	0.254219	5	0.035	0.667	60	7	0.62	0.5068
Cb	0.109375	5	0.035	0.456	68.7	2	0.623611	0.5497
Da	0.252031	5	0.035	0.667	60	7	0.616389	0.4753
Db	0.077969	5	0.035	0.667	60	7	0.736667	0.5832
Dc	0.39016	5	0.035	0.477	67.7	2	0.682222	0.5404
Ea	0.059219	5	0.035	0.667	60	7	0.508333	0.4086
Eb	0.1165625	5	0.035	0.488	67.2	3	0.6375	0.8028
F	0.069531	5	0.035	0.449	69	2	0.628611	0.5955
G	0.168125	5	0.035	0.342	74.5	2	0.565278	0.4493
H	0.190313	5	0.035	0.394	71.76	2	0.560833	0.4672
I	0.058594	5	0.035	0.266	79	2	0.53	0.3923
J	0.0157813	5	0.035	0.439	69.5	7	0.381944	0.2818
K	0.027813	5	0.035	0.316	76	7	0.403333	0.2914



HEC - HMS Proposed Sub-Basin Input Summary								
Sub-Basin	Area (sq. mi.)	Initial Storage (%)	Max. Storage (in)	Initial Abstraction	Curve Number	Impervious (%)	Time of Conc. (hr)	Storage Coeff. (hr)
A1	1.3529	5	0.035	0.657	60.36	7	0.960556	0.8296
A2	0.0577812	5	0.035	0.515	66	7	0.623611	0.5493
A3	0.0648125	5	0.035	0.307	76.5	4.5	0.563889	0.42855
B1	5.9948	5	0.035	0.657	60.34	7	1.396667	1.1437
B2	0.0204688	5	0.035	0.563	64	11	0.4075	0.2978
B3	0.0857813	5	0.035	0.536	65.1	7	0.655833	0.7436
B4	0.0648125	5	0.035	0.46	68.5	7	0.658333	0.5661
C1	0.25422	5	0.035	0.667	60	7	0.62	0.5095
C2	0.035	5	0.035	0.667	60	7	0.543333	0.408
C3	0.0251563	5	0.035	0.563	64	11	0.472778	0.3959
C4	0.0371875	5	0.035	0.538	65	4.5	0.685278	0.6931
D1.1	0.25203	5	0.035	0.667	60	7	0.616389	0.4753
D1.2	0.0779688	5	0.035	0.667	60	7	0.736667	0.5832
D2	0.10734	5	0.035	0.544	64.75	9	0.580278	0.4375
D3	0.064375	5	0.035	0.563	64	11	0.656111	0.5583
D4	0.0535938	5	0.035	0.563	64	11	0.506944	0.3793
D5	0.02	5	0.035	0.488	67.2	3	0.508611	0.4257
D6	0.0653125	5	0.035	0.622	61.65	6	0.661111	0.5753
E0	0.0592188	5	0.035	0.667	60	7	0.619722	0.5008
E1.1	0.0123438	5	0.035	0.316	76	44	0.532778	0.4103
E1.2	0.0254687	5	0.035	0.613	62	9	0.600278	0.4475
E2	0.0040625	5	0.035	0.563	64	11	0.3775	0.3153
E3	0.0309375	5	0.035	0.563	64	11	0.455833	0.3698
E4	0.0284375	5	0.035	0.563	64	11	0.468611	0.3698
E5	0.0210938	5	0.035	0.563	64	11	0.451111	0.3552
E6	0.0451563	5	0.035	0.603	62.4	9	0.47725	0.3719
E7	0.0153125	5	0.035	0.613	62	9	0.408056	0.322
F1	0.0670313	5	0.035	0.656	60.4	7.5	0.597222	0.5224
G1	0.039375	5	0.035	0.515	66	4.5	0.446667	0.3474
G2	0.033125	5	0.035	0.376	72.7	3	0.5725	0.527
H1	0.0217187	5	0.035	0.412	70.8	7	0.449167	0.3515
H2	0.0610938	5	0.035	0.488	67.2	7	0.55	0.4492
H3	0.0090625	5	0.035	0.515	66	9	0.399444	0.302
H4	0.0423437	5	0.035	0.356	73.75	6	0.560278	0.492
H5	0.0315625	5	0.035	0.337	74.8	5	0.54	0.4984
H6	0.049375	5	0.035	0.502	66.6	3	0.593056	0.569
H7	0.0403125	5	0.035	0.418	70.5	5	0.514722	0.4112
H8	0.0132812	5	0.035	0.341	74.55	4	0.424722	0.3412
H9	0.0107812	5	0.035	0.412	70.8	7	0.400833	0.3111
I1	0.010625	5	0.035	0.389	72	7	0.398333	0.3094
I2	0.023125	5	0.035	0.389	72	7	0.392778	0.2852
J1	0.0157813	5	0.035	0.439	69.5	7	0.381944	0.2818
K1	0.0278125	5	0.035	0.316	76	7	0.399667	0.2898



## **4.7 REACH INPUT DETAILS**



HEC - HMS Proposed Reach Input Summary							
Reach	Length (ft)	Slope (ft/ft)	Mannings Coeff	Shape	Bottom Width (ft)	Side Slopes (H:V)	Elevation
1	2473.3	0.0249	0.04	Trapezoid	20	4	7318.5
2	2839.57	0.0065	0.04	Trapezoid	20	4	7300
3	1717.53	0.0116	0.04	Trapezoid	20	4	7280
4	1277.36	0.0031	0.04	Trapezoid	20	4	7280
5	70.66	0.2264	0.04	Trapezoid	20	4	7260
6	2431.12	0.0249	0.04	Triangle		7	7318.5
7	3754.6	0.0226	0.04	Triangle		7	7300
8	2431	0.0249	0.04	Triangle		7	7300
9	5201.6	0.0271	0.04	Triangle		7	7276



HEC - HMS Proposed Reach Input Summary								
Reach	Length (ft)	Slope (ft/ft)	Mannings Coeff	Shape	Diameter (ft)	Bottom Width (ft)	Side Slopes (H:V)	Elevation
BOX CULVERT 1	100	0.005	0.012	Rectangle		32		7318
BOX CULV 2	100	0.005	0.012	Rectangle		32		7279.5
CLV E4	60	0.0167	0.012	Circle	3			7336
CULV B2	60	0.0667	0.012	Circle	1.5			7371
CULV C2	60	0.05	0.012	Circle	3			7360
CULV C3	60	0.0667	0.012	Circle	3			7337
CULV D2	60	0.0167	0.012	Circle	4.5			7328
CULV D3	60	0.0333	0.012	Circle	3			7370
CULV D4	60	0.0083	0.012	Circle	4			7337
CULV E1.2	60	0.0167	0.012	Circle	2.5			7380
CULV E2	60	0.0333	0.012	Circle	1.5			7399
CULV E5	60	0.0583	0.012	Circle	1.5			7333
CULV H2	60	0.0333	0.012	Circle	2.5			7332
CULV H3	60	0.0586	0.012	Circle	1.5			7376
CULV I1	60	0.0167	0.012	Circle	1.5			7354.5
CULV-E3	60	0.025	0.012	Circle	2			7367.5
EX CULV C1	100	0.03	0.025	Circle	2.5			7379
EX CULV D1.1	100	0.03	0.025	Circle	6			7385
EX CULV D1.2	100	0.04	0.025	Circle	2.5			7412
EX CULV E0	125	0.024	0.012	Circle	2.5			7417
OUT 2	865.85	0.02	0.04	Triangle			7	7282
OUT-1	1089	0.01	0.04	Trapezoid		20	4	7266
REACH A1	1609.87	0.0134	0.04	Triangle			7	7318.5
Reach H7	200	0.0796	0.04	Triangle			7	7376
Reach-A2	991.55	0.0751	0.04	Triangle			7	7318.5
Reach-B1	2137.84	0.0239	0.04	Trapezoid		20	4	7334
Reach-B2	1548.66	0.0339	0.04	Triangle			7	7318.5
Reach-B3	1801.86	0.0086	0.04	Trapezoid		20	4	7318.5
Reach-B4-3	155.46	0.119	0.04	Triangle			7	7318.5
Reach-C1	799.51	0.02	0.04	Triangle			7	7363
Reach-C2	861.57	0.0221	0.04	Triangle			7	7341
Reach-D1.1	1827.5	0.0306	0.04	Trapezoid		8	4	7329
Reach-D3	1312.44	0.0305	0.04	Triangle			7	7372
Reach-D4	1169.72	0.0278	0.04	Triangle			7	7337.5
Reach-D5	1270.02	0.022	0.04	Trapezoid		8	4	7300
Reach-D6	1418.47	0.0338	0.04	Triangle			7	7289
Reach-E1.1	1328.59	0.0128	0.04	Triangle			7	7400
Reach-E1.2	791.59	0.024	0.04	Triangle			4	7381
Reach-E3	974.31	0.0308	0.04	Triangle			7	7369
Reach-E4	1141.92	0.0267	0.04	Triangle			7	7337
Reach-E6	858.58	0.0512	0.04	Trapezoid		20	4	7289
Reach-E6-2	1915.96	0.0151	0.04	Triangle			7	7289
Reach-E7	712.94	0.0252	0.04	Triangle			7	7318
Reach-F1	1032.69	0.0513	0.04	Trapezoid		8	4	7327
Reach-F1-2	1886.42	0.0048	0.04	Triangle			7	7318
Reach-G2	1241.36	0.0499	0.04	Triangle			7	7311
Reach-H4	1249.62	0.0624	0.04	Triangle			7	7311
Reach-H6	586.28	0.0597	0.04	Triangle			7	7297
Reach-H7-1	1205.71	0.0796	0.04	Triangle			7	7295
Reach-H9	633.71	0.0284	0.04	Triangle			7	7301
Reach-I2-1	461.48	0.0769	0.04	Triangle			7	7319
Reach-P3	264.79	0.0264	0.04	Triangle			7	7280
Reach-1	866.29	0.0092	0.04	Trapezoid		20	4	7310
Reach-2	1071.31	0.0093	0.04	Trapezoid		20	4	7300
Reach-3	736.36	0.0109	0.04	Trapezoid		20	4	7292
Reach-4	1308.67	0.0092	0.04	Trapezoid		20	4	7280
Reach-5	340.25	0.0103	0.04	Trapezoid		20	4	7276
Reach-6 Kiowa Outfall	100	0.01	0.04	Trapezoid		20	4	7265



## **4.8 DETENTION POND SUMMARY**



CALCULATED BY: JP  
CHECKED BY:

JOB NO: 48157  
LOCATION: Monument, CO

LOCATION	DESIGN POINT	BASIN	AREA (Acres)	IMPERVIOUS FACTOR						SOIL				WATERSHED				CALCULATIONS		
				5 ACRE LOT (7%)	2.5 ACRE LOT (11%)	OPEN SPACE (2%)	COMMERCIAL (85%)	TOTAL % CHECK	WEIGHTED IMPERVIOUSNESS	SOIL GROUP A %	SOIL GROUP B %	SOIL GROUP C/D %	TOTAL % CHECK	WATERSHED LENGTH	WATERSHED HIGH POINT	WATERSHED LOW POINT	WATERSHED SLOPE	100-YEAR REQUIRED VOLUME (AC-FT)	PROPOSED VOLUME	PEAK OUTFLOW VS PREDEVELOPED FLOW RATIO
POND 1	P1	G1	25.2	70%	0%	30%	0%	100%	6%	0%	0%	100%	100%							
		G2	21.2	90%	0%	10%	0%	100%	7%	0%	0%	100%	100%							
		H1	13.9	100%	0%	0%	0%	100%	7%	0%	10%	90%	100%							
		H4	27.1	70%	0%	30%	0%	100%	6%	0%	0%	100%	100%							
			87.4						6.0%	0.0%	1.6%	98.4%	100%	3,246	7,465	7,317	0.046	2.557	8.815	0.2
POND 2	P2	H2	31.9	100%	0%	0%	0%	100%	7%	0%	70%	30%	100%							
		H5	20.2	70%	0%	30%	0%	100%	6%	0%	0%	100%	100%							
		H6	31.6	35%	0%	65%	0%	100%	4%	0%	0%	100%	100%							
			83.7						5.4%	0%	27%	73%	100%	2,628	7,444	7,305	0.053	2.341	8.132	0.2
POND 3	P3	D1.2	49.9	100%	0%	0%	0%	100%	7%	0.0%	100.0%	0.0%	100%							
		D3	41.2	0%	10%	90%	0%	100%	3%	0.0%	100.0%	0.0%	100%							
		D4	34.3	0%	100%	0%	0%	100%	11%	0.0%	100.0%	0.0%	100%							
		D6	41.8	80%	0%	20%	0%	100%	6%	0.0%	90.0%	10.0%	100%							
			167.2						6.6%	0.0%	97.5%	2.5%	100%	6,480	7,480	7,292	0.029	5.110	7.088	0.8
POND 4	P4	I1	6.8	100%	0%	0%	0%	100%	7%	0%	0%	100%	100%							
		I2	14.8	100%	0%	0%	0%	100%	7%	0%	0%	100%	100%							
		H9	6.9	100%	0%	0%	0%	100%	7%	0%	20%	80%	100%							
			28.5						7.0%	0.0%	4.8%	95.2%	100%	1,895	7,388	7,322	0.035	0.892	1.452	0.8
POND 5	P5	E1.2	16.3	50%	50%	0%	0%	100%	9%	0%	100%	0%	100%							
		E2	2.6	0%	100%	0%	0%	100%	11%	0%	100%	0%	100%							
		E3	19.8	0%	100%	0%	0%	100%	11%	0%	100%	0%	100%							
		E4	18.2	0%	100%	0%	0%	100%	11%	0%	100%	0%	100%							
		E5	13.5	0%	100%	0%	0%	100%	11%	0%	100%	0%	100%							
		E6	28.9	70%	20%	10%	0%	100%	7%	0%	90%	10%	100%							
		E7	9.8	0%	100%	0%	0%	100%	11%	0%	100%	0%	100%							
		F1	42.9	100%	0%	0%	0%	100%	7%	0%	100%	0%	100%							
			152.0						9.0%	0.0%	98.1%	1.9%	100%	4,755	7,427	7,295	0.028	5.656	11.565	0.4
POND 6	P6	E0	37.9	100%	0%	0%	0%	100%	7%	0%	100%	0%	100%							
		E1.1	7.9	0%	0%	50%	50%	100%	50%	0%	100%	0%	100%							
			45.8						14.5%	0.0%	100%	0%	100%	2,615	7,480	7,404	0.029	2.026	3.977	0.4



## **4.9 UD DETENTION CALCULATIONS**





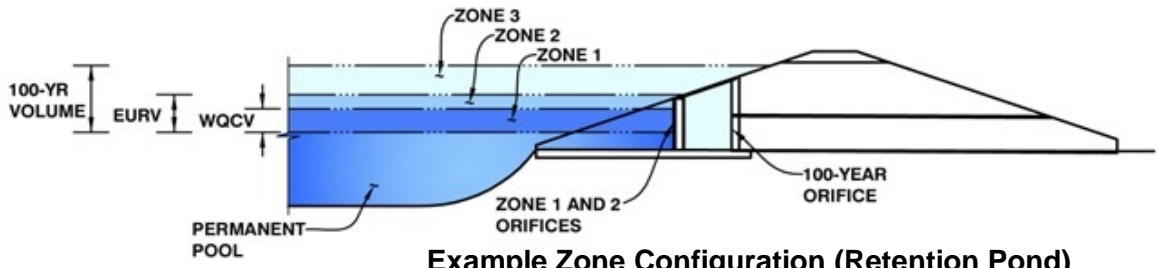


## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.24	0.311	Orifice Plate
Zone 2 (EURV)	0.32	0.108	Circular Orifice
Zone 3 (100-year)	1.87	2.137	Weir&Pipe (Circular)
		2.557	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.250E-02	ft <sup>2</sup>
Depth at top of Zone using Orifice Plate =	0.32	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	3.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	9.00	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft <sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.11	0.21					
Orifice Area (sq. inches)	9.00	9.00	9.00					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected		Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.24	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	2.18	ft <sup>2</sup>
Depth at top of Zone using Vertical Orifice =	0.32	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.83	feet
Vertical Orifice Diameter =	20.00	N/A	inches			

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H <sub>o</sub> =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H <sub>t</sub> =	4.33	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Over Flow Weir Slope Length =	4.22	feet
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	4.56	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	14.34	ft <sup>2</sup>
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	7.17	ft <sup>2</sup>
Debris Clogging % =	50%	N/A	%			

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected		Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.14	ft <sup>2</sup>
Circular Orifice Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	1.00	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	58.00	feet	Stage at Top of Freeboard =	7.46	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.67	acres
Freeboard above Max Water Surface =	1.00	feet			

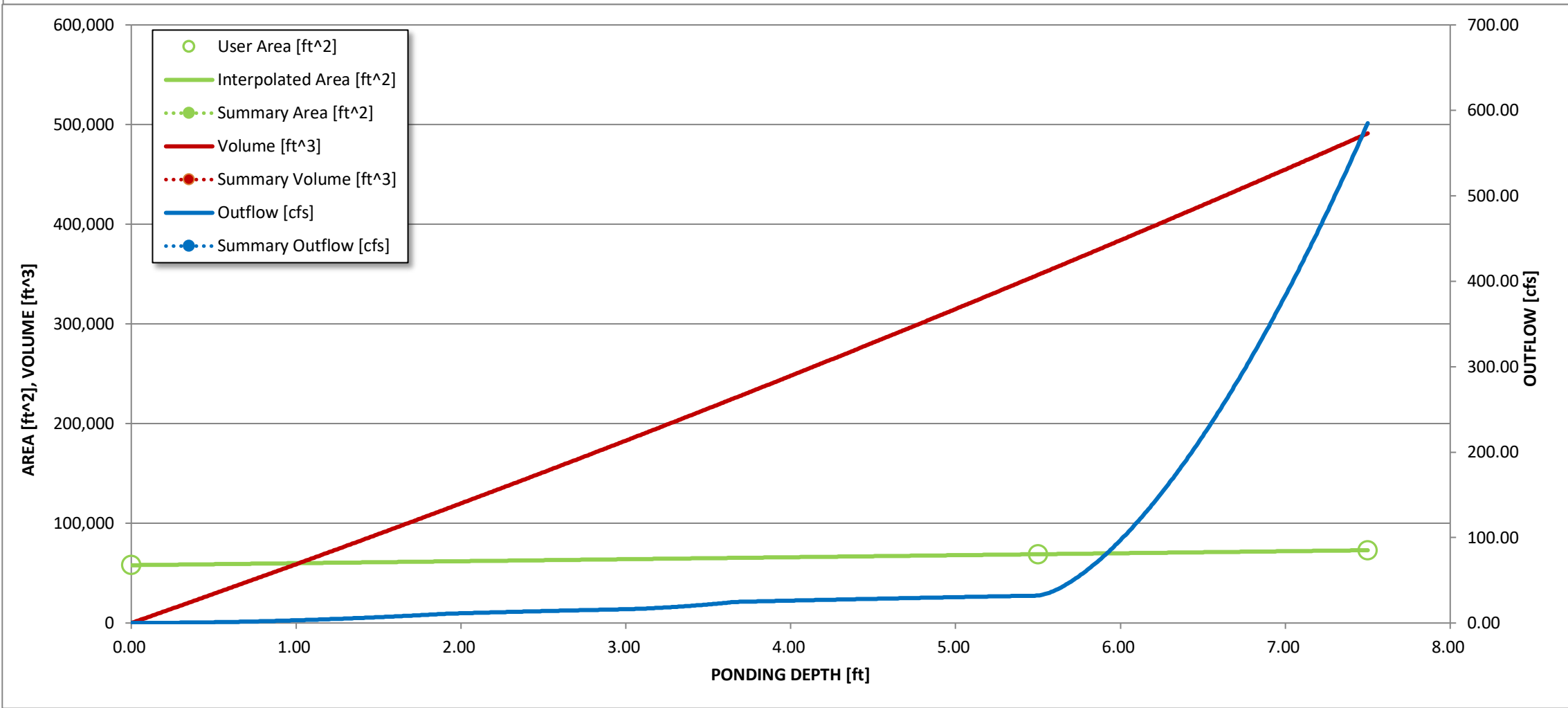
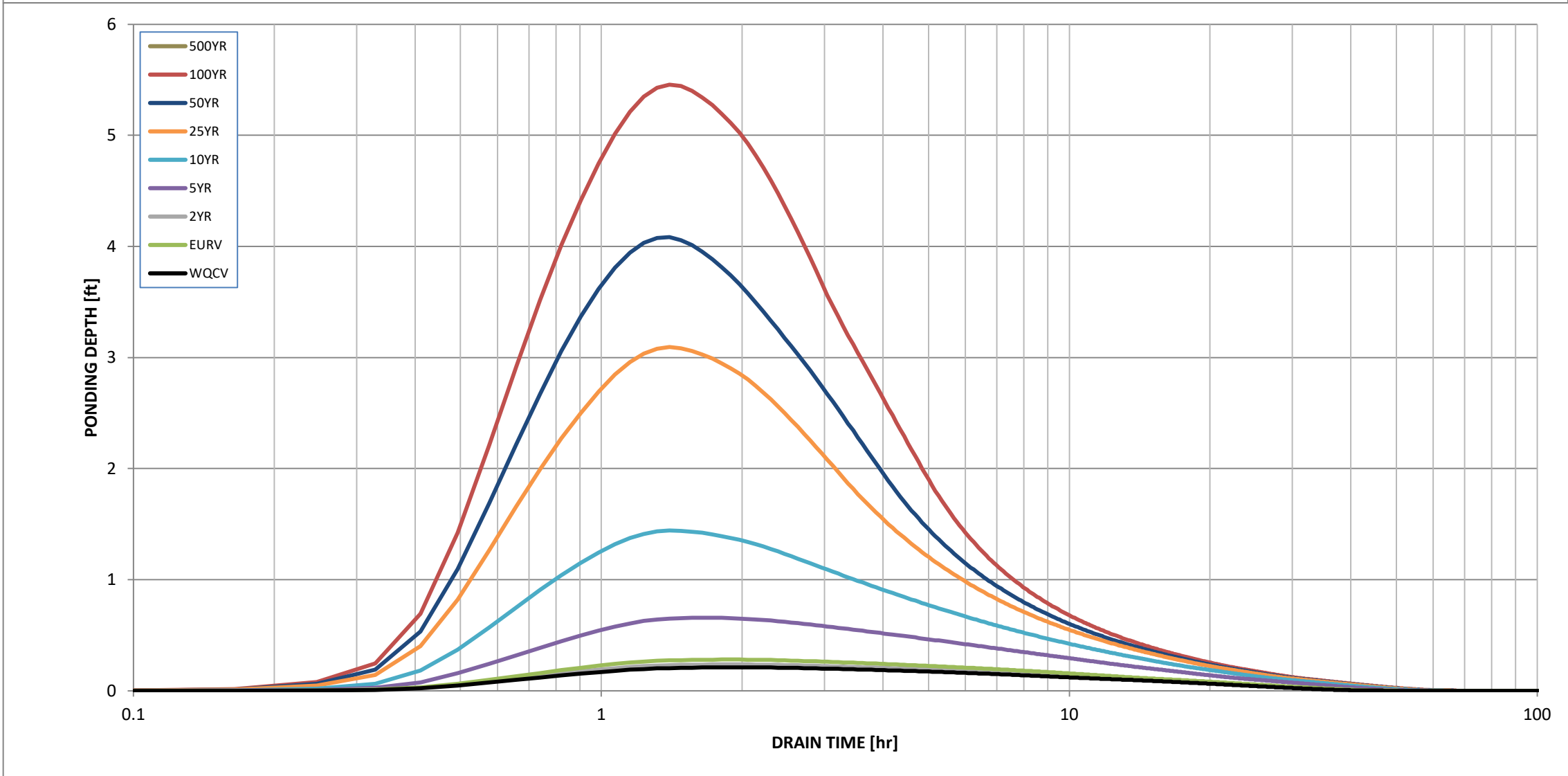
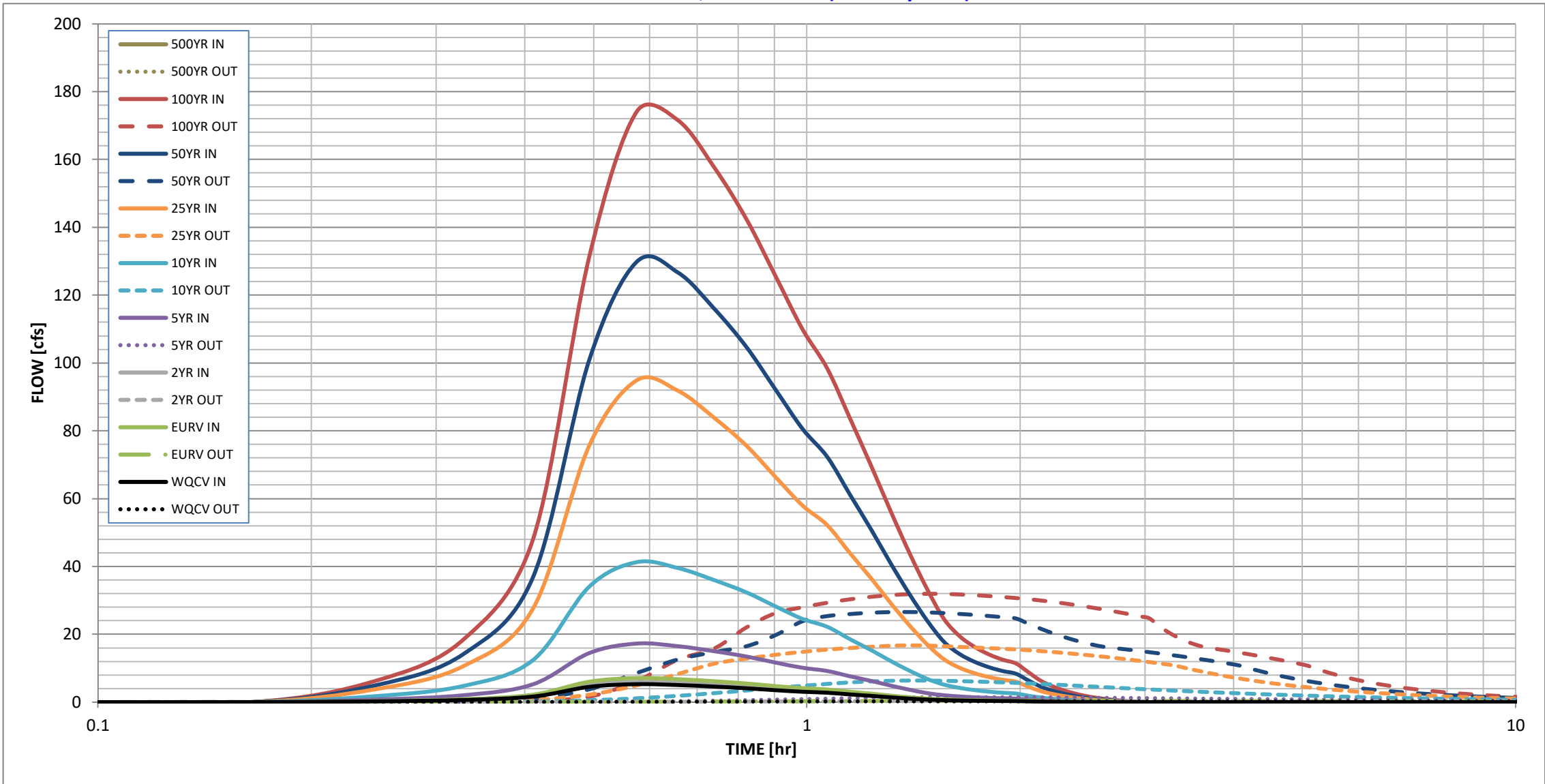
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
One-Hour Rainfall Depth (in) =	0.311	0.420	0.352	1.030	2.489	5.816	8.021	10.860	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.311	0.419	0.352	1.030	2.491	5.816	8.024	10.861	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.12	0.34	0.79	1.04	1.35	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.3	10.6	29.3	68.6	90.6	118.3	0.0
Peak Inflow Q (cfs) =	5.3	7.1	6.0	17.3	41.3	94.9	129.8	174.1	#N/A
Peak Outflow Q (cfs) =	0.2	0.4	0.3	1.5	6.4	16.7	26.6	31.9	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.2	0.2	0.3	0.3	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.5	0.5	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	40	39	43	38	27	24	21	#N/A
Time to Drain 99% of Inflow Volume (hours) =	44	46	45	50	49	43	40	37	#N/A
Maximum Ponding Depth (ft) =	0.21	0.28	0.24	0.66	1.44	3.09	4.08	5.46	#N/A
Area at Maximum Ponding Depth (acres) =	1.34	1.34	1.34	1.36	1.40	1.47	1.52	1.58	#N/A
Maximum Volume Stored (acre-ft) =	0.281	0.375	0.307	0.875	1.965	4.334	5.815	7.939	#N/A



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



## Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

### Storm Inflow Hydrographs

## UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.93 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:04:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph Constant	0:09:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:14:47	0.24	0.32	0.27	0.76	1.76	3.80	4.96	6.29	#N/A
	0:19:43	0.64	0.85	0.72	2.05	4.83	10.74	14.35	18.69	#N/A
1.015	0:24:39	1.63	2.19	1.85	5.26	12.39	27.58	36.85	48.03	#N/A
	0:29:35	4.49	6.01	5.08	14.44	34.01	75.56	100.81	131.20	#N/A
	0:34:31	5.28	7.09	5.98	17.26	41.26	94.87	129.79	174.05	#N/A
	0:39:26	5.03	6.76	5.69	16.49	39.54	91.84	126.70	171.61	#N/A
	0:44:22	4.58	6.15	5.18	15.01	35.99	83.87	116.07	157.76	#N/A
	0:49:18	4.07	5.48	4.61	13.44	32.35	75.60	104.70	142.40	#N/A
	0:54:14	3.50	4.72	3.97	11.64	28.18	66.30	92.04	125.48	#N/A
	0:59:10	3.06	4.12	3.46	10.12	24.52	57.96	80.55	109.91	#N/A
	1:04:05	2.77	3.73	3.13	9.18	22.21	52.19	72.32	98.39	#N/A
	1:09:01	2.27	3.06	2.57	7.61	18.54	43.92	61.15	83.63	#N/A
	1:13:57	1.84	2.49	2.09	6.24	15.31	36.45	50.84	69.61	#N/A
	1:18:53	1.40	1.91	1.59	4.84	12.05	29.03	40.70	55.99	#N/A
	1:23:49	1.03	1.41	1.17	3.64	9.22	22.53	31.70	43.76	#N/A
	1:28:44	0.75	1.03	0.86	2.63	6.82	16.93	23.94	33.18	#N/A
	1:33:40	0.59	0.80	0.67	2.03	5.15	12.62	17.76	24.49	#N/A
	1:38:36	0.48	0.66	0.55	1.66	4.18	10.10	14.13	19.40	#N/A
	1:43:32	0.41	0.56	0.47	1.41	3.52	8.48	11.85	16.24	#N/A
	1:48:28	0.36	0.49	0.41	1.24	3.08	7.37	10.27	14.03	#N/A
	1:53:23	0.33	0.44	0.37	1.11	2.76	6.58	9.15	12.49	#N/A
	1:58:19	0.30	0.41	0.34	1.02	2.53	6.02	8.36	11.39	#N/A
	2:03:15	0.22	0.30	0.25	0.75	1.87	4.53	6.37	8.79	#N/A
	2:08:11	0.16	0.22	0.18	0.55	1.36	3.27	4.59	6.33	#N/A
	2:13:07	0.12	0.16	0.13	0.40	1.00	2.42	3.41	4.70	#N/A
	2:18:02	0.09	0.12	0.10	0.30	0.74	1.80	2.53	3.49	#N/A
	2:22:58	0.06	0.08	0.07	0.21	0.54	1.32	1.87	2.58	#N/A
	2:27:54	0.04	0.06	0.05	0.15	0.39	0.95	1.35	1.87	#N/A
	2:32:50	0.03	0.04	0.03	0.11	0.28	0.69	0.98	1.35	#N/A
	2:37:46	0.02	0.03	0.02	0.07	0.19	0.49	0.69	0.96	#N/A
	2:42:41	0.01	0.02	0.01	0.04	0.12	0.32	0.46	0.64	#N/A
	2:47:37	0.01	0.01	0.01	0.02	0.07	0.18	0.27	0.38	#N/A
	2:52:33	0.00	0.00	0.00	0.01	0.03	0.09	0.13	0.19	#N/A
	2:57:29	0.00	0.00	0.00	0.00	0.01	0.03	0.04	0.06	#N/A
	3:02:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:07:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:12:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:17:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:22:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:27:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:31:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:36:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:41:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:46:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:51:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:56:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:01:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:06:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:11:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:16:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:21:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:26:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:31:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:36:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:41:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:45:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:50:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:55:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:00:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:05:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:10:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:15:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:20:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:25:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:30:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:35:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:40:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:45:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:50:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:54:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

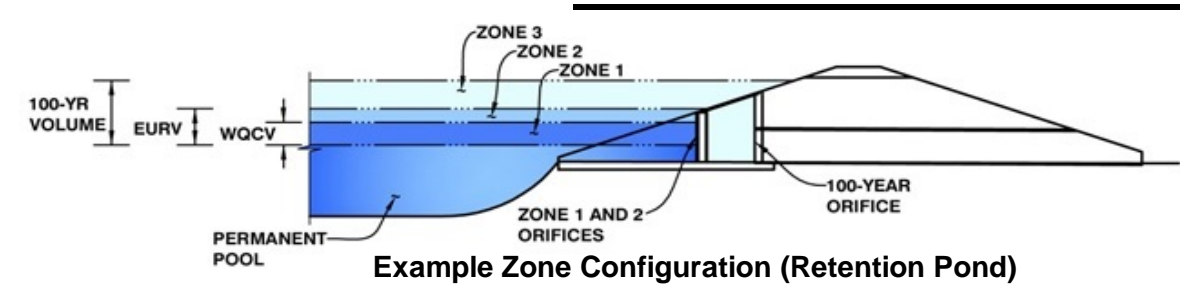


# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

**Project: Winsome**

Basin ID: Pond 2



### Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	83.70	acres
Watershed Length =	2,628	ft
Watershed Slope =	0.053	ft/ft
Watershed Imperviousness =	5.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	27.0%	percent
Percentage Hydrologic Soil Groups C/D =	73.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	70.7
Water Quality Capture Volume (WQCV) =	0.271	acre-feet
Excess Urban Runoff Volume (EURV) =	0.370	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.290	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.796	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.075	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	5.274	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	7.356	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	10.046	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.270	acre-feet
Approximate 5-yr Detention Volume =	0.762	acre-feet
Approximate 10-yr Detention Volume =	1.275	acre-feet
Approximate 25-yr Detention Volume =	1.612	acre-feet
Approximate 50-yr Detention Volume =	1.634	acre-feet
Approximate 100-yr Detention Volume =	2.341	acre-feet

### Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.271	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.100	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.970	acre-feet
Total Detention Basin Volume =	2.341	acre-feet
Initial Surge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surge Depth (ISD) =	user	ft
Total Available Detention Depth ( $H_{total}$ ) =	user	ft
Depth of Trickle Channel ( $H_{TC}$ ) =	user	ft
Slope of Trickle Channel ( $S_{TC}$ ) =	user	ft/ft
Slopes of Main Basin Sides ( $S_{main}$ ) =	user	H:V
Basin Length-to-Width Ratio ( $R_{L/W}$ ) =	user	

[illegible]

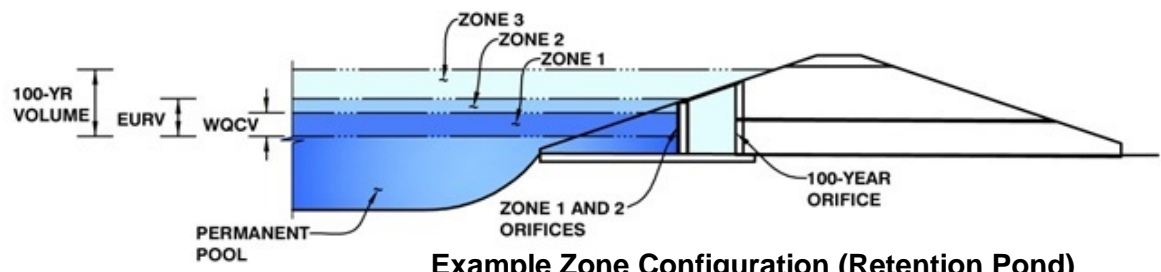


## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.28	0.271	Orifice Plate
Zone 2 (EURV)	0.38	0.100	Circular Orifice
Zone 3 (100-year)	2.26	1.970	Weir&Pipe (Circular)
		2.341	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.861E-02	ft <sup>2</sup>
Depth at top of Zone using Orifice Plate =	0.38	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	2.90	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	7.00	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft <sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.13	0.25					
Orifice Area (sq. inches)	7.00	7.00	7.00					
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected
Invert of Vertical Orifice =	0.33	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.55	N/A
Depth at top of Zone using Vertical Orifice =	0.45	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.42	N/A
Vertical Orifice Diameter =	10.00	N/A	inches			

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, H <sub>o</sub> =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H <sub>t</sub> =	3.33	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	Over Flow Weir Slope Length =	4.22	N/A
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	4.56	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	14.34	N/A
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	7.17	N/A
Debris Clogging % =	50%	N/A	%			

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.14	N/A
Circular Orifice Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	1.00	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	6.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	61.00	feet	Stage at Top of Freeboard =	8.47	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.38	acres
Freeboard above Max Water Surface =	1.00	feet			

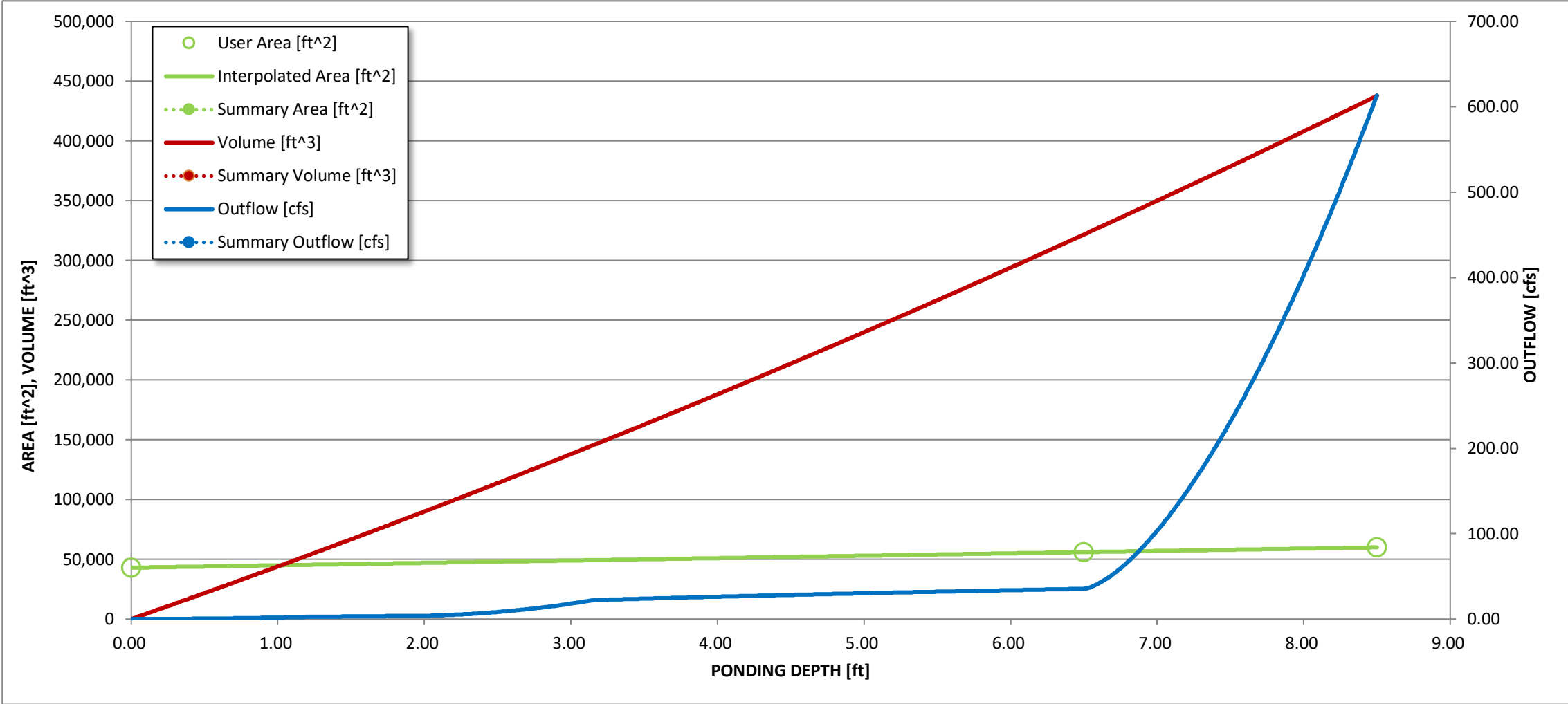
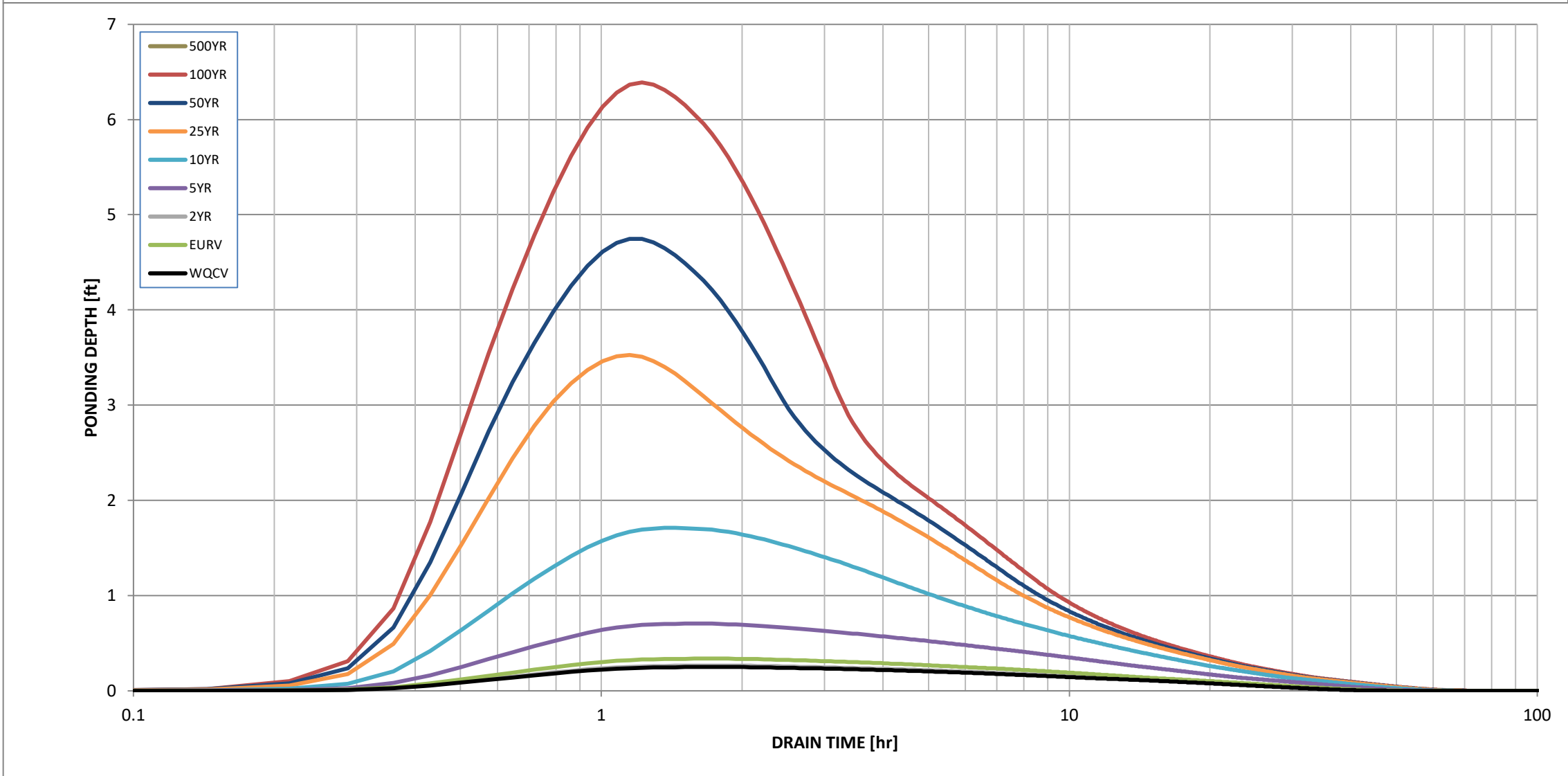
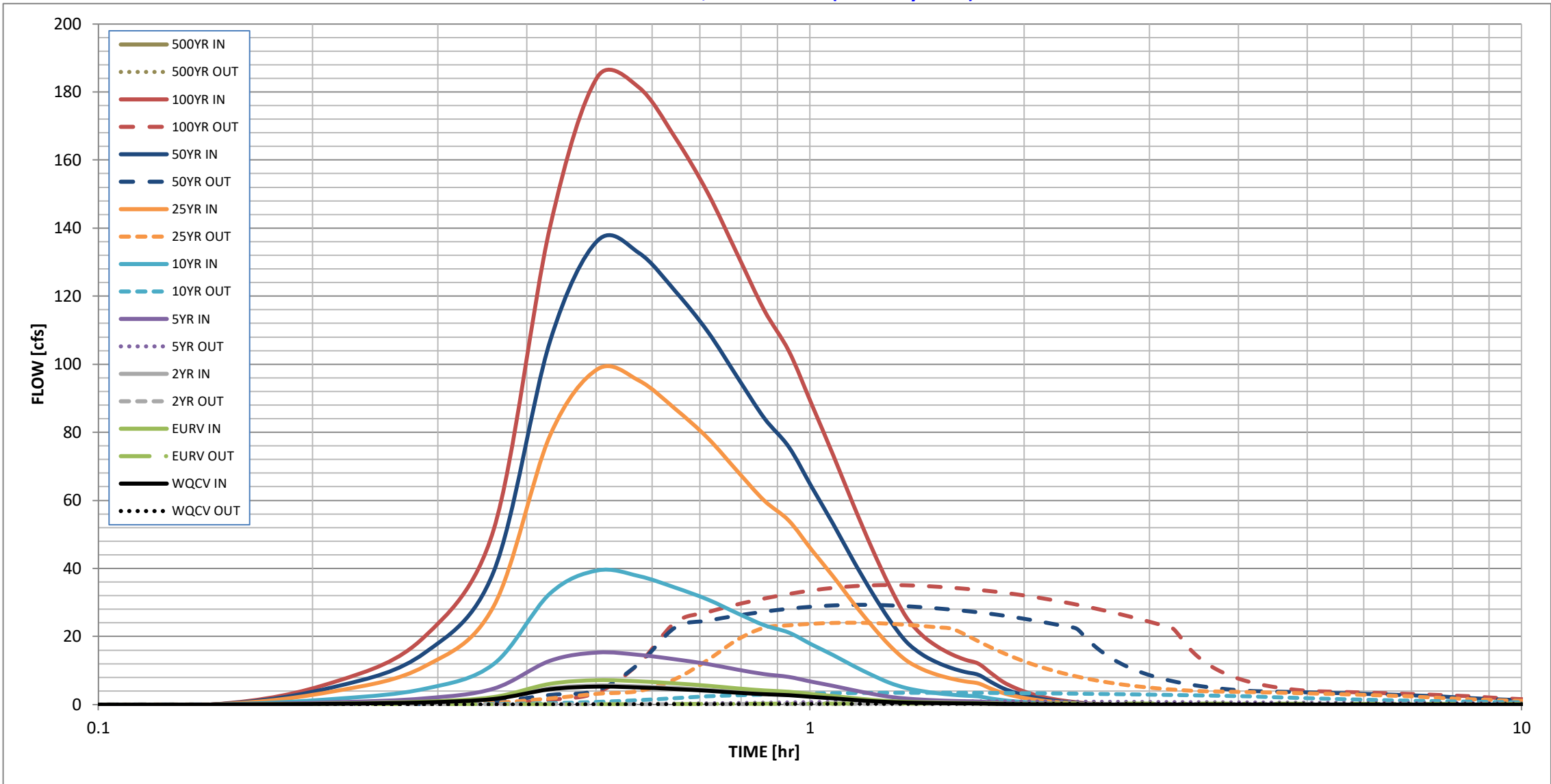
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.271	0.370	0.290	0.796	2.075	5.274	7.356	10.046	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.270	0.369	0.289	0.796	2.075	5.270	7.349	10.037	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.11	0.35	0.87	1.16	1.51	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.4	9.4	29.4	72.5	96.8	126.5	0.0
Peak Inflow Q (cfs) =	5.3	7.2	5.6	15.3	39.4	98.6	136.3	184.5	#N/A
Peak Outflow Q (cfs) =	0.2	0.3	0.2	0.9	3.5	24.0	29.3	35.1	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.3	0.3	0.3	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Vertical Orifice 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	1.3	1.6	1.9	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	39	42	40	45	42	30	26	22	#N/A
Time to Drain 99% of Inflow Volume (hours) =	45	48	46	52	52	47	43	39	#N/A
Maximum Ponding Depth (ft) =	0.25	0.34	0.27	0.71	1.71	3.53	4.75	6.39	#N/A
Area at Maximum Ponding Depth (acres) =	1.00	1.00	1.00	1.02	1.07	1.15	1.20	1.28	#N/A
Maximum Volume Stored (acre-ft) =	0.248	0.328	0.258	0.702	1.755	3.759	5.195	7.232	#N/A



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



## Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

### Storm Inflow Hydrographs

## UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

[illegible]



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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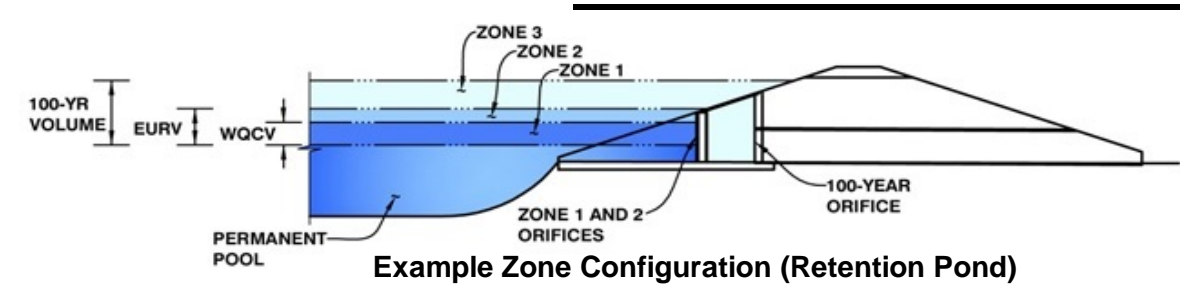


# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

**Project: Winsome**

Basin ID: Pond 3



### Required Volume Calculation

Selected BMP Type =	<b>EDB</b>	
Watershed Area =	167.20	acres
Watershed Length =	6,480	ft
Watershed Slope =	0.029	ft/ft
Watershed Imperviousness =	6.60%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	97.5%	percent
Percentage Hydrologic Soil Groups C/D =	2.5%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	70.7
Water Quality Capture Volume (WQCV) =	0.649	acre-feet
Excess Urban Runoff Volume (EURV) =	1.000	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.664	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.091	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	3.075	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	9.462	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	13.432	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	18.613	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.615	acre-feet
Approximate 5-yr Detention Volume =	1.022	acre-feet
Approximate 10-yr Detention Volume =	2.542	acre-feet
Approximate 25-yr Detention Volume =	3.747	acre-feet
Approximate 50-yr Detention Volume =	3.861	acre-feet
Approximate 100-yr Detention Volume =	5.110	acre-feet

### Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.649	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.352	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.109	acre-feet
Total Detention Basin Volume =	5.110	acre-feet
Initial Surge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surge Depth (ISD) =	user	ft
Total Available Detention Depth ( $H_{total}$ ) =	user	ft
Depth of Trickle Channel ( $H_{TC}$ ) =	user	ft
Slope of Trickle Channel ( $S_{TC}$ ) =	user	ft/ft
Slopes of Main Basin Sides ( $S_{main}$ ) =	user	H:V
Basin Length-to-Width Ratio ( $R_{L/W}$ ) =	user	

[illegible]

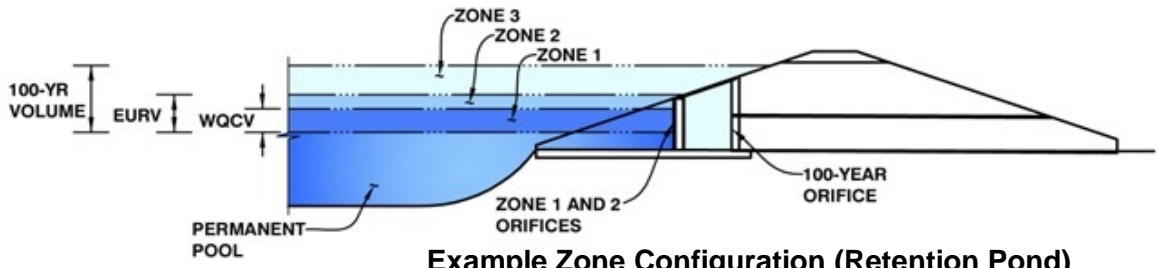


## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome

Basin ID: Pond 3



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.68	0.649	Orifice Plate
Zone 2 (EURV)	1.04	0.352	Circular Orifice
Zone 3 (100-year)	4.86	4.109	Weir&Pipe (Circular)
		5.110	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.944E-02	ft <sup>2</sup>
Depth at top of Zone using Orifice Plate =	1.04	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	10.00	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft <sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	10.00	10.00	10.00	10.00	10.00			

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.68	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	6.31	N/A	ft <sup>2</sup>
Depth at top of Zone using Vertical Orifice =	1.04	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	1.42	N/A	feet
Vertical Orifice Diameter =	34.00	N/A	inches				

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H <sub>o</sub> =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H <sub>t</sub> =	3.33	N/A	feet
Overflow Weir Front Edge Length =	8.00	N/A	feet	Over Flow Weir Slope Length =	4.22	N/A	feet
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	2.28	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	28.67	N/A	ft <sup>2</sup>
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	14.34	N/A	ft <sup>2</sup>
Debris Clogging % =	50%	N/A	%				

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.57	N/A	ft <sup>2</sup>
Circular Orifice Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	2.00	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	6.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	51.00	feet	Stage at Top of Freeboard =	8.46	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.33	acres
Freeboard above Max Water Surface =	1.00	feet			

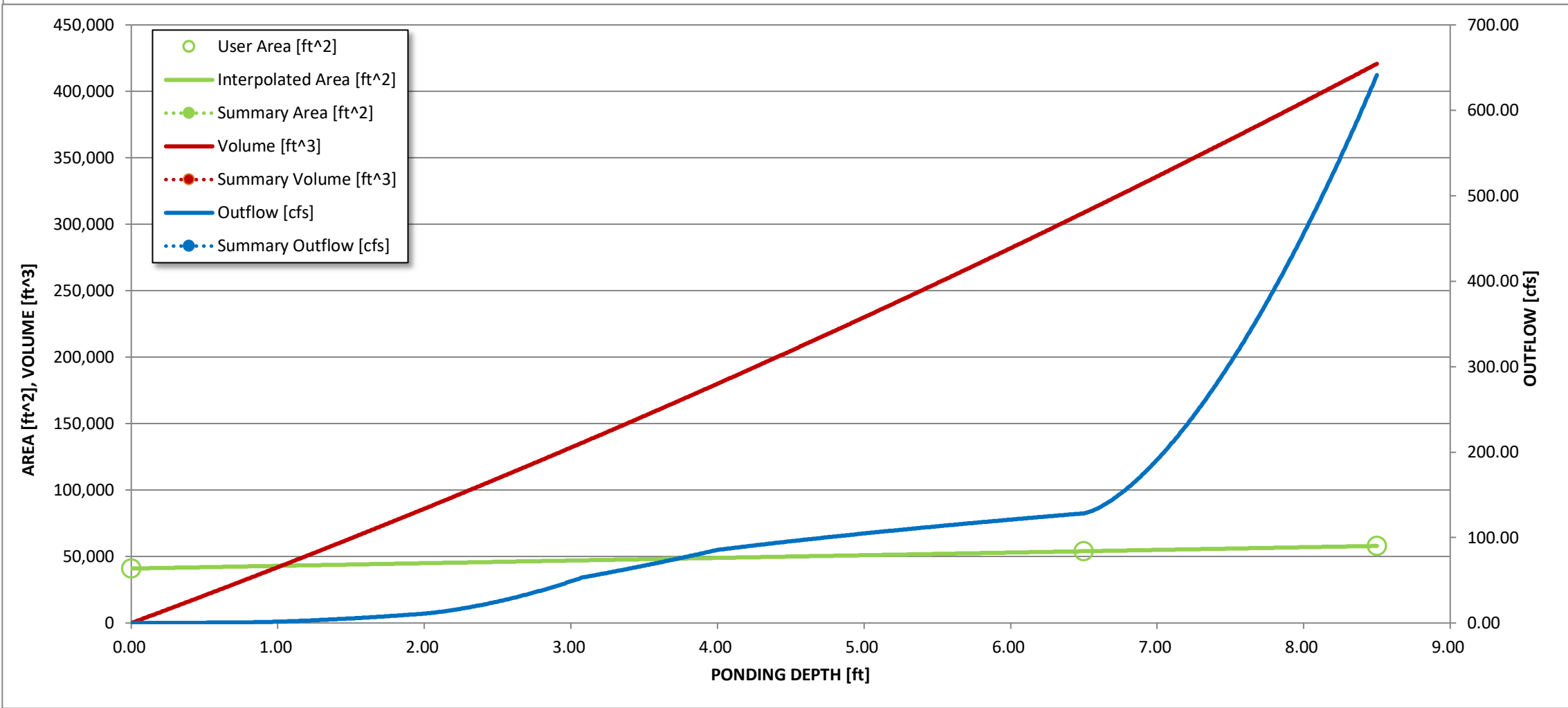
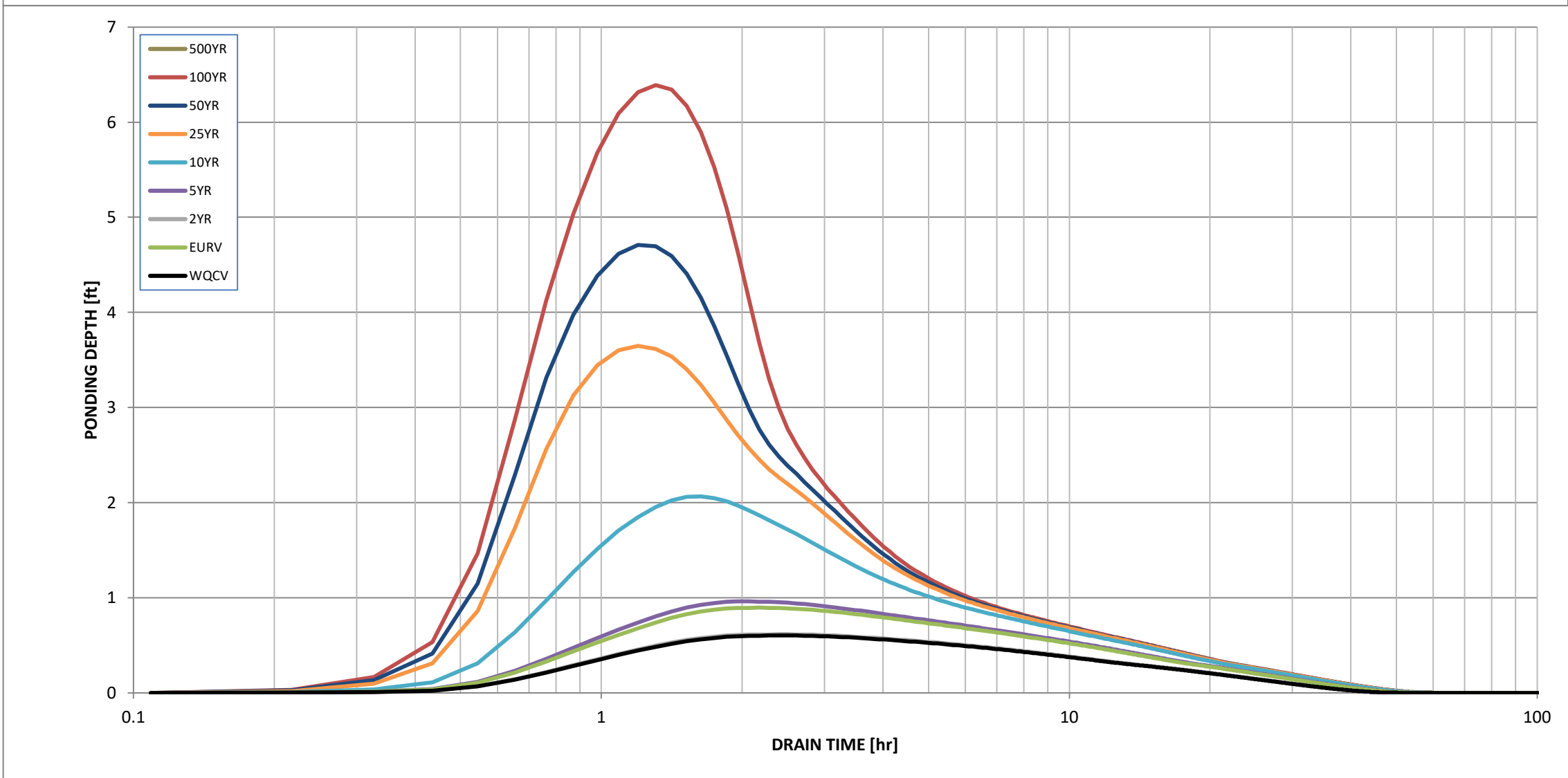
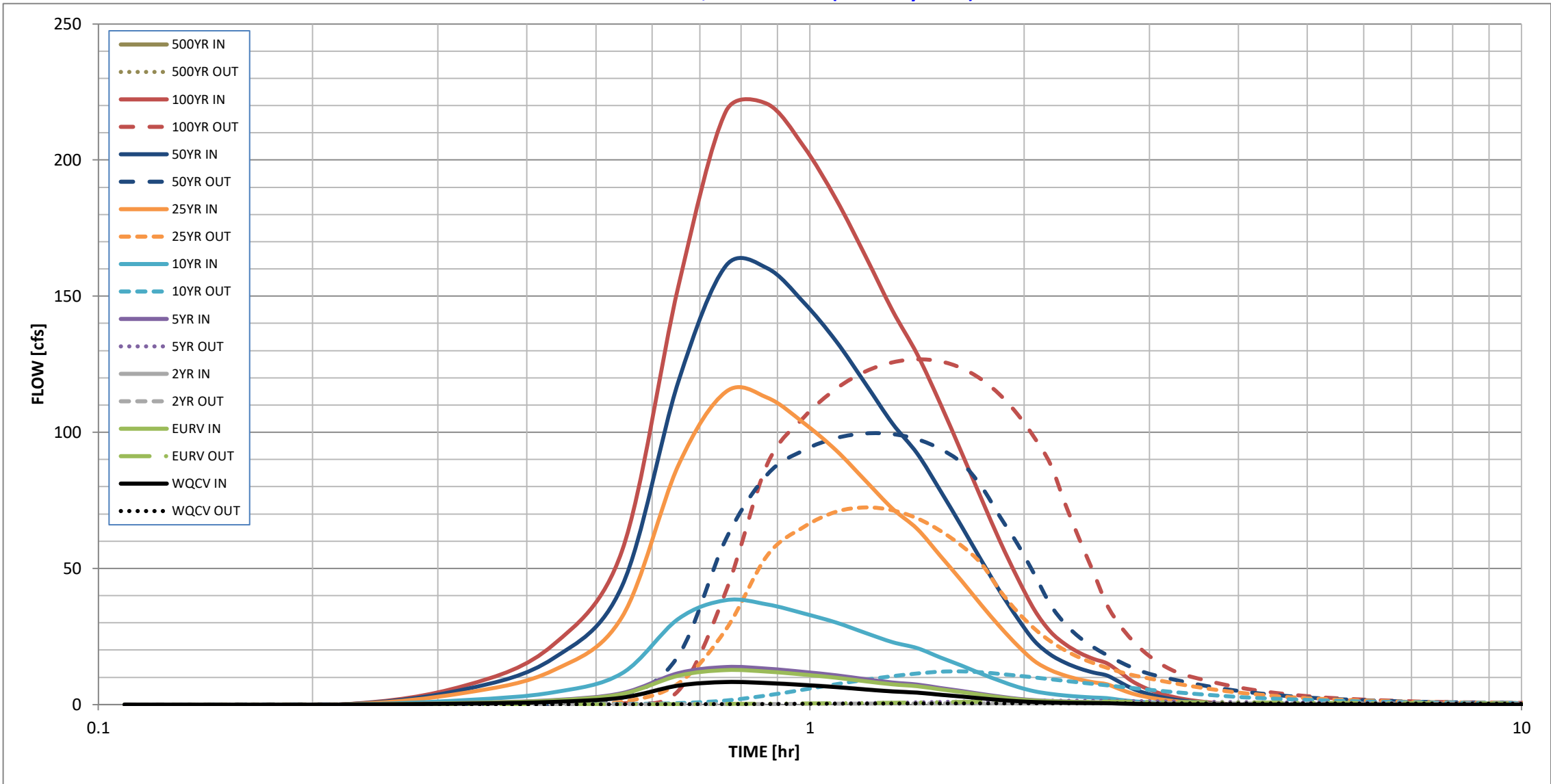
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.649	1.000	0.664	1.091	3.075	9.462	13.432	18.613	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.648	1.000	0.664	1.091	3.075	9.452	13.425	18.605	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.14	0.48	0.67	0.91	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.4	2.7	23.1	80.3	111.2	151.6	0.0
Peak Inflow Q (cfs) =	8.2	12.7	8.4	13.8	38.3	114.9	161.2	220.6	#N/A
Peak Outflow Q (cfs) =	0.5	1.1	0.5	1.4	12.2	72.4	99.6	126.8	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.5	0.9	0.9	0.8	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	1.1	1.6	2.1	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	41	44	42	44	38	23	17	13	#N/A
Time to Drain 99% of Inflow Volume (hours) =	46	49	46	49	47	38	34	30	#N/A
Maximum Ponding Depth (ft) =	0.60	0.90	0.62	0.96	2.07	3.65	4.71	6.39	#N/A
Area at Maximum Ponding Depth (acres) =	0.97	0.98	0.97	0.99	1.04	1.11	1.16	1.23	#N/A
Maximum Volume Stored (acre-ft) =	0.573	0.856	0.583	0.925	2.036	3.730	4.931	6.952	#N/A



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



## Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

### Storm Inflow Hydrographs

## UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
6.53 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:06:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph Constant	0:13:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:19:35	0.37	0.55	0.37	0.60	1.62	4.27	5.55	6.88	#N/A
0.766	0:26:07	0.98	1.50	1.01	1.63	4.47	12.51	16.90	21.89	#N/A
	0:32:39	2.53	3.86	2.58	4.20	11.47	32.13	43.47	56.41	#N/A
	0:39:11	6.94	10.59	7.10	11.53	31.46	87.84	118.58	153.55	#N/A
	0:45:43	8.24	12.65	8.43	13.79	38.34	114.87	161.18	217.90	#N/A
	0:52:14	7.86	12.09	8.05	13.18	36.78	112.71	160.25	220.61	#N/A
	0:58:46	7.16	11.01	7.33	12.00	33.47	103.45	147.74	205.02	#N/A
	1:05:18	6.39	9.85	6.55	10.74	30.12	93.34	133.41	185.51	#N/A
	1:11:50	5.52	8.53	5.65	9.31	26.28	82.16	117.75	164.59	#N/A
	1:18:22	4.81	7.42	4.93	8.10	22.90	71.94	103.19	144.68	#N/A
	1:24:53	4.36	6.73	4.46	7.34	20.71	64.49	92.16	128.61	#N/A
	1:31:25	3.60	5.57	3.68	6.09	17.32	54.68	78.65	110.63	#N/A
	1:37:57	2.94	4.57	3.01	4.99	14.32	45.49	65.52	92.63	#N/A
	1:44:29	2.26	3.54	2.32	3.88	11.30	36.51	52.89	75.57	#N/A
	1:51:01	1.68	2.66	1.73	2.92	8.68	28.49	41.43	59.82	#N/A
	1:57:32	1.22	1.93	1.25	2.12	6.45	21.57	31.54	46.27	#N/A
	2:04:04	0.95	1.48	0.97	1.63	4.86	15.96	23.30	34.68	#N/A
	2:10:36	0.78	1.22	0.80	1.33	3.93	12.66	18.35	26.78	#N/A
	2:17:08	0.66	1.03	0.68	1.13	3.31	10.61	15.32	22.10	#N/A
	2:23:40	0.58	0.90	0.59	0.99	2.88	9.18	13.21	18.94	#N/A
	2:30:11	0.52	0.81	0.53	0.89	2.58	8.18	11.74	16.75	#N/A
	2:36:43	0.48	0.75	0.49	0.82	2.37	7.46	10.70	15.18	#N/A
	2:43:15	0.35	0.55	0.36	0.60	1.76	5.72	8.34	12.06	#N/A
	2:49:47	0.26	0.40	0.27	0.44	1.27	4.12	6.01	8.73	#N/A
	2:56:19	0.19	0.30	0.19	0.32	0.94	3.06	4.46	6.44	#N/A
	3:02:50	0.14	0.22	0.14	0.24	0.70	2.27	3.31	4.79	#N/A
	3:09:22	0.10	0.16	0.10	0.17	0.51	1.68	2.45	3.56	#N/A
	3:15:54	0.07	0.11	0.07	0.12	0.36	1.21	1.78	2.61	#N/A
	3:22:26	0.05	0.08	0.05	0.09	0.26	0.88	1.28	1.89	#N/A
	3:28:58	0.03	0.05	0.03	0.06	0.18	0.62	0.92	1.38	#N/A
	3:35:29	0.02	0.03	0.02	0.04	0.12	0.41	0.62	0.95	#N/A
	3:42:01	0.01	0.02	0.01	0.02	0.07	0.25	0.37	0.60	#N/A
	3:48:33	0.00	0.01	0.00	0.01	0.03	0.12	0.19	0.33	#N/A
	3:55:05	0.00	0.00	0.00	0.00	0.01	0.04	0.07	0.14	#N/A
	4:01:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	#N/A
	4:08:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:14:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:21:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:27:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:34:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:40:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:47:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:53:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:00:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:06:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:13:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:19:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:26:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:33:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:39:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:46:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:52:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:59:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:05:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:12:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:18:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:25:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:31:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:38:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:44:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:51:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:57:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:04:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:10:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:17:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:24:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:30:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:37:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:43:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:50:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]





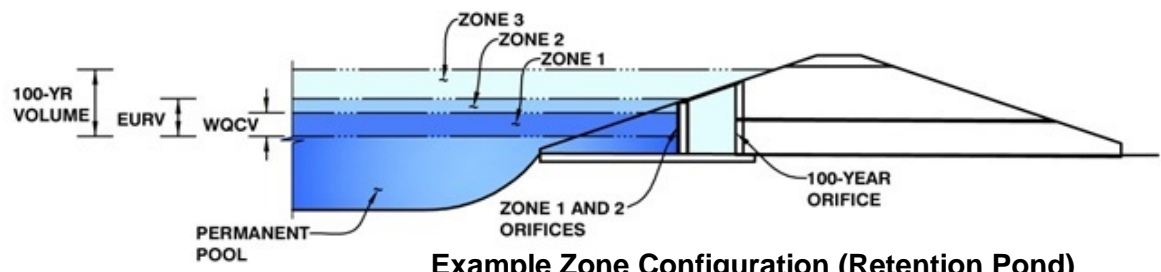


## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome

Basin ID: Pond 4



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.76	0.117	Orifice Plate
Zone 2 (EURV)	1.01	0.046	Circular Orifice
Zone 3 (100-year)	3.92	0.730	Weir&Pipe (Circular)
		0.892	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.111E-02	ft <sup>2</sup>
Depth at top of Zone using Orifice Plate =	0.76	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	3.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.60	sq. inches (diameter = 1-7/16 inches)	Elliptical Slot Area =	N/A	ft <sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.25	0.51					
Orifice Area (sq. inches)	1.60	1.60	1.60					
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected		Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.01	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.79	ft <sup>2</sup>
Depth at top of Zone using Vertical Orifice =	1.01	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.50	feet
Vertical Orifice Diameter =	12.00	N/A	inches			

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H <sub>o</sub> =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H <sub>t</sub> =	3.33	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Over Flow Weir Slope Length =	4.22	feet
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	4.56	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	14.34	ft <sup>2</sup>
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	7.17	ft <sup>2</sup>
Debris Clogging % =	50%	N/A	%			

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected		Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.14	ft <sup>2</sup>
Circular Orifice Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	1.00	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.90	feet
Spillway Crest Length =	19.00	feet	Stage at Top of Freeboard =	7.40	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.48	acres
Freeboard above Max Water Surface =	1.00	feet			

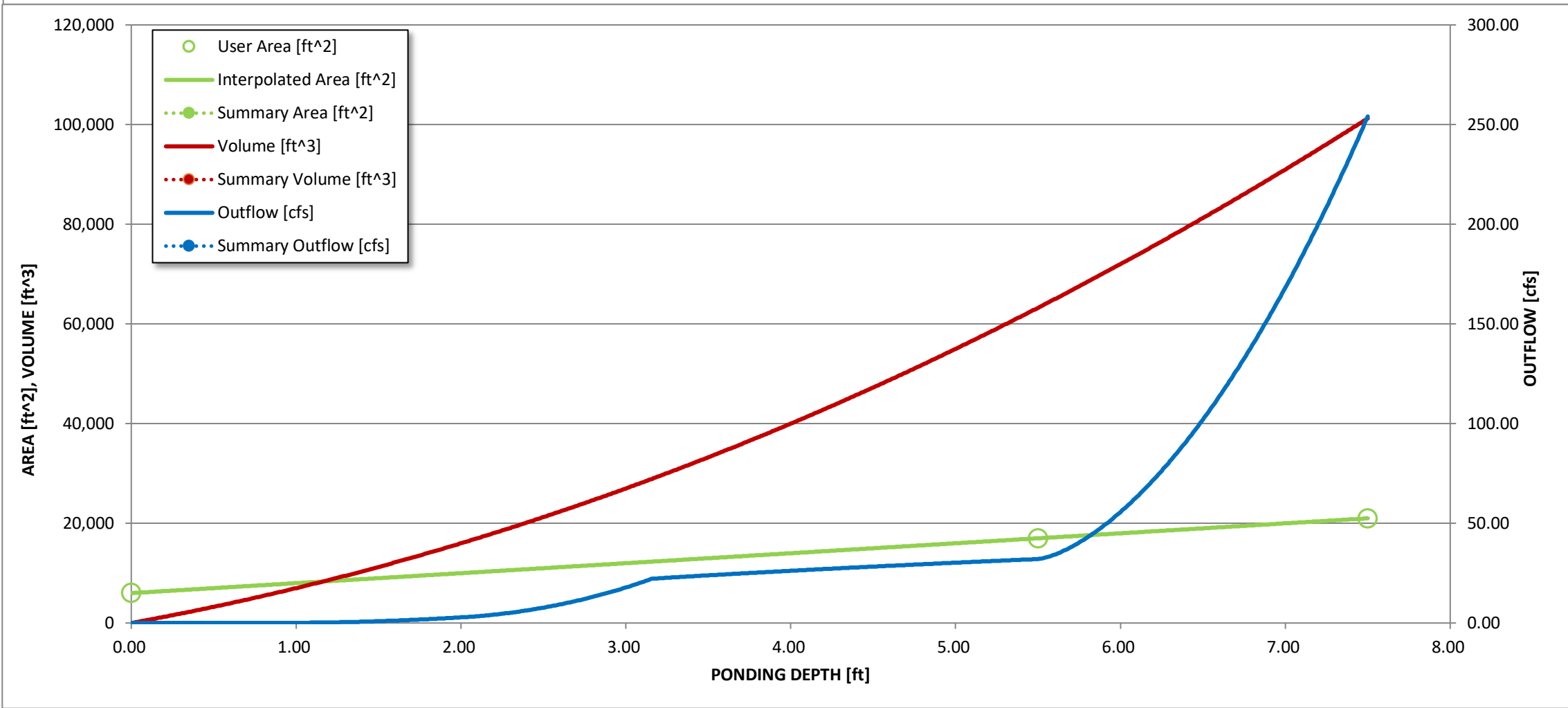
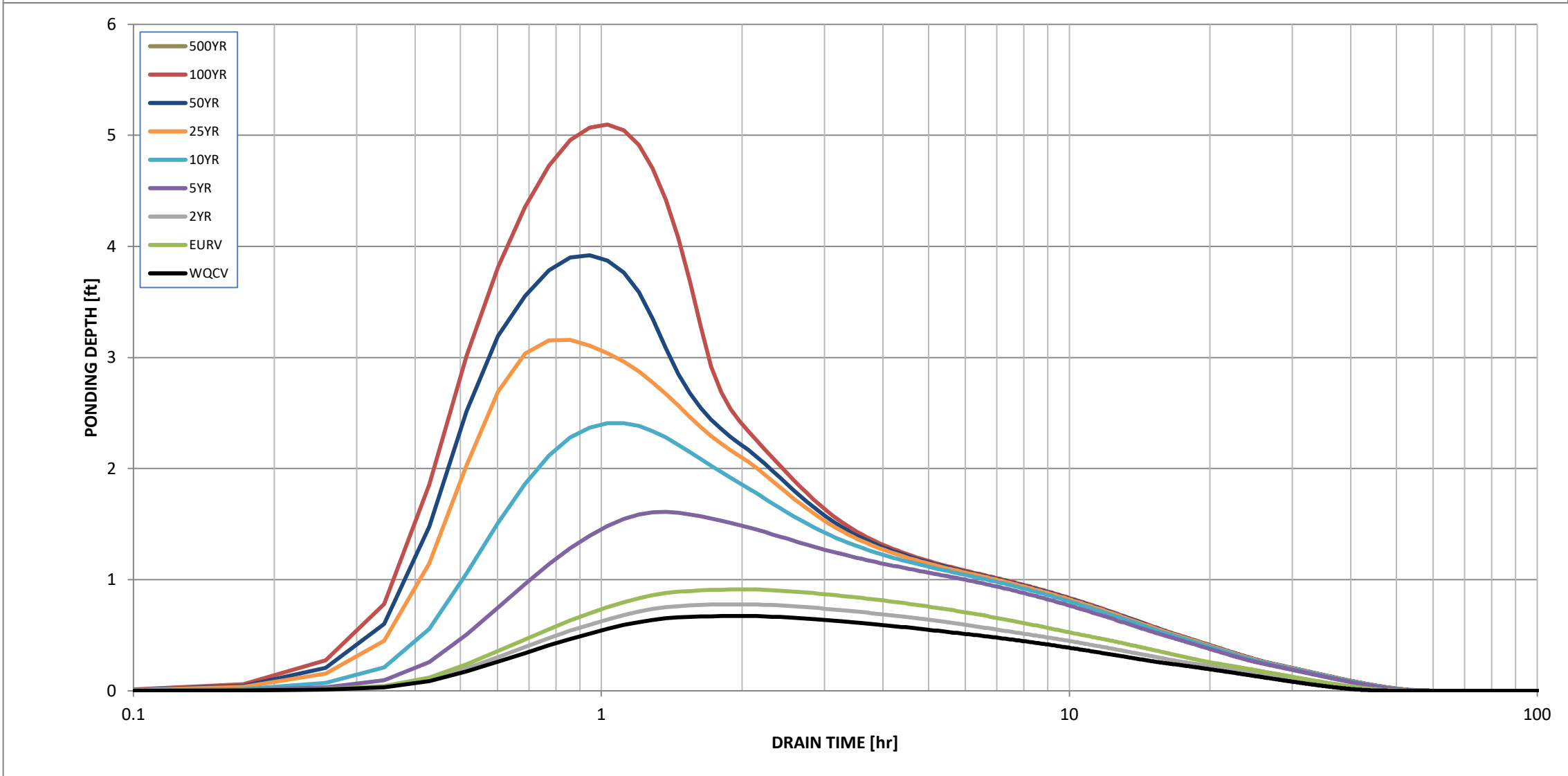
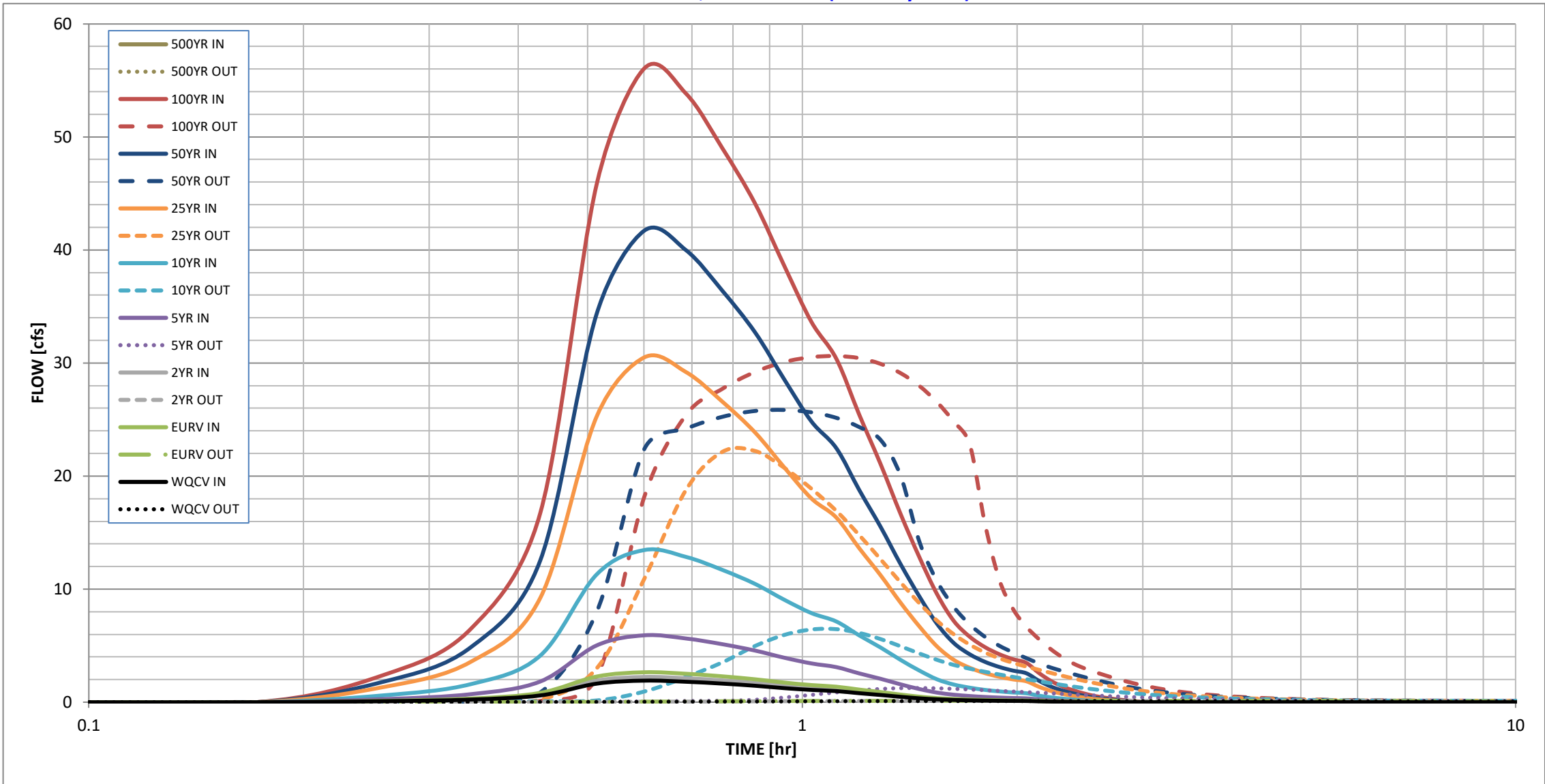
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
One-Hour Rainfall Depth (in) =	0.117	0.162	0.136	0.365	0.838	1.918	2.635	3.557	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.116	0.161	0.136	0.364	0.837	1.916	2.633	3.554	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.11	0.32	0.75	0.99	1.30	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	3.2	9.0	21.4	28.3	37.0	0.0
Peak Inflow Q (cfs) =	1.9	2.6	2.2	5.9	13.5	30.5	41.7	56.1	#N/A
Peak Outflow Q (cfs) =	0.1	0.1	0.1	1.3	6.5	22.2	25.8	30.6	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.7	1.0	0.9	0.8	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Vertical Orifice 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	1.2	1.4	1.6	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	41	39	40	32	21	16	13	#N/A
Time to Drain 99% of Inflow Volume (hours) =	42	46	44	48	43	35	31	27	#N/A
Maximum Ponding Depth (ft) =	0.67	0.91	0.78	1.61	2.41	3.16	3.92	5.10	#N/A
Area at Maximum Ponding Depth (acres) =	0.17	0.18	0.17	0.21	0.25	0.28	0.32	0.37	#N/A
Maximum Volume Stored (acre-ft) =	0.103	0.144	0.120	0.281	0.463	0.662	0.890	1.296	#N/A



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



## Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

### Storm Inflow Hydrographs

## UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

[illegible]



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]



## DETENTION BASIN STAGE-STORAGE TABLE BUILDER

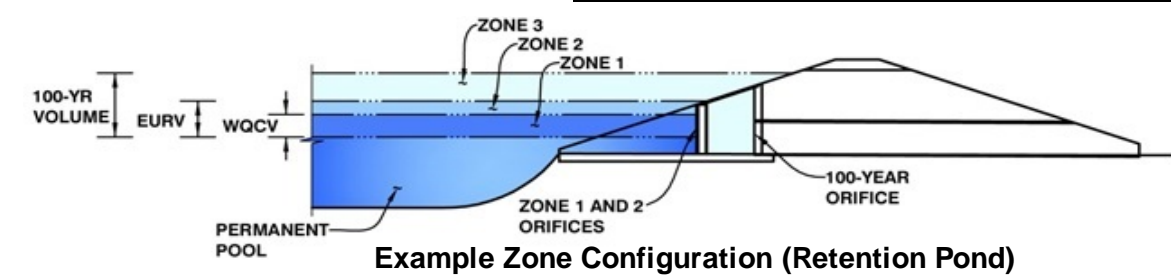
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UD-Detention, Version 3.07 (February 2017)

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Project: Winsome  
Basin ID: Pond 5

Basin ID: Pond 5



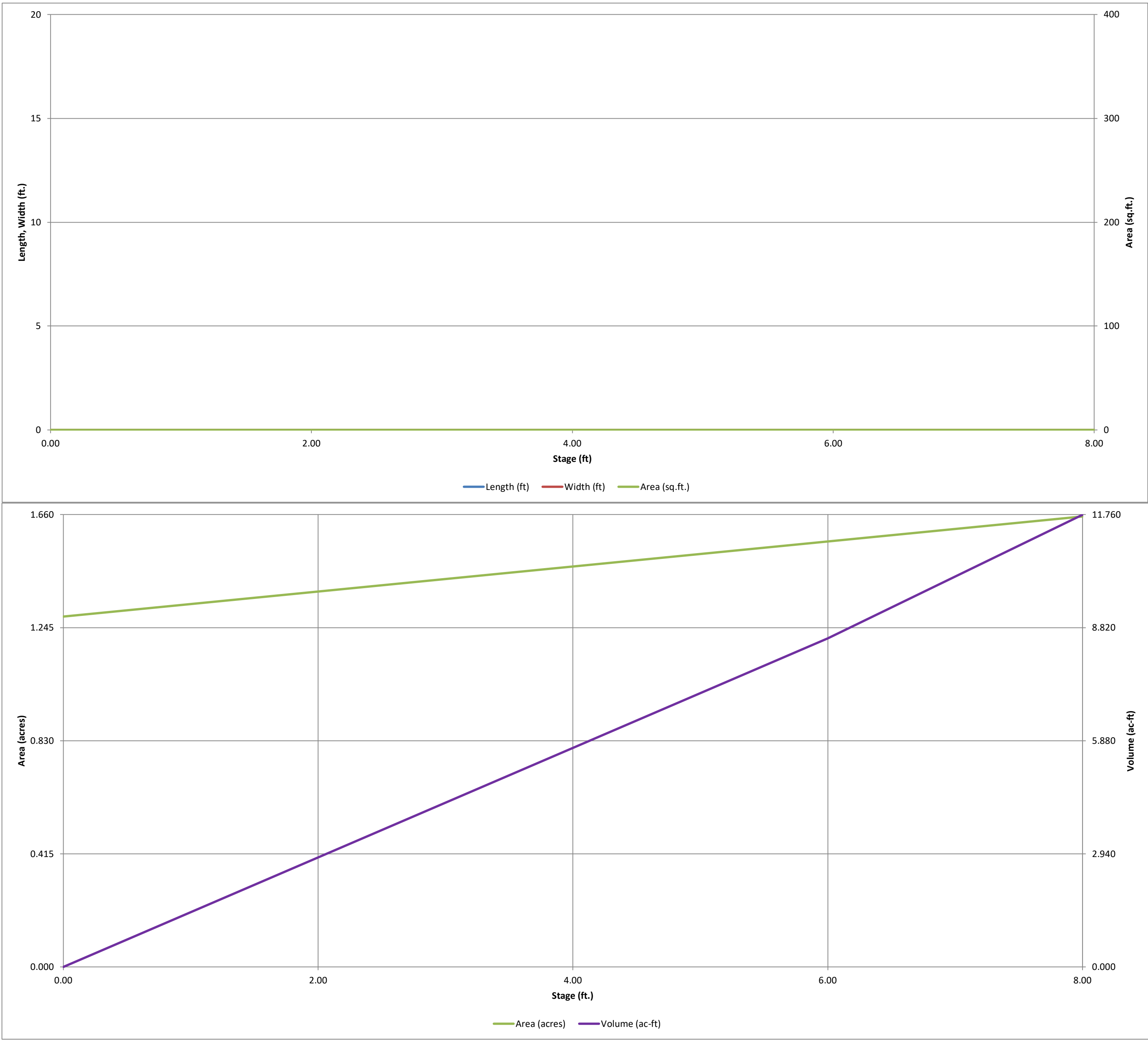
Required Volume Calculation		
Selected BMP Type =	EDB	
Watershed Area =	152.00	acres
Watershed Length =	4.755	ft
Watershed Slope =	0.028	ft/ft
Watershed Imperviousness =	9.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	98.1%	percent
Percentage Hydrologic Soil Groups C/D =	1.9%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths = User Input		
Water Quality Capture Volume (WQCV) =	0.776	acre-feet
Excess Urban Runoff Volume (EURV) =	1.272	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.869	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.380	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	3.301	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	9.051	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	12.642	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	17.330	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.807	acre-feet
Approximate 5-yr Detention Volume =	1.293	acre-feet
Approximate 10-yr Detention Volume =	2.779	acre-feet
Approximate 25-yr Detention Volume =	3.933	acre-feet
Approximate 50-yr Detention Volume =	4.100	acre-feet
Approximate 100-yr Detention Volume =	5.340	acre-feet

[illegible]



DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



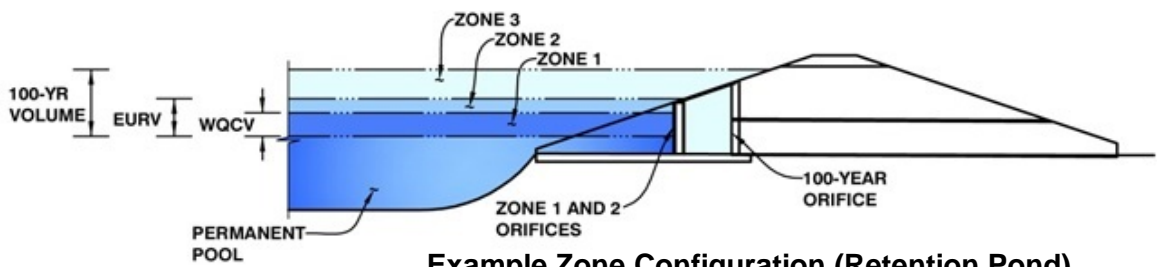


## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome

Basin ID: Pond 5



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.60	0.776	Orifice Plate
Zone 2 (EURV)	0.98	0.497	Circular Orifice
Zone 3 (100-year)	3.89	4.067	Weir&Pipe (Circular)
		5.340	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.036E-01	ft <sup>2</sup>
Depth at top of Zone using Orifice Plate =	1.01	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	2.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	14.92	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft <sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.34	0.67					
Orifice Area (sq. inches)	14.92	14.92	14.92					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected
Invert of Vertical Orifice =	0.52	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	4.28	N/A
Depth at top of Zone using Vertical Orifice =	0.85	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	1.17	N/A
Vertical Orifice Diameter =	28.00	N/A	inches			

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, H <sub>o</sub> =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H <sub>t</sub> =	4.33	N/A
Overflow Weir Front Edge Length =	8.00	N/A	feet	Over Flow Weir Slope Length =	4.22	N/A
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	2.28	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	28.67	N/A
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	14.34	N/A
Debris Clogging % =	50%	N/A	%			

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.57	N/A
Circular Orifice Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	2.00	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	81.00	feet	Stage at Top of Freeboard =	7.97	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.65	acres
Freeboard above Max Water Surface =	1.00	feet			

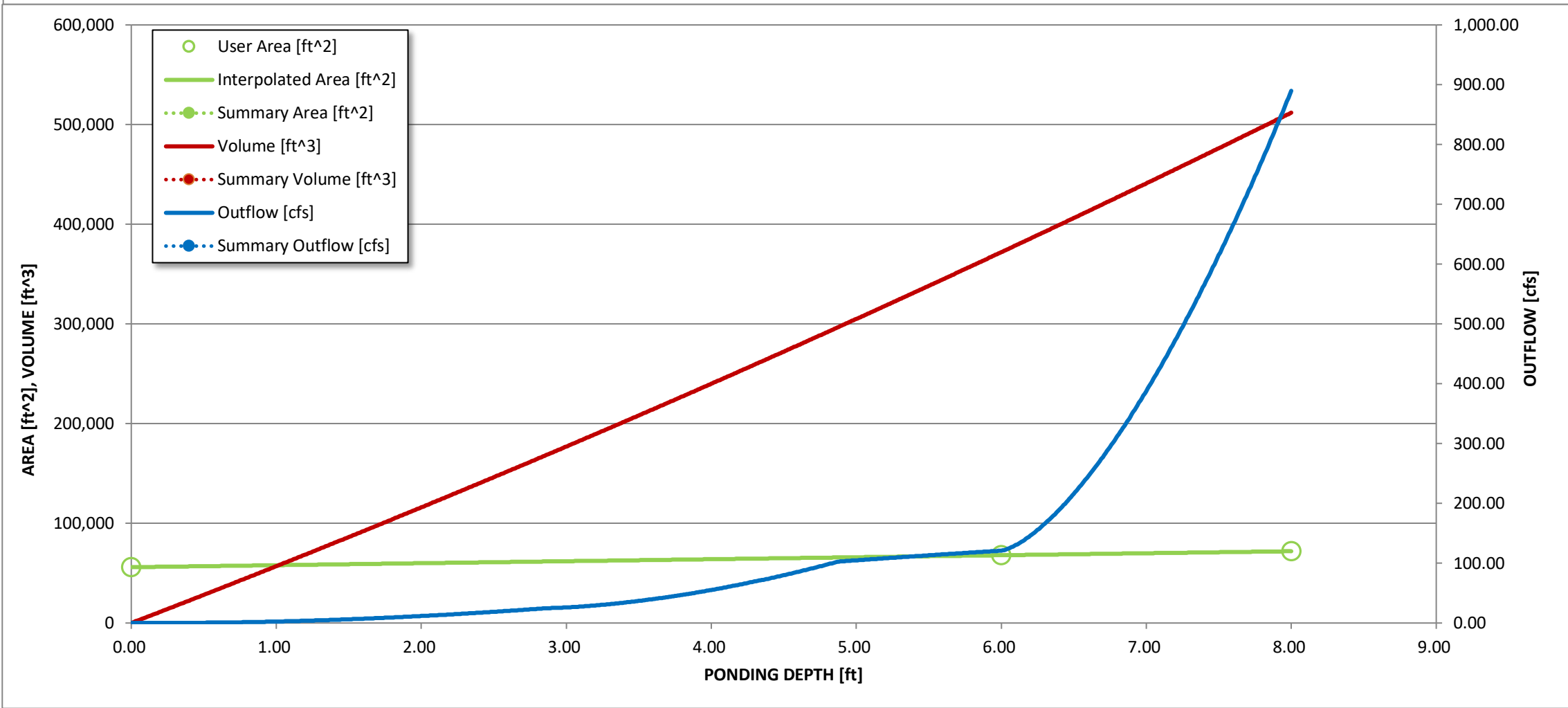
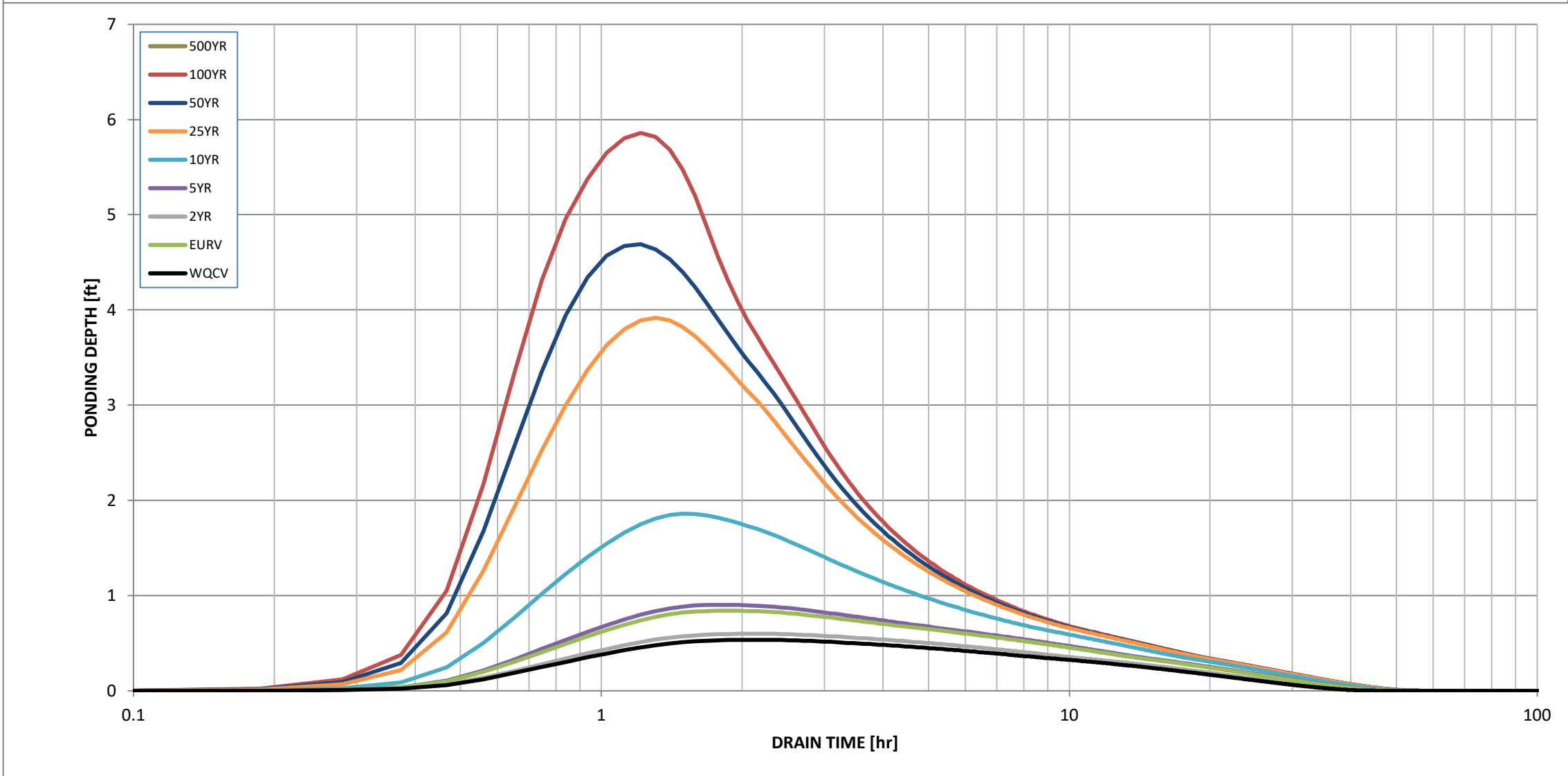
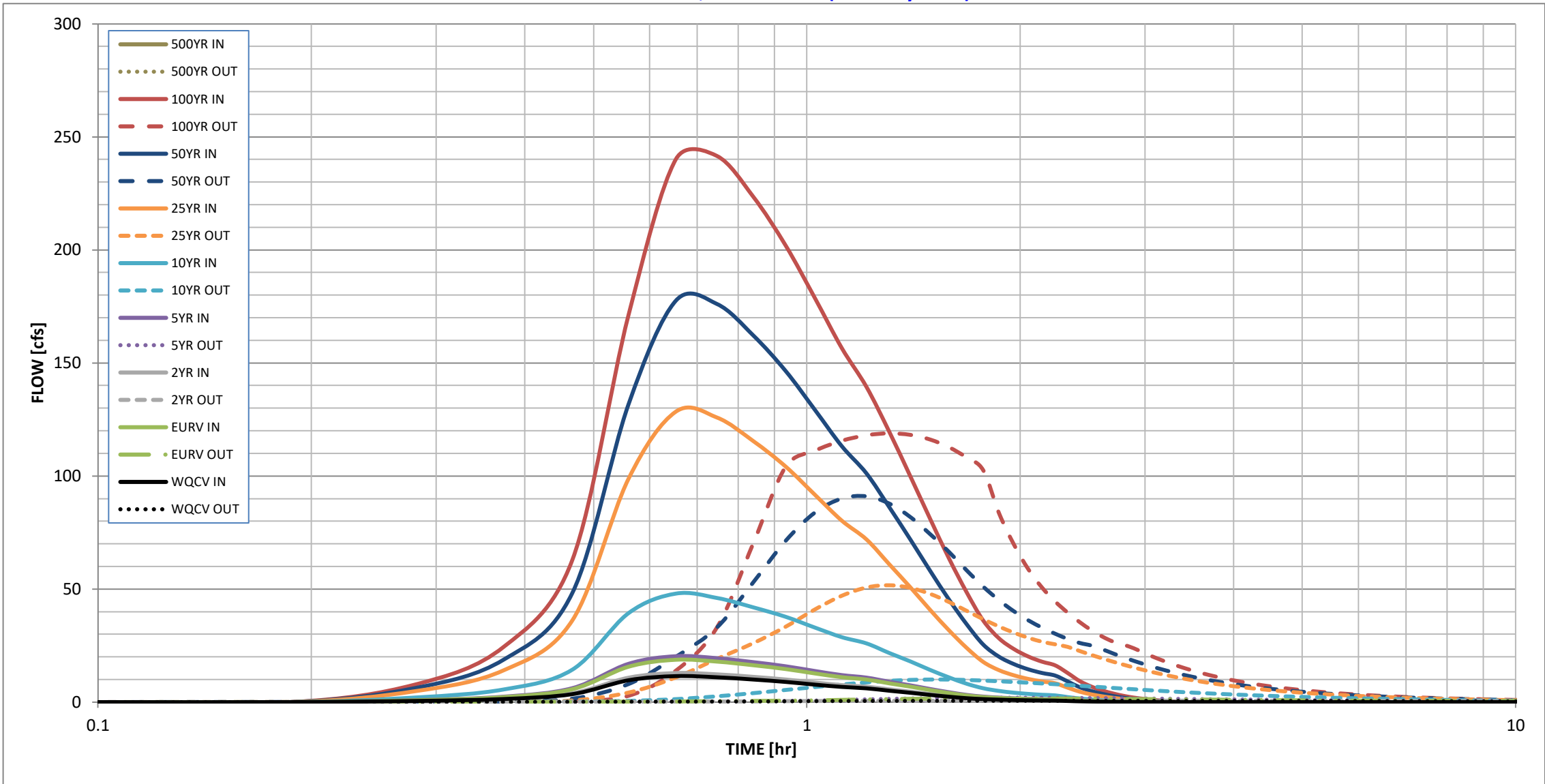
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
One-Hour Rainfall Depth (in) =	0.776	1.272	0.869	1.380	3.301	9.051	12.642	17.330	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.776	1.273	0.870	1.382	3.303	9.053	12.652	17.338	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.58	0.80	1.08	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.6	3.0	26.1	88.1	121.9	164.8	0.0
Peak Inflow Q (cfs) =	11.5	18.7	12.9	20.3	48.0	128.5	177.5	241.5	#N/A
Peak Outflow Q (cfs) =	0.6	1.6	0.7	1.9	10.0	51.7	91.0	118.9	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.4	0.6	0.7	0.7	#N/A
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.6	1.8	2.6	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	37	40	39	40	37	27	22	18	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	45	42	45	45	40	37	34	#N/A
Maximum Ponding Depth (ft) =	0.54	0.84	0.60	0.90	1.86	3.92	4.69	5.86	#N/A
Area at Maximum Ponding Depth (acres) =	1.31	1.32	1.31	1.33	1.37	1.47	1.50	1.55	#N/A
Maximum Volume Stored (acre-ft) =	0.688	1.096	0.766	1.176	2.457	5.378	6.519	8.306	#N/A



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



## Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

[illegible]



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

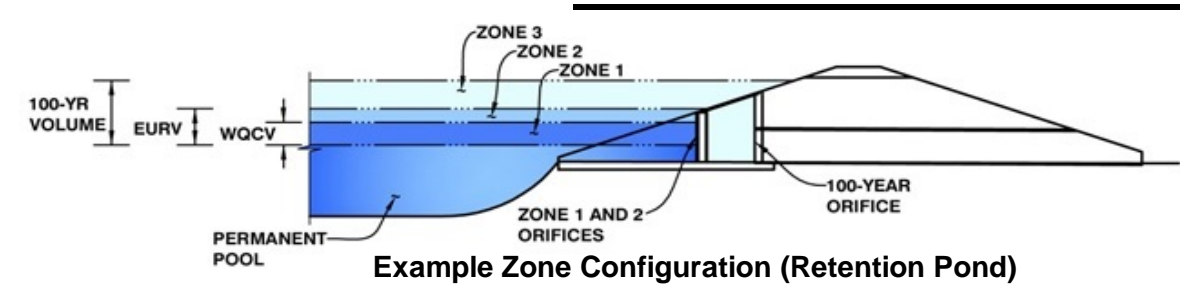


# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

**Project: Winsome**

Basin ID: Pond 6



### Required Volume Calculation

Selected BMP Type =	<b>EDB</b>	
Watershed Area =	45.80	acres
Watershed Length =	2,615	ft
Watershed Slope =	0.029	ft/ft
Watershed Imperviousness =	14.50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	70.7
Water Quality Capture Volume (WQCV) =	0.347	acre-feet
Excess Urban Runoff Volume (EURV) =	0.643	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.459	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.692	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.342	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	3.035	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	4.104	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	5.502	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.427	acre-feet
Approximate 5-yr Detention Volume =	0.649	acre-feet
Approximate 10-yr Detention Volume =	1.163	acre-feet
Approximate 25-yr Detention Volume =	1.524	acre-feet
Approximate 50-yr Detention Volume =	1.606	acre-feet
Approximate 100-yr Detention Volume =	2.026	acre-feet

### Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.347	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.296	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.383	acre-feet
Total Detention Basin Volume =	2.026	acre-feet
Initial Surge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surge Depth (ISD) =	user	ft
Total Available Detention Depth ( $H_{total}$ ) =	user	ft
Depth of Trickle Channel ( $H_{TC}$ ) =	user	ft
Slope of Trickle Channel ( $S_{TC}$ ) =	user	ft/ft
Slopes of Main Basin Sides ( $S_{main}$ ) =	user	H:V
Basin Length-to-Width Ratio ( $R_{L/W}$ ) =	user	

[illegible]

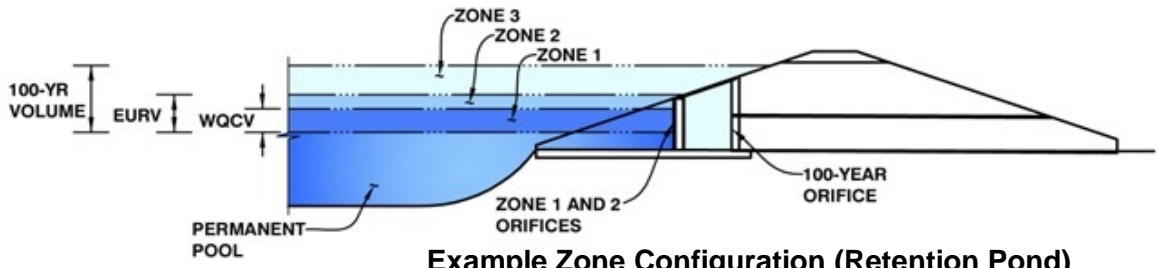


## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome

Basin ID: Pond 6



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.57	0.347	Orifice Plate
Zone 2 (EURV)	1.04	0.296	Circular Orifice
Zone 3 (100-year)	3.04	1.383	Weir&Pipe (Circular)
		2.026	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.167E-02	ft <sup>2</sup>
Depth at top of Zone using Orifice Plate =	1.04	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	3.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.00	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft <sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.35	0.69					
Orifice Area (sq. inches)	6.00	6.00	6.00					
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected
Invert of Vertical Orifice =	0.73	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.79	N/A
Depth at top of Zone using Vertical Orifice =	1.32	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.50	N/A
Vertical Orifice Diameter =	12.00	N/A	inches			

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, H <sub>o</sub> =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H <sub>t</sub> =	3.33	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	Over Flow Weir Slope Length =	4.22	N/A
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	8.11	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	14.34	N/A
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	7.17	N/A
Debris Clogging % =	50%	N/A	%			

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77	N/A
Circular Orifice Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.94	feet
Spillway Crest Length =	26.00	feet	Stage at Top of Freeboard =	7.44	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.94	acres
Freeboard above Max Water Surface =	1.00	feet			

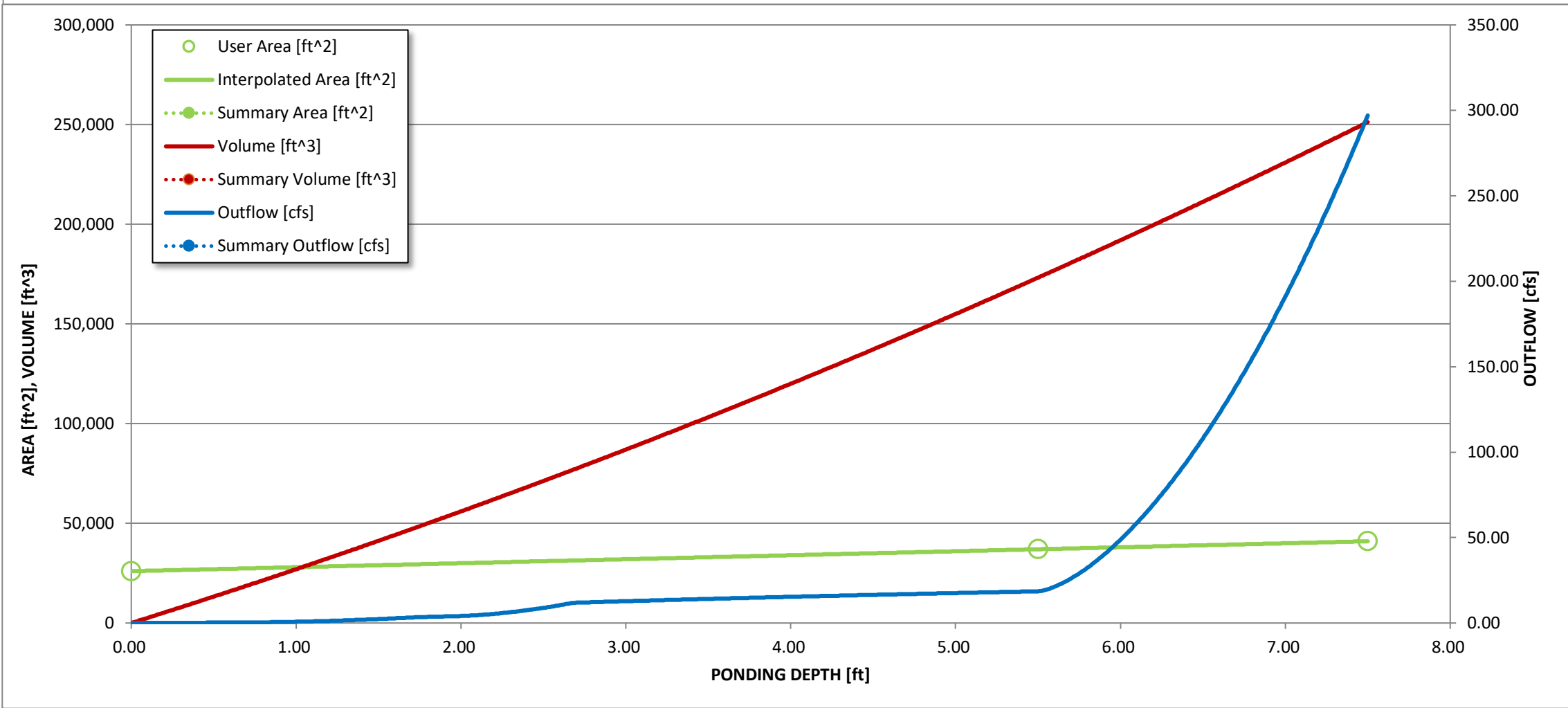
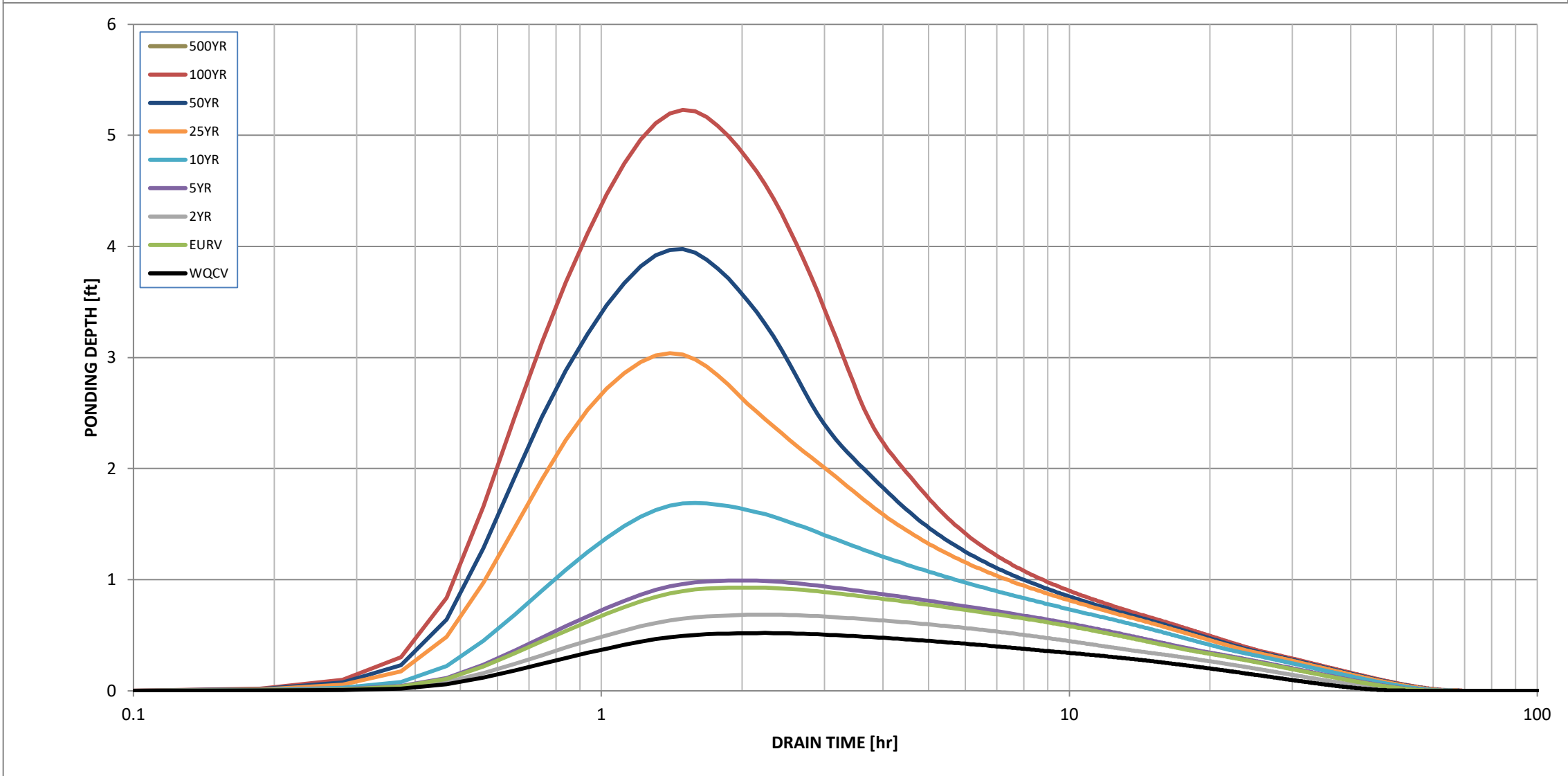
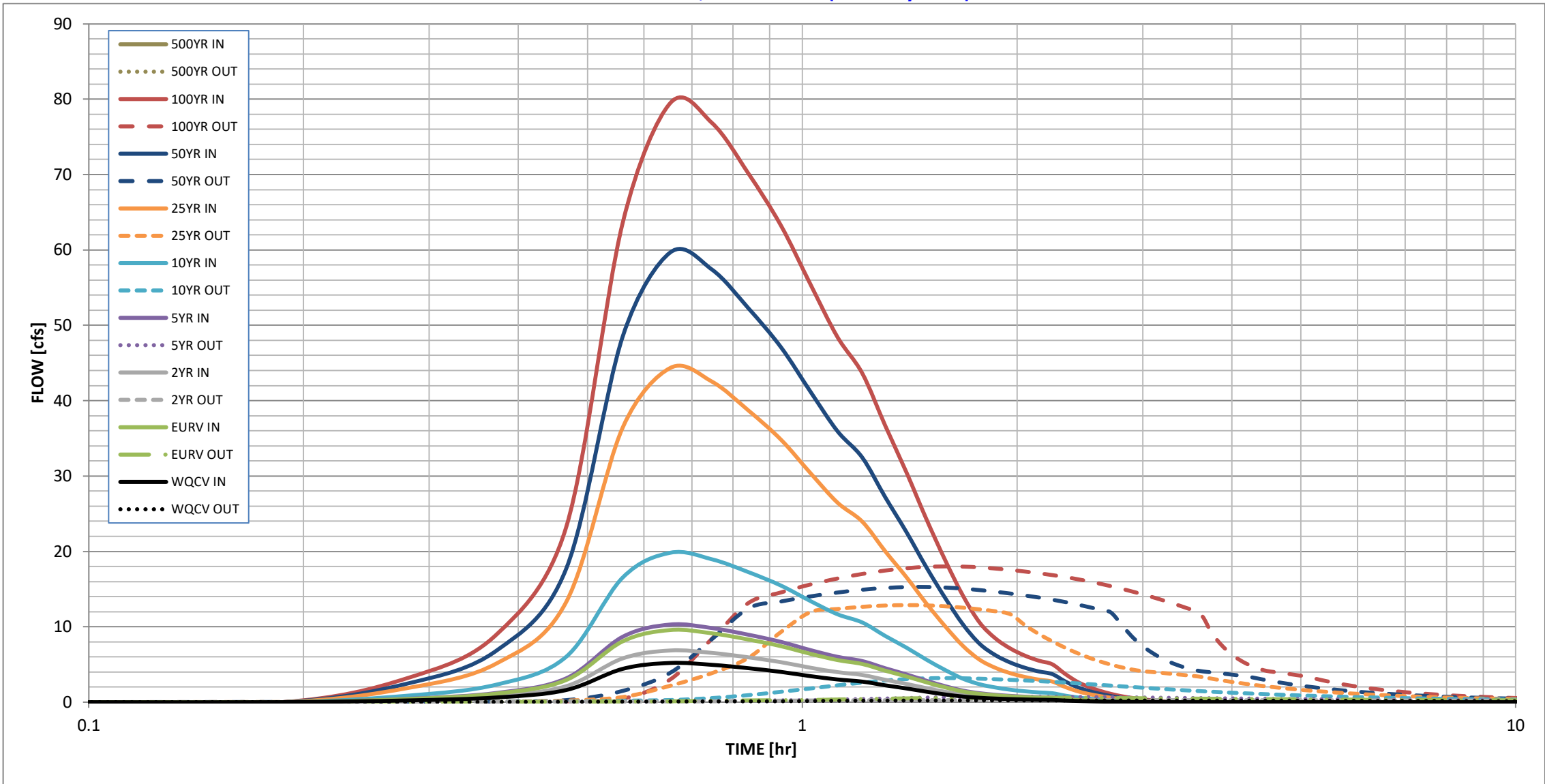
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
One-Hour Rainfall Depth (in) =	0.347	0.643	0.459	0.692	1.342	3.035	4.104	5.502	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.348	0.645	0.461	0.695	1.349	3.049	4.124	5.529	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.58	0.80	1.09	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	0.8	7.8	26.6	36.8	49.8	0.0
Peak Inflow Q (cfs) =	5.2	9.6	6.9	10.3	19.8	44.3	59.7	79.5	#N/A
Peak Outflow Q (cfs) =	0.2	0.6	0.3	0.7	3.2	12.9	15.3	18.0	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.4	0.5	0.4	0.4	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Vertical Orifice 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.5	0.5	0.6	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	43	49	47	49	47	40	36	31	#N/A
Time to Drain 99% of Inflow Volume (hours) =	47	55	51	55	55	51	49	47	#N/A
Maximum Ponding Depth (ft) =	0.52	0.93	0.69	0.99	1.69	3.04	3.98	5.23	#N/A
Area at Maximum Ponding Depth (acres) =	0.62	0.64	0.63	0.64	0.67	0.74	0.78	0.84	#N/A
Maximum Volume Stored (acre-ft) =	0.317	0.575	0.416	0.613	1.074	2.019	2.731	3.750	#N/A



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



## Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: .\P6 - Outflow Hydrographs.xlsx

### Storm Inflow Hydrographs

## UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

[illegible]



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]



UD-Detention Outflow Hydrographs

Pond 6 Outlet Hydrograph

		WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Time [hr]	Time [min]	Outflow2 - [cfs]	Outflow2 - [cfs]	Outflow2 - [cfs]	Outflow2 - [cfs]	Outflow2 - [cfs]	Outflow2 - [cfs]	Outflow2 - [cfs]	Outflow2 - [cfs]
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.09	5.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.19	11.20	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.03
0.28	16.80	0.01	0.02	0.02	0.02	0.03	0.05	0.06	0.06
0.37	22.40	0.03	0.04	0.03	0.04	0.06	0.08	0.10	0.11
0.47	28.00	0.05	0.07	0.06	0.07	0.09	0.21	0.27	0.45
0.56	33.60	0.07	0.09	0.08	0.10	0.20	0.67	1.49	3.03
0.65	39.20	0.09	0.12	0.10	0.14	0.28	2.18	3.91	8.39
0.75	44.80	0.10	0.20	0.11	0.21	0.54	3.84	8.34	13.14
0.84	50.40	0.11	0.23	0.16	0.25	0.93	5.87	12.43	14.55
0.93	56.00	0.12	0.26	0.20	0.28	1.37	9.30	13.35	15.61
1.03	61.60	0.16	0.29	0.22	0.35	1.82	11.95	14.03	16.40
1.12	67.20	0.18	0.36	0.24	0.41	2.23	12.36	14.54	17.01
1.21	72.80	0.19	0.41	0.25	0.48	2.59	12.65	14.91	17.46
1.31	78.40	0.21	0.46	0.26	0.55	2.87	12.82	15.15	17.77
1.40	84.00	0.21	0.50	0.27	0.61	3.06	12.87	15.27	17.94
1.49	89.60	0.22	0.54	0.27	0.65	3.16	12.84	15.28	18.01
1.59	95.20	0.22	0.56	0.28	0.68	3.19	12.72	15.21	17.98
1.68	100.80	0.22	0.57	0.28	0.69	3.17	12.53	15.06	17.88
1.77	106.40	0.22	0.58	0.28	0.70	3.11	12.30	14.87	17.72
1.87	112.00	0.23	0.59	0.28	0.71	3.04	12.05	14.64	17.53
1.96	117.60	0.23	0.59	0.28	0.71	2.96	11.63	14.40	17.32
2.05	123.20	0.23	0.59	0.28	0.71	2.87	10.18	14.15	17.10
2.15	128.80	0.23	0.59	0.28	0.70	2.79	9.03	13.88	16.86
2.24	134.40	0.23	0.59	0.28	0.70	2.70	8.08	13.60	16.61
2.33	140.00	0.23	0.58	0.28	0.69	2.60	7.24	13.29	16.33
2.43	145.60	0.23	0.58	0.28	0.68	2.50	6.53	12.96	16.03
2.52	151.20	0.23	0.57	0.28	0.67	2.40	5.92	12.62	15.71
2.61	156.80	0.23	0.56	0.28	0.66	2.30	5.41	12.27	15.39
2.71	162.40	0.22	0.55	0.28	0.65	2.20	4.98	11.90	15.05
2.80	168.00	0.22	0.54	0.28	0.63	2.10	4.63	10.32	14.71
2.89	173.60	0.22	0.53	0.28	0.62	2.01	4.34	8.77	14.35
2.99	179.20	0.22	0.52	0.28	0.61	1.93	4.13	7.58	13.99
3.08	184.80	0.22	0.51	0.28	0.60	1.85	4.01	6.66	13.63
3.17	190.40	0.22	0.50	0.28	0.58	1.77	3.90	5.94	13.26
3.27	196.00	0.22	0.50	0.27	0.57	1.70	3.79	5.36	12.88
3.36	201.60	0.22	0.49	0.27	0.56	1.63	3.68	4.90	12.50
3.45	207.20	0.22	0.48	0.27	0.55	1.56	3.57	4.54	12.12
3.55	212.80	0.22	0.47	0.27	0.54	1.50	3.46	4.26	11.35
3.64	218.40	0.21	0.46	0.27	0.53	1.45	3.32	4.08	9.47
3.73	224.00	0.21	0.46	0.27	0.52	1.39	3.14	3.97	8.08
3.83	229.60	0.21	0.45	0.27	0.51	1.34	2.97	3.86	7.03
3.92	235.20	0.21	0.44	0.27	0.50	1.29	2.81	3.75	6.21
4.01	240.80	0.21	0.43	0.27	0.49	1.25	2.67	3.64	5.58
4.11	246.40	0.21	0.43	0.27	0.48	1.20	2.53	3.53	5.07
4.20	252.00	0.21	0.42	0.26	0.47	1.16	2.41	3.41	4.67
4.29	257.60	0.21	0.42	0.26	0.47	1.13	2.29	3.25	4.36
4.39	263.20	0.21	0.41	0.26	0.46	1.09	2.19	3.07	4.14
4.48	268.80	0.20	0.40	0.26	0.45	1.05	2.09	2.90	4.01
4.57	274.40	0.20	0.40	0.26	0.44	1.02	1.99	2.75	3.90
4.67	280.00	0.20	0.39	0.26	0.44	0.99	1.91	2.61	3.79
4.76	285.60	0.20	0.39	0.26	0.43	0.96	1.82	2.48	3.68
4.85	291.20	0.20	0.38	0.26	0.42	0.93	1.75	2.36	3.57
4.95	296.80	0.20	0.38	0.26	0.42	0.90	1.68	2.25	3.46
5.04	302.40	0.20	0.37	0.25	0.41	0.88	1.61	2.14	3.32
5.13	308.00	0.20	0.37	0.25	0.41	0.85	1.54	2.05	3.14
5.23	313.60	0.19	0.36	0.25	0.40	0.83	1.48	1.96	2.97
5.32	319.20	0.19	0.36	0.25	0.40	0.81	1.43	1.87	2.81
5.41	324.80	0.19	0.36	0.25	0.39	0.79	1.38	1.79	2.67
5.51	330.40	0.19	0.35	0.25	0.39	0.77	1.33	1.72	2.53
5.60	336.00	0.19	0.35	0.25	0.38	0.75	1.28	1.65	2.41
5.69	341.60	0.19	0.35	0.25	0.38	0.73	1.23	1.58	2.29
5.79	347.20	0.19	0.34	0.25	0.37	0.71	1.19	1.52	2.19
5.88	352.80	0.19	0.34	0.25	0.37	0.69	1.15	1.46	2.09
5.97	358.40	0.19	0.33	0.24	0.36	0.68	1.11	1.41	1.99
6.07	364.00	0.18	0.33	0.24	0.36	0.66	1.08	1.36	1.90
6.16	369.60	0.18	0.33	0.24	0.35	0.65	1.04	1.31	1.82
6.25	375.20	0.18	0.32	0.24	0.35	0.63	1.01	1.26	1.75
6.35	380.80	0.18	0.32	0.24	0.35	0.62	0.98	1.22	1.67
6.44	386.40	0.18	0.32	0.24	0.34	0.60	0.95	1.18	1.61
6.53	392.00	0.18	0.31	0.24	0.34	0.59	0.92	1.14	1.54
6.63	397.60	0.18	0.31	0.24	0.34	0.58	0.90	1.10	1.48
6.72	403.20	0.18	0.30	0.24	0.33	0.57	0.87	1.06	1.43



## DETENTION BASIN STAGE-STORAGE TABLE BUILDER

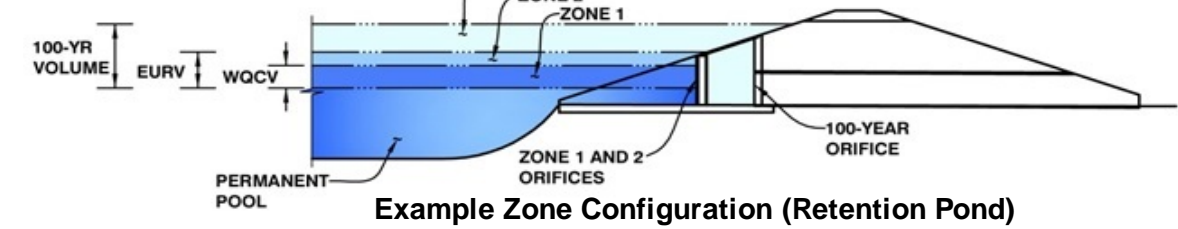
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UD-Detention, Version 3.07 (February 2017)

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Project: Winsome  
 Basin ID: P5 w/ P6 Outlet (manual hydrograph)

Basin ID: P5 w/ P6 Outlet (manual hydrograph)



**Required Volume Calculation**

Selected BMP Type = **EDB**

Watershed Area =	152.00	acres		
Watershed Length =	4,755	ft		
Watershed Slope =	0.028	ft/ft		
Watershed Imperviousness =	9.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	98.1%	percent		
Percentage Hydrologic Soil Groups C/D =	1.9%	percent		
Desired WQCW Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths = User Input				
Water Quality Capture Volume (WQCW) =	0.776	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.272	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.869	acre-feet		1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.380	acre-feet		1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.301	acre-feet		1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	9.051	acre-feet		2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	12.642	acre-feet		2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	17.330	acre-feet		2.52 inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.807	acre-feet		
Approximate 5-yr Detention Volume =	1.293	acre-feet		
Approximate 10-yr Detention Volume =	2.779	acre-feet		
Approximate 25-yr Detention Volume =	3.933	acre-feet		
Approximate 50-yr Detention Volume =	4.100	acre-feet		
Approximate 100-yr Detention Volume =	5.340	acre-feet		

**Stage-Storage Calculation**

Zone 1 Volume (WQCV) = 0.776 acre-feet

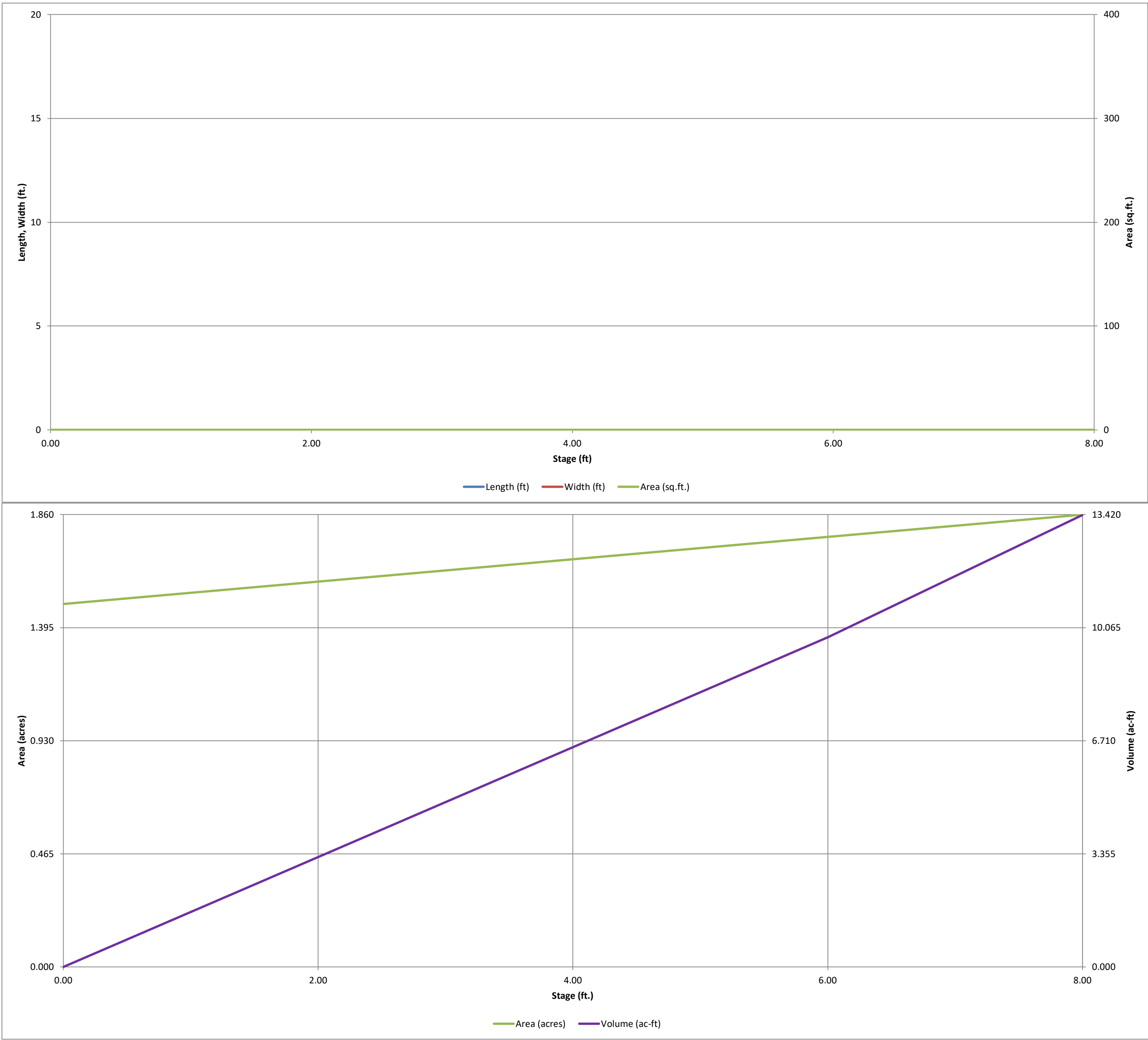
Zone 2 Volume ( $E_{URV} - Zone 1$ ) =	0.497	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.067	acre-feet
Total Detention Basin Volume =	5.340	acre-feet
Initial Surcharge Volume ( $ISV$ ) =	user	ft <sup>3</sup>
Initial Surcharge Depth ( $ISD$ ) =	user	ft
Total Available Detention Depth ( $H_{total}$ ) =	user	ft
Depth of Trickle Channel ( $H_{TC}$ ) =	user	ft
Slope of Trickle Channel ( $S_{TC}$ ) =	user	ft/ft
Slopes of Main Basin Sides ( $S_{main}$ ) =	user	H:V
Basin Length-to-Width Ratio ( $R_{L/W}$ ) =	user	
Initial Surcharge Area ( $A_{ISV}$ ) =	user	ft <sup>2</sup>
Surcharge Volume Length ( $L_{ISV}$ ) =	user	ft
Surcharge Volume Width ( $W_{ISV}$ ) =	user	ft
Depth of Basin Floor ( $H_{FLOOR}$ ) =	user	ft
Length of Basin Floor ( $L_{FLOOR}$ ) =	user	ft
Width of Basin Floor ( $W_{FLOOR}$ ) =	user	ft
Area of Basin Floor ( $A_{FLOOR}$ ) =	user	ft <sup>2</sup>
Volume of Basin Floor ( $V_{FLOOR}$ ) =	user	ft <sup>3</sup>
Depth of Main Basin ( $H_{MAIN}$ ) =	user	ft
Length of Main Basin ( $L_{MAIN}$ ) =	user	ft
Width of Main Basin ( $W_{MAIN}$ ) =	user	ft
Area of Main Basin ( $A_{MAIN}$ ) =	user	ft <sup>2</sup>
Volume of Main Basin ( $V_{MAIN}$ ) =	user	ft <sup>3</sup>
Calculated Total Basin Volume ( $V_{total}$ ) =	user	acre-feet

[illegible]



DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



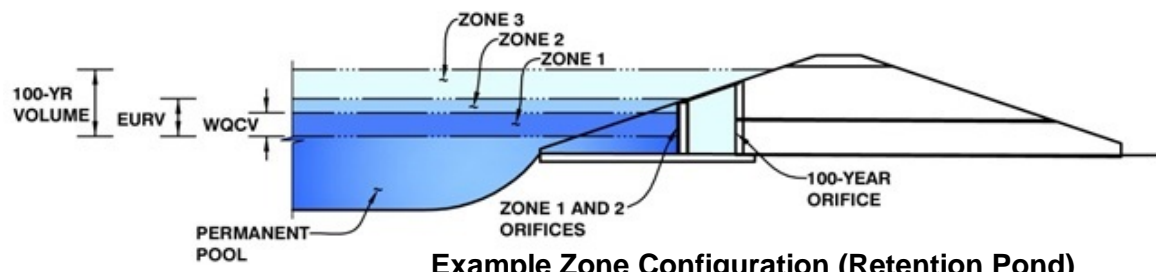


## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Winsome

Basin ID: P5 w/ P6 Outlet (manual hydrograph)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.52	0.776	Orifice Plate
Zone 2 (EURV)	0.85	0.497	Circular Orifice
Zone 3 (100-year)	3.41	4.067	Weir&Pipe (Circular)
		5.340	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.111E-01	ft <sup>2</sup>
Depth at top of Zone using Orifice Plate =	0.85	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	3.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	16.00	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft <sup>2</sup>

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60					
Orifice Area (sq. inches)	16.00	16.00	16.00					
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected		Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.49	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	4.91	ft <sup>2</sup>
Depth at top of Zone using Vertical Orifice =	0.79	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	1.25	feet
Vertical Orifice Diameter =	30.00	N/A	inches			

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H <sub>o</sub> =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H <sub>t</sub> =	4.33	feet
Overflow Weir Front Edge Length =	8.00	N/A	feet	Over Flow Weir Slope Length =	4.22	feet
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	2.28	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	28.67	ft <sup>2</sup>
Overflow Grate Open Area % =	85%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	14.34	ft <sup>2</sup>
Debris Clogging % =	50%	N/A	%			

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected		Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.57	ft <sup>2</sup>
Circular Orifice Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	2.00	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	86.00	feet	Stage at Top of Freeboard =	7.97	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.86	acres
Freeboard above Max Water Surface =	1.00	feet			

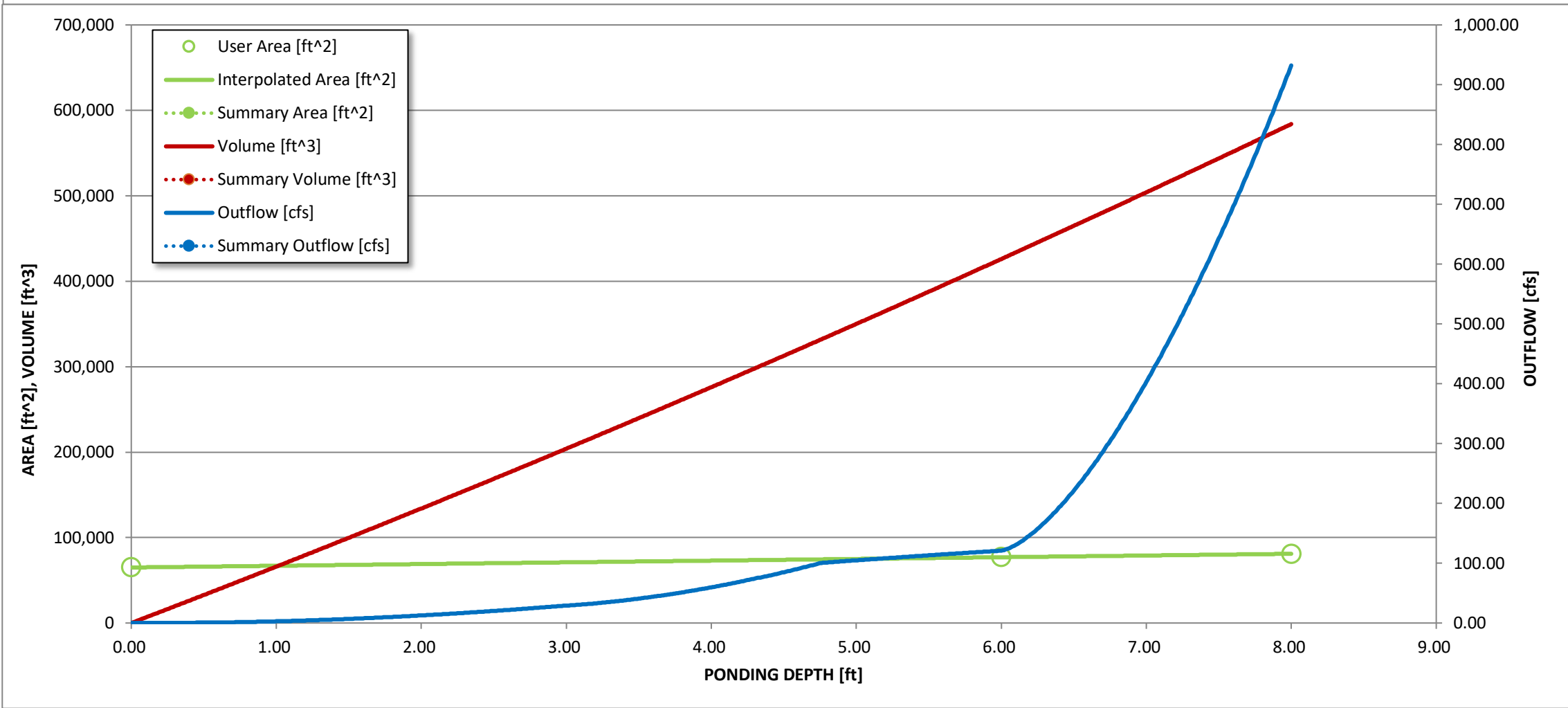
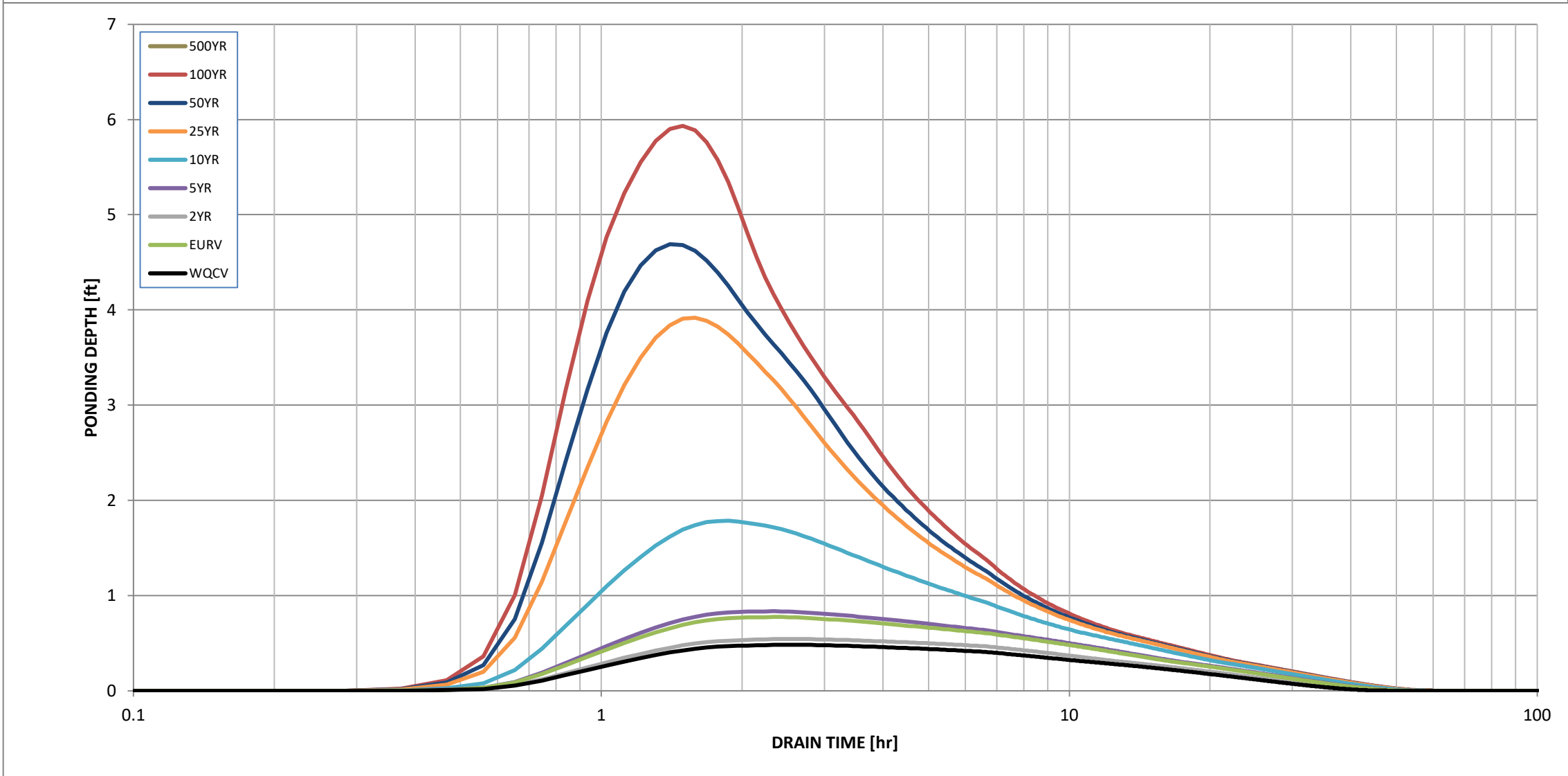
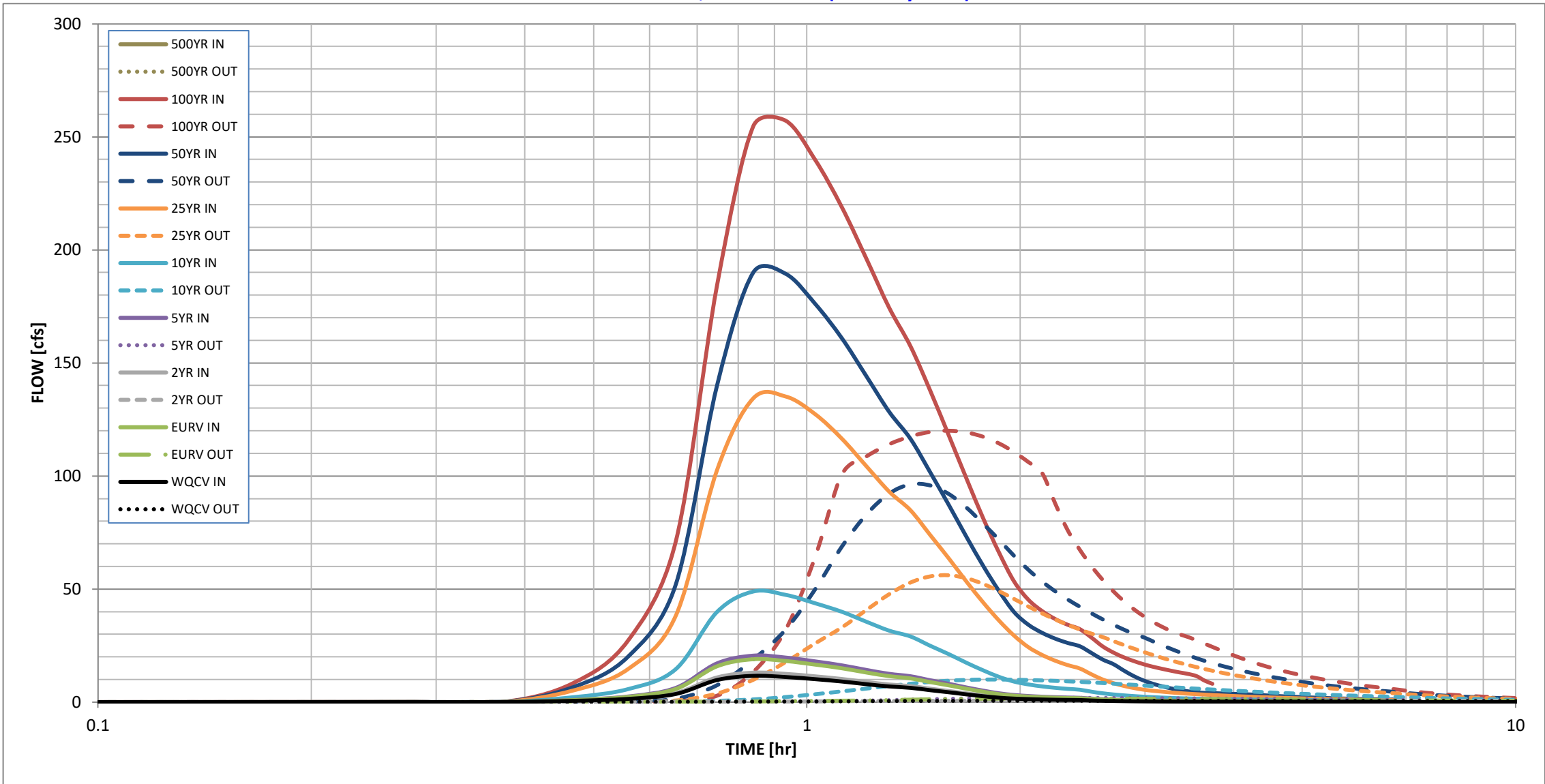
### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
One-Hour Rainfall Depth (in) =	0.776	1.272	0.869	1.380	3.301	9.051	12.642	17.330	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.879	1.492	1.001	1.632	4.087	11.443	16.069	22.082	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.58	0.80	1.08	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.6	3.0	26.1	88.1	121.9	164.8	0.0
Peak Inflow Q (cfs) =	11.6	19.0	13.0	20.6	48.9	135.2	190.0	257.1	#N/A
Peak Outflow Q (cfs) =	0.6	1.6	0.7	1.9	10.0	56.1	96.3	120.0	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.4	0.6	0.8	0.7	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.6	1.8	2.4	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	40	43	41	43	39	27	22	18	#N/A
Time to Drain 99% of Inflow Volume (hours) =	44	47	45	48	47	41	38	35	#N/A
Maximum Ponding Depth (ft) =	0.48	0.77	0.54	0.83	1.78	3.92	4.69	5.93	#N/A
Area at Maximum Ponding Depth (acres) =	1.51	1.53	1.52	1.53	1.57	1.67	1.71	1.76	#N/A
Maximum Volume Stored (acre-ft) =	0.722	1.163	0.812	1.254	2.729	6.185	7.503	9.656	#N/A



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow HydrographsUD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	USER	USER	USER	USER	USER	USER	USER	USER	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.60 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:05:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph Constant	0:11:12	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.03	#N/A
	0:16:48	0.01	0.02	0.02	0.02	0.03	0.05	0.06	0.06	#N/A
0.894	0:22:24	0.03	0.04	0.03	0.04	0.06	0.08	0.10	0.11	#N/A
	0:28:00	0.56	0.88	0.62	0.95	2.12	5.02	6.47	8.19	#N/A
	0:33:36	1.44	2.31	1.61	2.50	5.78	14.72	20.24	27.41	#N/A
	0:39:12	3.60	5.80	4.02	6.30	14.61	38.27	52.11	71.18	#N/A
	0:44:48	9.75	15.82	10.90	17.12	39.84	102.50	139.89	184.12	#N/A
	0:50:24	11.59	18.96	13.02	20.55	48.91	134.32	189.97	254.63	#N/A
	0:56:00	11.08	18.17	12.47	19.69	47.43	135.16	189.43	257.14	#N/A
	1:01:36	10.14	16.59	11.40	18.02	43.72	127.40	176.22	239.94	#N/A
	1:07:12	9.10	14.96	10.23	16.26	39.95	116.53	160.98	218.95	#N/A
	1:12:48	7.91	13.07	8.90	14.23	35.53	104.31	144.11	196.07	#N/A
	1:18:24	6.92	11.47	7.79	12.50	31.59	93.06	128.35	174.35	#N/A
	1:24:00	6.30	10.49	7.09	11.44	29.02	84.84	116.44	157.39	#N/A
	1:29:36	5.25	8.83	5.92	9.65	24.88	73.81	101.52	137.61	#N/A
	1:35:12	4.34	7.37	4.90	8.08	21.16	63.43	87.03	117.72	#N/A
	1:40:48	3.40	5.88	3.85	6.46	17.36	53.21	72.97	98.72	#N/A
	1:46:24	2.60	4.59	2.96	5.07	14.03	44.03	60.21	81.24	#N/A
	1:52:00	1.94	3.50	2.21	3.89	11.16	36.05	49.11	66.13	#N/A
	1:57:36	1.55	2.82	1.77	3.14	9.07	29.40	39.84	53.37	#N/A
	2:03:12	1.32	2.42	1.51	2.70	7.81	24.30	34.22	45.28	#N/A
	2:08:48	1.15	2.14	1.32	2.39	6.94	20.86	30.65	40.28	#N/A
	2:14:24	1.04	1.94	1.20	2.17	6.32	18.31	28.07	36.75	#N/A
	2:20:00	0.96	1.80	1.10	2.02	5.84	16.36	26.16	34.20	#N/A
	2:25:36	0.90	1.70	1.04	1.90	5.47	14.85	24.69	32.27	#N/A
	2:31:12	0.72	1.39	0.84	1.57	4.60	12.29	21.74	28.55	#N/A
	2:36:48	0.59	1.16	0.69	1.31	3.89	10.00	18.83	24.65	#N/A
	2:42:24	0.49	0.99	0.58	1.13	3.38	8.39	16.78	21.91	#N/A
	2:48:00	0.42	0.87	0.50	0.99	2.98	7.16	13.94	19.79	#N/A
	2:53:36	0.36	0.77	0.44	0.88	2.65	6.21	11.45	18.12	#N/A
	2:59:12	0.32	0.69	0.39	0.79	2.39	5.48	9.53	16.73	#N/A
	3:04:48	0.29	0.63	0.36	0.73	2.18	4.99	8.07	15.61	#N/A
	3:10:24	0.27	0.59	0.33	0.67	2.00	4.60	6.94	14.69	#N/A
	3:16:00	0.25	0.55	0.31	0.63	1.84	4.25	6.03	13.85	#N/A
	3:21:36	0.23	0.51	0.29	0.59	1.71	3.96	5.31	13.09	#N/A
	3:27:12	0.22	0.49	0.28	0.56	1.60	3.71	4.74	12.43	#N/A
	3:32:48	0.22	0.47	0.27	0.54	1.51	3.50	4.33	11.47	#N/A
	3:38:24	0.21	0.46	0.27	0.53	1.45	3.32	4.08	9.48	#N/A
	3:44:00	0.21	0.46	0.27	0.52	1.39	3.14	3.97	8.08	#N/A
	3:49:36	0.21	0.45	0.27	0.51	1.34	2.97	3.86	7.03	#N/A
	3:55:12	0.21	0.44	0.27	0.50	1.29	2.81	3.75	6.21	#N/A
	4:00:48	0.21	0.43	0.27	0.49	1.25	2.67	3.64	5.58	#N/A
	4:06:24	0.21	0.43	0.27	0.48	1.20	2.53	3.53	5.07	#N/A
	4:12:00	0.21	0.42	0.26	0.47	1.16	2.41	3.41	4.67	#N/A
	4:17:36	0.21	0.42	0.26	0.47	1.13	2.29	3.25	4.36	#N/A
	4:23:12	0.21	0.41	0.26	0.46	1.09	2.19	3.07	4.14	#N/A
	4:28:48	0.20	0.40	0.26	0.45	1.05	2.09	2.90	4.01	#N/A
	4:34:24	0.20	0.40	0.26	0.44	1.02	1.99	2.75	3.90	#N/A
	4:40:00	0.20	0.39	0.26	0.44	0.99	1.91	2.61	3.79	#N/A
	4:45:36	0.20	0.39	0.26	0.43	0.96	1.82	2.48	3.68	#N/A
	4:51:12	0.20	0.38	0.26	0.42	0.93	1.75	2.36	3.57	#N/A
	4:56:48	0.20	0.38	0.26	0.42	0.90	1.68	2.25	3.46	#N/A
	5:02:24	0.20	0.37	0.25	0.41	0.88	1.61	2.14	3.32	#N/A
	5:08:00	0.20	0.37	0.25	0.41	0.85	1.54	2.05	3.14	#N/A
	5:13:36	0.19	0.36	0.25	0.40	0.83	1.48	1.96	2.97	#N/A
	5:19:12	0.19	0.36	0.25	0.40	0.81	1.43	1.87	2.81	#N/A
	5:24:48	0.19	0.36	0.25	0.39	0.79	1.38	1.79	2.67	#N/A
	5:30:24	0.19	0.35	0.25	0.39	0.77	1.33	1.72	2.53	#N/A
	5:36:00	0.19	0.35	0.25	0.38	0.75	1.28	1.65	2.41	#N/A
	5:41:36	0.19	0.35	0.25	0.38	0.73	1.23	1.58	2.29	#N/A
	5:47:12	0.19	0.34	0.25	0.37	0.71	1.19	1.52	2.19	#N/A
	5:52:48	0.19	0.34	0.25	0.37	0.69	1.15	1.46	2.09	#N/A
	5:58:24	0.19	0.33	0.24	0.36	0.68	1.11	1.41	1.99	#N/A
	6:04:00	0.18	0.33	0.24	0.36	0.66	1.08	1.36	1.90	#N/A
	6:09:36	0.18	0.33	0.24	0.35	0.65	1.04	1.31	1.82	#N/A
	6:15:12	0.18	0.32	0.24	0.35	0.63	1.01	1.26	1.75	#N/A
	6:20:48	0.18	0.32	0.24	0.35	0.62	0.98	1.22	1.67	#N/A
	6:26:24	0.18	0.32	0.24	0.34	0.60	0.95	1.18	1.61	#N/A
	6:32:00	0.18	0.31	0.24	0.34	0.59	0.92	1.14	1.54	#N/A
	6:37:36	0.18	0.31	0.24	0.34	0.58	0.90	1.10	1.48	#N/A
	6:43:12	0.18	0.30	0.24	0.33	0.57	0.87	1.06	1.43	#N/A



## Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]



## **5.1 BASIN RUNOFF SUMMARY**



5-yr Existing				
Basin	Area (SqMiles)	Acres	Peak Q	Volume (In)
A	1.4303	915.4	56.40	0.18
Ba	5.9948	3,836.7	180.90	0.19
Bb	0.1572	100.6	9.90	0.14
Ca	0.2542	162.7	14.40	0.19
Cb	0.1094	70.0	6.00	0.11
Da	0.2520	161.3	14.70	0.19
Db	0.0780	49.9	4.00	0.19
Dc	0.3902	249.7	18.10	0.10
Ea	0.0592	37.9	3.90	0.19
Eb	0.1166	74.6	2.20	0.08
F	0.0695	44.5	3.80	0.11
G	0.1681	107.6	28.90	0.24
H	0.1903	121.8	21.60	0.17
I	0.0586	37.5	17.60	0.37
J	0.0158	10.1	1.70	0.12
K	0.0278	17.8	7.90	0.28



100-yr Existing				
Basin	Area (SqMiles)	Acres	Peak Q	Volume (In)
A	1.4303	915.40	345.60	0.65
Ba	5.9948	3836.67	893.30	0.63
Bb	0.1572	100.60	66.50	0.86
Ca	0.2542	162.70	81.50	0.63
Cb	0.1094	70.00	53.80	0.79
Da	0.2520	161.30	83.70	0.63
Db	0.0780	49.90	21.90	0.63
Dc	0.3902	249.70	177.10	0.74
Ea	0.0592	37.90	22.70	0.63
Eb	0.1166	74.60	41.90	0.76
F	0.0695	44.50	33.10	0.81
G	0.1681	107.60	132.40	1.42
H	0.1903	121.80	126.40	1.00
I	0.0586	37.50	62.00	2.03
J	0.0158	10.10	13.40	0.84
K	0.0278	17.80	32.00	1.62



5-yr Proposed				
Basin	Area (SqMiles)	Acres	Peak Q	Volume (In)
A1	1.3529	865.86	54.90	0.19
A2	0.0578	36.98	3.10	0.19
A3	0.0648	41.48	15.00	0.35
B1	5.9948	3836.67	190.00	0.19
B2	0.0205	13.10	2.50	0.30
B3	0.0858	54.90	4.00	0.19
B4	0.0648	41.48	5.60	0.24
C1	0.2542	162.70	14.30	0.19
C2	0.0350	22.40	2.20	0.19
C3	0.0252	16.10	2.60	0.30
C4	0.0372	23.80	1.10	0.12
D1.1	0.2520	161.30	14.70	0.19
D1.2	0.0780	49.90	4.00	0.19
D2	0.1073	68.70	8.40	0.24
D3	0.0644	41.20	5.40	0.30
D4	0.0536	34.30	5.70	0.30
D5	0.0200	12.80	0.50	0.08
D6	0.0653	41.80	2.90	0.16
E0	0.0592	37.90	3.40	0.19
E1.1	0.0123	7.90	6.30	1.32
E1.2	0.0255	16.30	2.00	0.24
E2	0.0041	2.60	0.50	0.30
E3	0.0309	19.80	3.40	0.30
E4	0.0284	18.20	3.10	0.30
E5	0.0211	13.50	2.30	0.30
E6	0.0452	28.90	4.00	0.24
E7	0.0153	9.80	1.50	0.24
F1	0.0670	42.90	4.00	0.20
G1	0.0394	25.20	1.80	0.12
G2	0.0331	21.20	4.50	0.23
H1	0.0217	13.90	3.70	0.29
H2	0.0611	39.10	3.70	0.19
H3	0.0091	5.80	0.90	0.24
H4	0.0423	27.10	7.60	0.33
H5	0.0316	20.20	6.00	0.32
H6	0.0494	31.60	1.10	0.08
H7	0.0403	25.80	5.30	0.23
H8	0.0133	8.50	3.20	0.29
H9	0.0108	6.90	2.00	0.29
I1	0.0106	6.80	2.20	0.31
I2	0.0231	14.80	5.10	0.31
J1	0.0158	10.10	2.50	0.25
K1	0.0278	17.80	9.10	0.40



100-yr Proposed				
Basin	Area (SqMiles)	Acres	Peak Q	Volume (In)
A1	1.3529	865.86	291.50	0.63
A2	0.0578	36.98	26.70	0.86
A3	0.0648	41.48	58.60	1.77
B1	5.9948	3836.67	948.80	0.63
B2	0.0205	13.10	14.20	0.94
B3	0.0858	54.90	30.40	0.81
B4	0.0648	41.48	33.20	0.98
C1	0.2542	162.70	81.30	0.63
C2	0.0350	22.40	13.10	0.63
C3	0.0252	16.10	14.40	0.94
C4	0.0372	23.80	12.80	0.71
D1.1	0.2520	161.30	83.70	0.63
D1.2	0.0780	49.90	21.90	0.63
D2	0.1073	68.70	54.70	0.88
D3	0.0644	41.20	27.90	0.94
D4	0.0536	34.30	30.70	0.94
D5	0.0200	12.80	11.20	0.76
D6	0.0653	41.80	20.30	0.62
E0	0.0592	37.90	19.10	0.63
E1.1	0.0123	7.90	14.60	2.90
E1.2	0.0255	16.30	10.40	0.76
E2	0.0041	2.60	2.80	0.94
E3	0.0309	19.80	18.50	0.94
E4	0.0284	18.20	16.90	0.94
E5	0.0211	13.50	13.00	0.94
E6	0.0452	28.90	23.00	0.79
E7	0.0153	9.80	8.40	0.76
F1	0.0670	42.90	22.20	0.66
G1	0.0394	25.20	24.50	0.76
G2	0.0331	21.20	21.90	1.11
H1	0.0217	13.90	17.90	1.11
H2	0.0611	39.10	34.90	0.92
H3	0.0091	5.80	6.80	0.94
H4	0.0423	27.10	31.70	1.44
H5	0.0316	20.20	24.70	1.55
H6	0.0494	31.60	21.60	0.73
H7	0.0403	25.80	28.40	1.01
H8	0.0133	8.50	13.20	1.49
H9	0.0108	6.90	9.70	1.11
I1	0.0106	6.80	10.20	1.20
I2	0.0231	14.80	23.20	1.20
J1	0.0158	10.10	14.20	1.03
K1	0.0278	17.80	32.90	1.78



## **5.2 CONVEYANCE REACH SUMMARY**



Reach Summary Table - 5 Year Existing Conditions				
Reach Name	Drainage Area (sq. m)	Peak Discharge (cfs)	Time of Peak	Volume (in)
1	5.9948	180.80	26Feb2019, 13:14	0.19
2	7.9459	235.20	26Feb2019, 13:12	0.19
3	9.0245	271.00	26Feb2019, 12:58	0.18
4	9.0245	271.00	26Feb2019, 13:04	0.18
5	9.3284	281.30	26Feb2019, 13:00	0.18
6	0.2542	14.20	26Feb2019, 12:34	0.19
7	0.2520	14.40	26Feb2019, 12:38	0.19
8	0.0780	3.90	26Feb2019, 12:42	0.19
9	0.0592	3.60	26Feb2019, 12:46	0.19

Reach Summary Table - 100 Year Existing Conditions				
Reach Name	Drainage Area (sq. m)	Peak Discharge (cfs)	Time of Peak	Volume (in)
1	5.9948	892.80	26Feb2019, 13:16	0.63
2	7.9459	1209.00	26Feb2019, 13:04	0.64
3	9.0245	1505.80	26Feb2019, 12:50	0.67
4	9.0245	1505.30	26Feb2019, 12:52	0.67
5	9.3284	1601.60	26Feb2019, 12:50	0.68
6	0.2542	81.40	26Feb2019, 12:32	0.63
7	0.2520	83.60	26Feb2019, 12:36	0.63
8	0.0780	21.80	26Feb2019, 12:40	0.63
9	0.0592	22.70	26Feb2019, 12:38	0.62



Reach Summary Table - 5 Year Proposed Conditions				
Reach Name	Drainage Area (sq. mi.)	Peak Discharge (cfs)	Time of Peak	Volume (in)
BOX CULVERT 1	7.9557	254.90	26Feb2019, 13:04	0.19
BOX CULV 2	8.9615	293.60	26Feb2019, 13:06	0.19
CLV E4	0.0634	6.80	26Feb2019, 12:20	0.3
CULV B2	0.0205	2.50	26Feb2019, 12:12	0.3
CULV C2	0.2892	16.40	26Feb2019, 12:26	0.19
CULV C3	0.3144	18.50	26Feb2019, 12:28	0.2
CULV D2	0.3594	22.60	26Feb2019, 12:26	0.21
CULV D3	0.1423	9.10	26Feb2019, 12:30	0.24
CULV D4	0.1959	13.40	26Feb2019, 12:28	0.25
CULV E1.2	0.0970	6.80	26Feb2019, 12:42	0.35
CULV E2	0.0041	0.50	26Feb2019, 12:12	0.3
CULV E5	0.0211	2.30	26Feb2019, 12:14	0.3
CULV H2	0.0611	3.70	26Feb2019, 12:20	0.19
CULV H3	0.0091	0.90	26Feb2019, 12:12	0.24
CULV I1	0.0106	2.20	26Feb2019, 12:16	0.31
CULV-E3	0.0350	3.80	26Feb2019, 12:16	0.3
EX CULV C1	0.2542	14.30	26Feb2019, 12:24	0.19
EX CULV D1.2	0.0780	4.00	26Feb2019, 12:30	0.19
EX CULV E0	0.0592	3.40	26Feb2019, 12:24	0.19
OUT 2	0.0445	7.70	26Feb2019, 12:30	0.3
OUT-1	9.2839	309.80	26Feb2019, 13:08	0.2
REACH A1	1.3529	54.80	26Feb2019, 12:48	0.19
Reach H7	0.0494	6.20	26Feb2019, 12:22	0.23
Reach-A2	0.0648	15.00	26Feb2019, 12:26	0.35
Reach-B1	5.9948	189.90	26Feb2019, 13:08	0.19
Reach-B2	0.0205	2.50	26Feb2019, 12:20	0.3
Reach-B3	6.0806	192.20	26Feb2019, 13:14	0.19
Reach-B4-3	0.3144	18.50	26Feb2019, 12:28	0.2
Reach-C1	0.2542	14.30	26Feb2019, 12:28	0.19
Reach-C2	0.2892	16.40	26Feb2019, 12:30	0.19
Reach-D1.1	0.2520	14.70	26Feb2019, 12:30	0.19
Reach-D3	0.0780	4.00	26Feb2019, 12:36	0.19
Reach-D4	0.1423	9.10	26Feb2019, 12:34	0.24
Reach-D5	0.3594	22.50	26Feb2019, 12:32	0.21
Reach-D6	0.1959	13.40	26Feb2019, 12:34	0.25
Reach-E1.1	0.0592	3.30	26Feb2019, 12:34	0.19
Reach-E1.2	0.0716	5.60	26Feb2019, 12:54	0.38
Reach-E3	0.0041	0.50	26Feb2019, 12:20	0.3
Reach-E4	0.0350	3.80	26Feb2019, 12:22	0.3
Reach-E6	0.0211	2.30	26Feb2019, 12:20	0.3
Reach-E6-2	0.2428	15.00	26Feb2019, 12:46	0.29
Reach-E7	0.0634	6.70	26Feb2019, 12:24	0.3
Reach-F1	0.0970	6.80	26Feb2019, 12:46	0.35
Reach-F1-2	0.1641	10.00	26Feb2019, 12:48	0.29
Reach-G2	0.0394	1.80	26Feb2019, 12:20	0.12
Reach-H4	0.0217	3.70	26Feb2019, 12:22	0.29
Reach-H6	0.0611	3.70	26Feb2019, 12:22	0.19
Reach-H7-1	0.0091	0.90	26Feb2019, 12:18	0.24
Reach-H9	0.0338	7.30	26Feb2019, 12:18	0.31
Reach-I2-1	0.0106	2.20	26Feb2019, 12:18	0.31
Reach-P3	0.2613	15.90	26Feb2019, 12:38	0.23
Reach-1	7.9557	254.90	26Feb2019, 13:06	0.19
Reach-2	8.1295	264.50	26Feb2019, 13:08	0.19
Reach-3	8.5404	278.50	26Feb2019, 13:06	0.19
Reach-4	8.6509	281.40	26Feb2019, 13:08	0.19
Reach-5	8.9615	293.50	26Feb2019, 13:06	0.19
Reach-6 Kiowa Outfall	9.328384	311.7	26Feb2019, 13:06	0.2



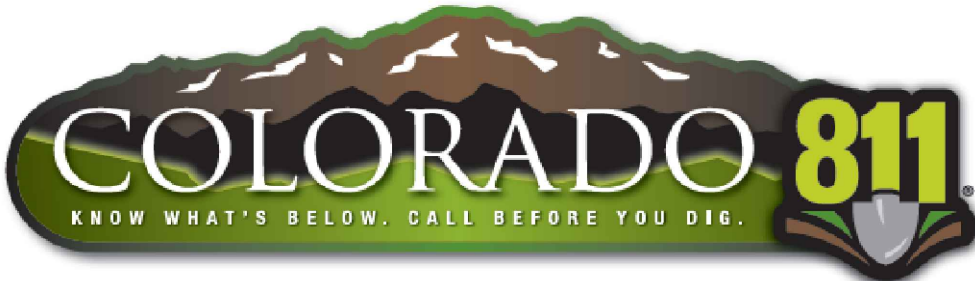
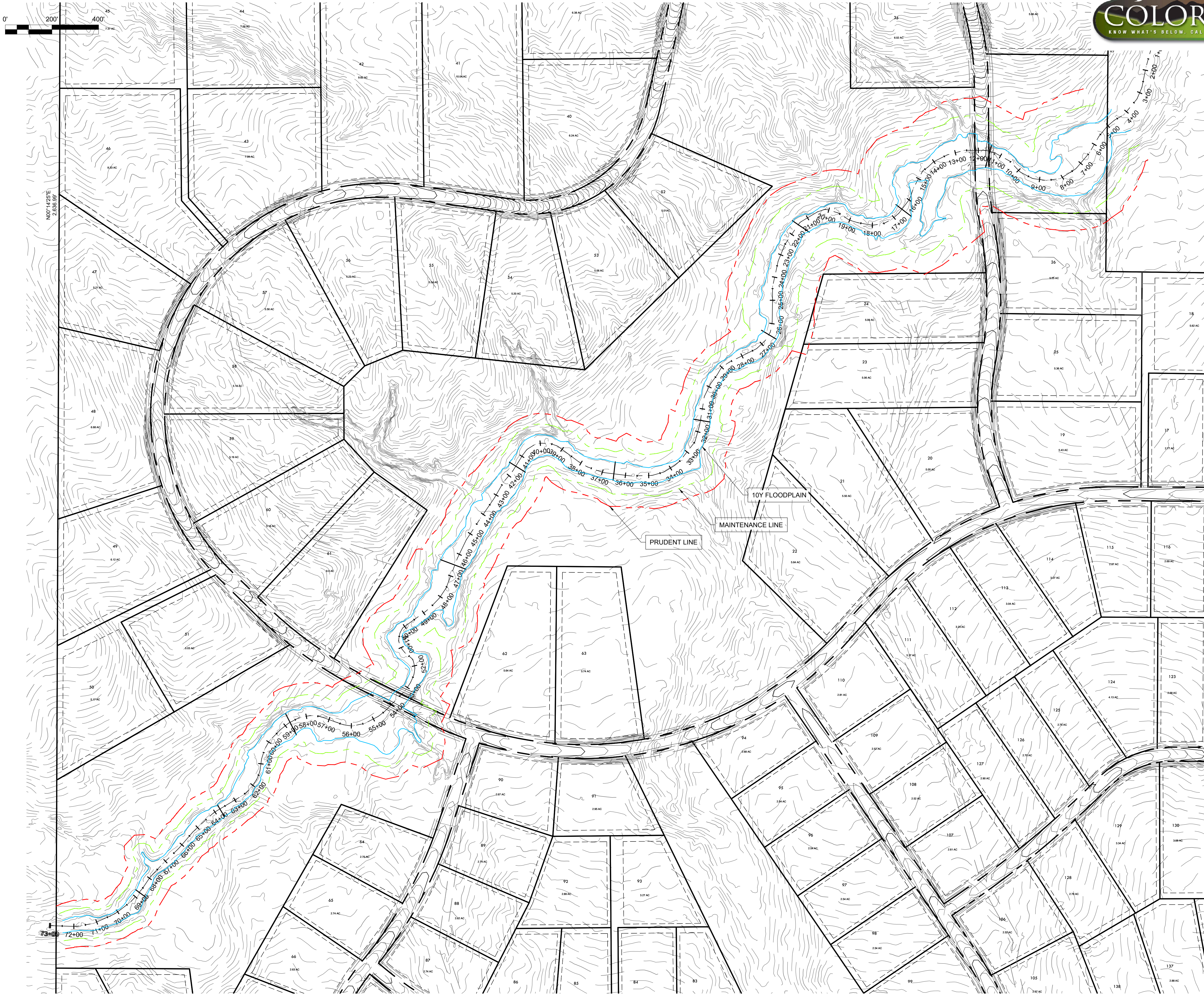
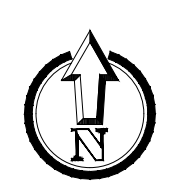
Reach Summary Table - 100 Year Proposed Conditions				
Reach Name	Drainage Area (sq. mi.)	Peak Discharge (cfs)	Time of Peak	Volume (in)
BOX CULVERT 1	7.9557	1283.40	26Feb2019, 13:00	0.65
BOX CULV 2	8.9615	1492.80	26Feb2019, 13:00	0.67
CLV E4	0.0634	37.70	26Feb2019, 12:20	0.93
CULV B2	0.0205	14.20	26Feb2019, 12:14	0.94
CULV C2	0.2892	93.10	26Feb2019, 12:28	0.63
CULV C3	0.3144	104.40	26Feb2019, 12:28	0.65
CULV D2	0.3594	135.50	26Feb2019, 12:26	0.7
CULV D3	0.1423	48.30	26Feb2019, 12:30	0.77
CULV D4	0.1959	71.70	26Feb2019, 12:28	0.81
CULV E1.2	0.0970	19.00	26Feb2019, 12:30	0.95
CULV E2	0.0041	2.80	26Feb2019, 12:14	0.94
CULV E5	0.0211	13.00	26Feb2019, 12:16	0.94
CULV H2	0.0611	34.90	26Feb2019, 12:22	0.92
CULV H3	0.0091	6.80	26Feb2019, 12:14	0.94
CULV I1	0.0106	10.20	26Feb2019, 12:14	1.2
CULV-E3	0.0350	21.30	26Feb2019, 12:18	0.93
EX CULV C1	0.2542	81.20	26Feb2019, 12:26	0.63
EX CULV D1.2	0.0780	21.90	26Feb2019, 12:32	0.63
EX CULV E0	0.0592	19.10	26Feb2019, 12:26	0.63
OUT 2	0.0445	25.20	26Feb2019, 12:36	1.18
OUT-1	9.2839	1568.30	26Feb2019, 13:02	0.68
REACH A1	1.3529	291.20	26Feb2019, 12:48	0.63
Reach H7	0.0494	34.90	26Feb2019, 12:20	1
Reach-A2	0.0648	58.60	26Feb2019, 12:24	1.77
Reach-B1	5.9948	948.80	26Feb2019, 13:10	0.63
Reach-B2	0.0205	14.10	26Feb2019, 12:20	0.93
Reach-B3	6.0806	963.20	26Feb2019, 13:12	0.64
Reach-B4-3	0.3144	104.30	26Feb2019, 12:28	0.65
Reach-C1	0.2542	81.20	26Feb2019, 12:28	0.63
Reach-C2	0.2892	93.10	26Feb2019, 12:30	0.63
Reach-D1.1	0.2520	83.50	26Feb2019, 12:30	0.62
Reach-D3	0.0780	21.80	26Feb2019, 12:36	0.62
Reach-D4	0.1423	48.30	26Feb2019, 12:34	0.76
Reach-D5	0.3594	135.40	26Feb2019, 12:30	0.7
Reach-D6	0.1959	71.60	26Feb2019, 12:32	0.81
Reach-E1.1	0.0592	19.10	26Feb2019, 12:32	0.63
Reach-E1.2	0.0716	12.80	26Feb2019, 13:10	1.02
Reach-E3	0.0041	2.80	26Feb2019, 12:18	0.93
Reach-E4	0.0350	21.20	26Feb2019, 12:22	0.93
Reach-E6	0.0211	12.90	26Feb2019, 12:20	0.93
Reach-E6-2	0.2428	72.70	26Feb2019, 12:36	0.85
Reach-E7	0.0634	37.70	26Feb2019, 12:22	0.93
Reach-F1	0.0970	19.00	26Feb2019, 12:34	0.95
Reach-F1-2	0.1641	40.20	26Feb2019, 12:38	0.83
Reach-G2	0.0394	24.40	26Feb2019, 12:20	0.76
Reach-H4	0.0217	17.80	26Feb2019, 12:20	1.11
Reach-H6	0.0611	34.70	26Feb2019, 12:24	0.92
Reach-H7-1	0.0091	6.70	26Feb2019, 12:18	0.94
Reach-H9	0.0338	33.40	26Feb2019, 12:16	1.2
Reach-I2-1	0.0106	10.20	26Feb2019, 12:16	1.2
Reach-P3	0.2613	74.20	26Feb2019, 12:46	0.76
Reach-1	7.9557	1283.10	26Feb2019, 13:02	0.65
Reach-2	8.1295	1319.00	26Feb2019, 13:02	0.66
Reach-3	8.5404	1393.80	26Feb2019, 13:00	0.66
Reach-4	8.6509	1415.70	26Feb2019, 13:02	0.67
Reach-5	8.9615	1492.70	26Feb2019, 13:02	0.67
Reach-6 Kiowa Outfall	9.328384	1587.9	26Feb2019, 13:02	0.68
Reach-6 Kiowa Outfall	9.328384	311.7	26Feb2019, 13:06	0.2



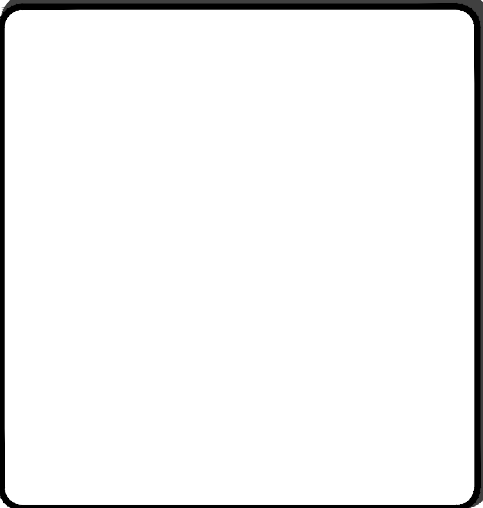
## **6.0 PRUDENT LINE ANALYSIS AND EXHIBIT**



P:\Shared\Projects\49388\49388.dwg  
Friday, March 8, 2019 8:56:59 PM  
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PRUDENT LINE EXHIBIT



SITE:  
FOR: PROTERRA PROPERTIES, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

NO.	REVISIONS
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DATE: 10/1/2018	1
DRAWN BY: JCP	
CHECKED BY: JWD	
JOB #: 49388	



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Main: 303.623.9116 | VERTEXENG.COM



Prudent Line Stream Carrying Capacity Calulations																										
Project:	Winsome	Date:			3/8/2019																		Prepared By:		BJJ	
Downstream Station	2 Year Storm			5 Year Storm			10 Year Storm			25 Year Storm			50 Year Storm			100 Year Storm										
	Q	Carrying Capacity	Sediment Deficit	Q	Carrying Capacity	Sediment Deficit	Q	Carrying Capacity	Sediment Deficit	Q	Carrying Capacity	Sediment Deficit	Q	Carrying Capacity	Sediment Deficit	Q	Carrying Capacity	Sediment Deficit	Average Annual	30-year Sediment						
6+50	76.00	10,944.00	2,736.00	348.00	50,112.00	12,528.00	660.00	95,040.00	23,760.00	1,208.00	173,952.00	43,488.00	1,647.00	237,168.00	59,292.00	2,180.00	313,920.00	78,480.00	9,306.90	279,207.00						
11+50	73.35	10,562.47	2,640.62	335.87	48,364.98	12,091.24	636.99	91,726.68	22,931.67	1,165.89	167,887.62	41,971.90	1,589.58	228,899.76	57,224.94	2,104.00	302,976.00	75,744.00	8,982.44	269,473.18						
16+50	69.77	10,046.39	2,511.60	319.46	46,001.90	11,500.47	605.87	87,244.98	21,811.24	1,108.92	159,684.74	39,921.19	1,511.92	217,715.87	54,428.97	2,001.20	288,172.80	72,043.20	8,543.56	256,306.90						
21+50	69.77	10,046.39	2,511.60	319.46	46,001.90	11,500.47	605.87	87,244.98	21,811.24	1,108.92	159,684.74	39,921.19	1,511.92	217,715.87	54,428.97	2,001.20	288,172.80	72,043.20	8,543.56	256,306.90						
26+50	69.20	9,965.06	2,491.27	316.87	45,629.50	11,407.38	600.96	86,538.72	21,634.68	1,099.94	158,392.07	39,598.02	1,499.68	215,953.43	53,988.36	1,985.00	285,840.00	71,460.00	8,474.40	254,232.06						
31+50	69.20	9,965.06	2,491.27	316.87	45,629.50	11,407.38	600.96	86,538.72	21,634.68	1,099.94	158,392.07	39,598.02	1,499.68	215,953.43	53,988.36	1,985.00	285,840.00	71,460.00	8,474.40	254,232.06						
36+50	65.61	9,447.99	2,362.00	300.43	43,261.83	10,815.46	569.78	82,048.29	20,512.07	1,042.87	150,173.24	37,543.31	1,421.86	204,747.79	51,186.95	1,882.00	271,008.00	67,752.00	8,034.67	241,040.17						
41+50	65.61	9,447.99	2,362.00	300.43	43,261.83	10,815.46	569.78	82,048.29	20,512.07	1,042.87	150,173.24	37,543.31	1,421.86	204,747.79	51,186.95	1,882.00	271,008.00	67,752.00	8,034.67	241,040.17						
46+50	64.60	9,302.40	2,325.60	295.80	42,595.20	10,648.80	561.00	80,784.00	20,196.00	1,026.80	147,859.20	36,964.80	1,399.95	201,592.80	50,398.20	1,853.00	266,832.00	66,708.00	7,910.87	237,325.95						
53+75	48.80	7,026.75	1,756.69	223.44	32,175.12	8,043.78	423.76	61,021.78	15,255.45	775.61	111,688.36	27,922.09	1,057.48	152,277.09	38,069.27	1,399.70	201,556.80	50,389.20	5,975.63	179,268.82						
58+75	48.13	6,930.36	1,732.59	220.37	31,733.77	7,933.44	417.95	60,184.73	15,046.18	764.97	110,156.30	27,539.08	1,042.97	150,188.27	37,547.07	1,380.50	198,792.00	49,698.00	5,893.66	176,809.75						
63+75	48.13	6,930.36	1,732.59	220.37	31,733.77	7,933.44	417.95	60,184.73	15,046.18	764.97	110,156.30	27,539.08	1,042.97	150,188.27	37,547.07	1,380.50	198,792.00	49,698.00	5,893.66	176,809.75						
68+75	48.13	6,930.36	1,732.59	220.37	31,733.77	7,933.44	417.95	60,184.73	15,046.18	764.97	110,156.30	27,539.08	1,042.97	150,188.27	37,547.07	1,380.50	198,792.00	49,698.00	5,893.66	176,809.75						



Prudent Line Channel Migration Calculations									
Project: Winsome		Date: 3/8/2019		Prepared By: BJJ					
Downstream Station	Channel Type	Channel Side Slope	Bank Height	30-yr Sediment Deficiency	30-year Bank Migration Swale	30-year Bank Migration Channel	Short-Term Sediment Deficiency	Short-Term Bank Migration Swale	Short-Term Bank Migration Channel
6+50	Swale	11.75		466,275.69	148.04		131061.6	78.48499984	
11+50	Defined		6	450,020.21		150.01	126492.48		140.5472
16+50	Defined		6	428,032.53		142.68	120312.144		133.68016
21+50	Defined		6	428,032.53		142.68	120312.144		133.68016
26+50	Swale	4		424,567.54	82.42		119338.2	43.69680995	
31+50	Defined		8	424,567.54		106.14	119338.2		99.4485
36+50	Swale	5		402,537.09	89.73		113145.84	47.57012508	
41+50	Defined		9	402,537.09		89.45	113145.84		83.81173333
46+50	Swale	6.67		396,334.34	102.83		111402.36	54.51802422	
53+75	Swale	4		299,378.94	69.21		84149.964	36.69331579	
58+75	Defined		8	295,272.29		73.82	82995.66		69.16305
63+75	Defined		8	295,272.29		73.82	82995.66		69.16305
68+75	Swale	4		295,272.29	68.73		82995.66	36.44078155	



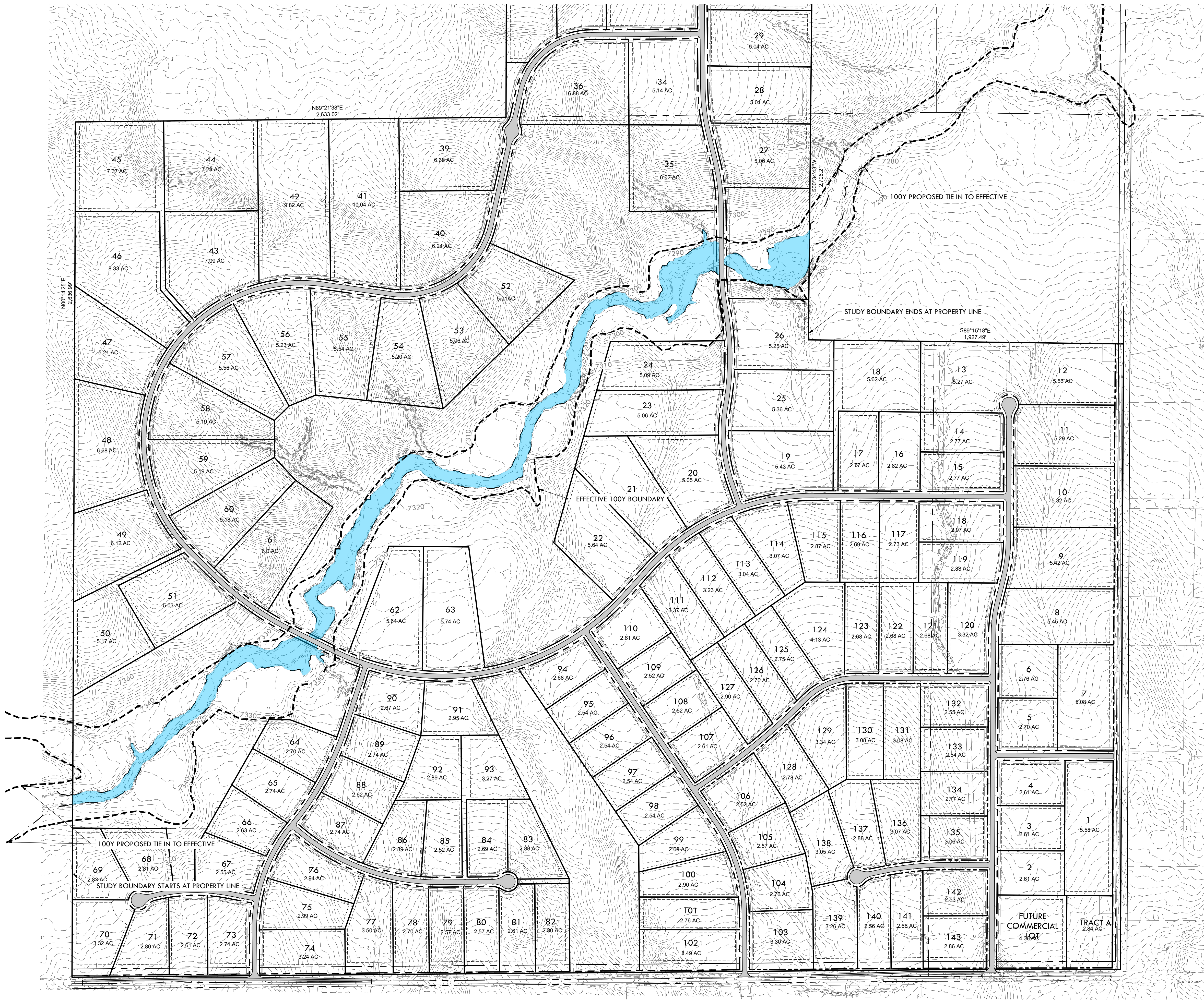
## **7.1 FLOODPLAIN EXHIBIT**



FEMA CLOMR SUBMITTAL  
MCCUNE RANCH SUBDIVISION

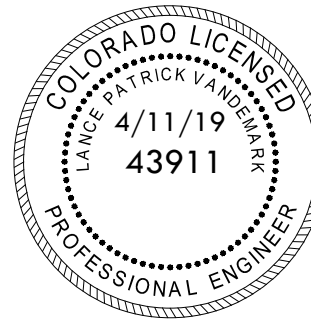
CASE #: 19-08-0185R

A PARCEL OF PROPERTY LOCATED IN SECTIONS 13 & 24, TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH P.M. AND IN THE WEST HALF OF THE WEST HALF OF SECTION 19, TOWNSHIP 11 SOUTH, RANGE 64 WEST OF THE 6TH P.M., COUNTY OF EL PASO, STATE OF COLORADO



100Y FLOODPLAIN PC

**VERTIX**  
2420 W. 26th Avenue, Suite 100-D | Denver, CO 80211  
Main: 303.623.9116 | VERTEXENG.COM



100Y FLOODPLAIN PC AND EC  
SITE: 17480 MERIDIAN ROAD  
ELBERT, COLORADO 80106  
FOR: PT MCCUNE, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

NO.	REVISIONS
1	REVISED PER REVIEW COMMENTS 3/26/19
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BENCHMARK: NORTHWEST CORNER OF SECTION 24, TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH P.M.  
A 3.5" ALUMINUM CAP STAMPED "LS 12103"  
ELEVATION IS 7429.30 NAVD88

DATE: 11/16/18  
DRAWN BY: JCP  
CHECKED BY: LPV  
JOB #: 49388

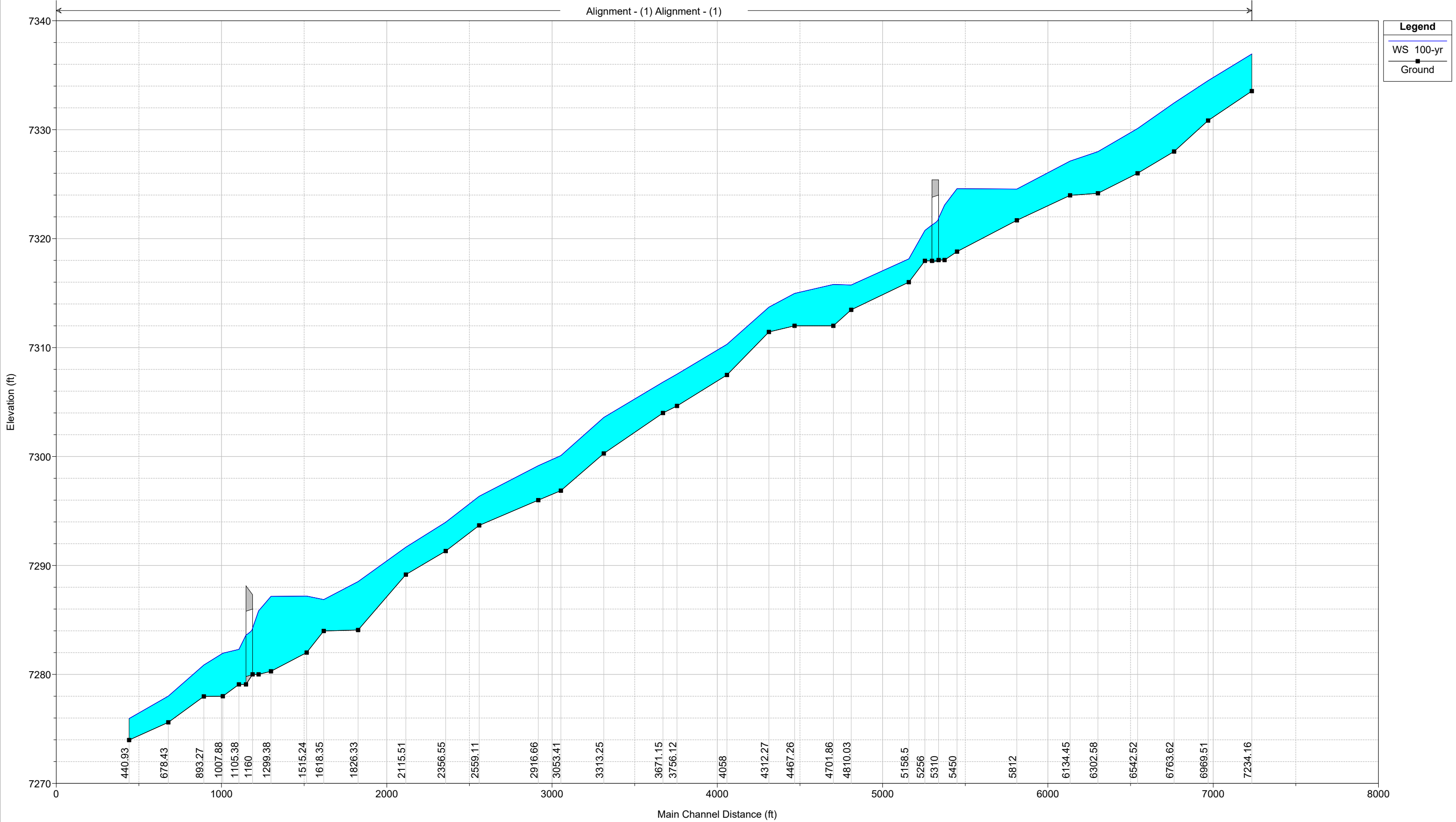


## **7.2 FLOODPLAIN PROFILE**



WEST KIOWA CREEK PROPOSED 100-YEAR FLOOD PROFILE

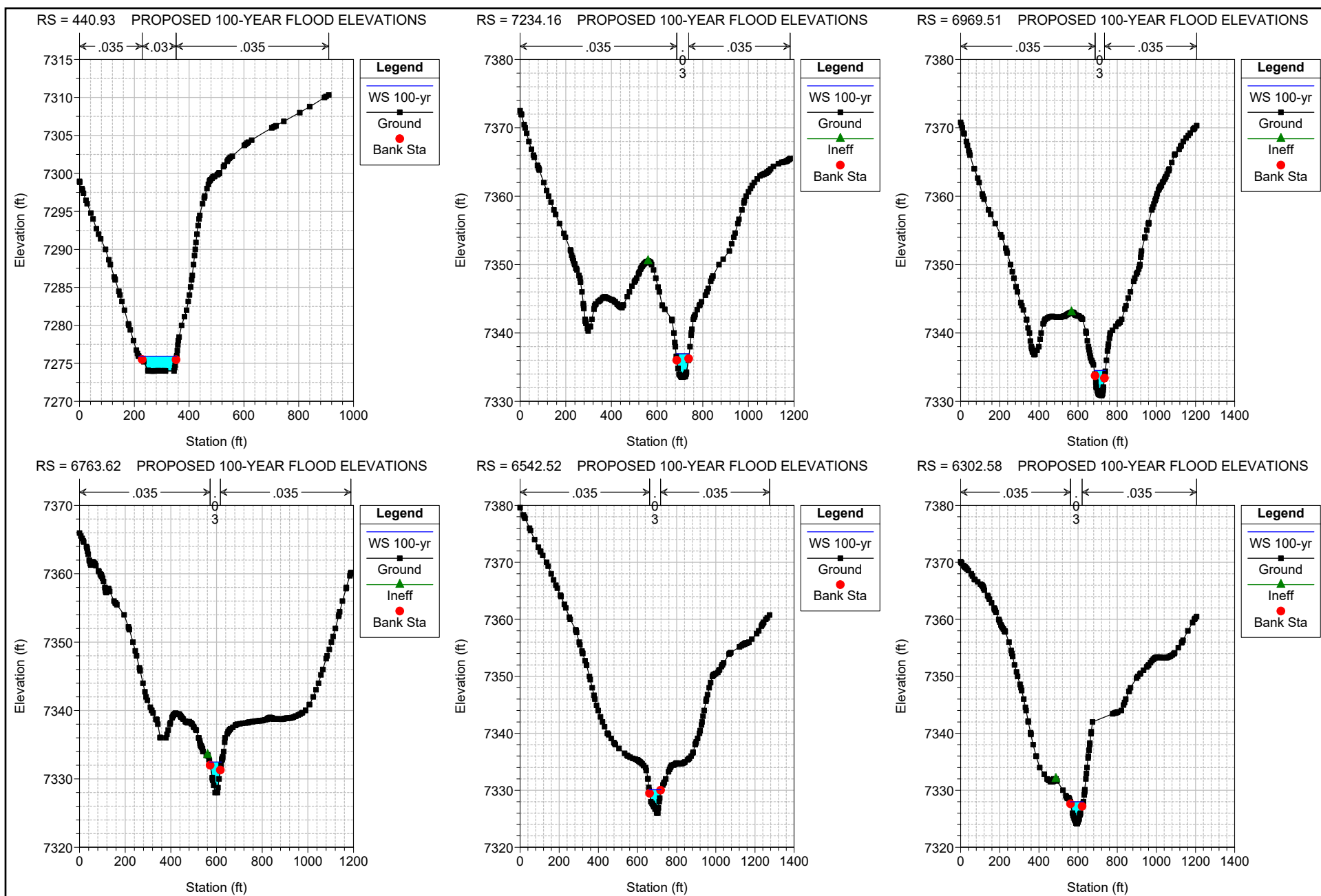
Alignment - (1) Alignment - (1)



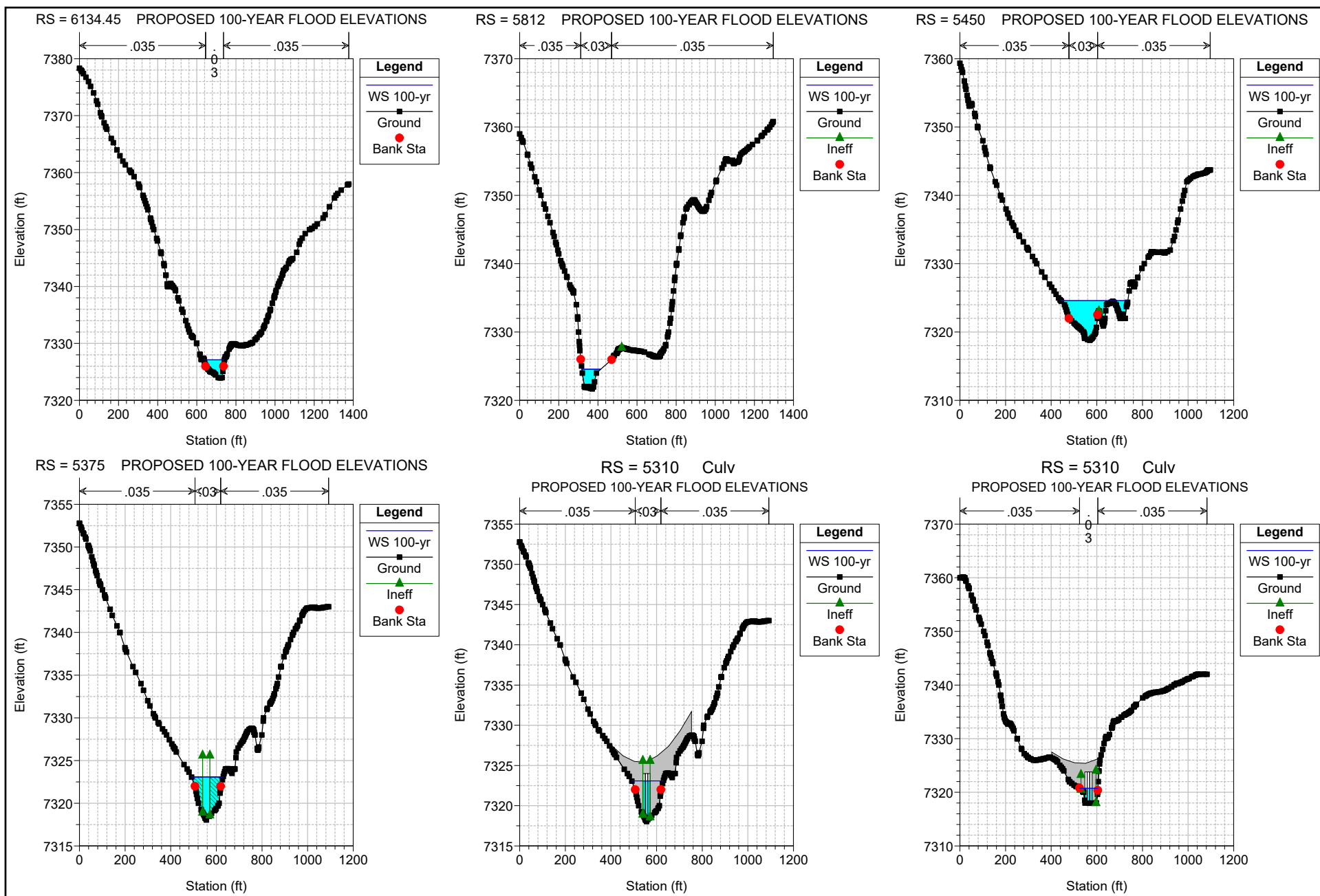


### **7.3 FLOODPLAIN CROSS SECTIONS**

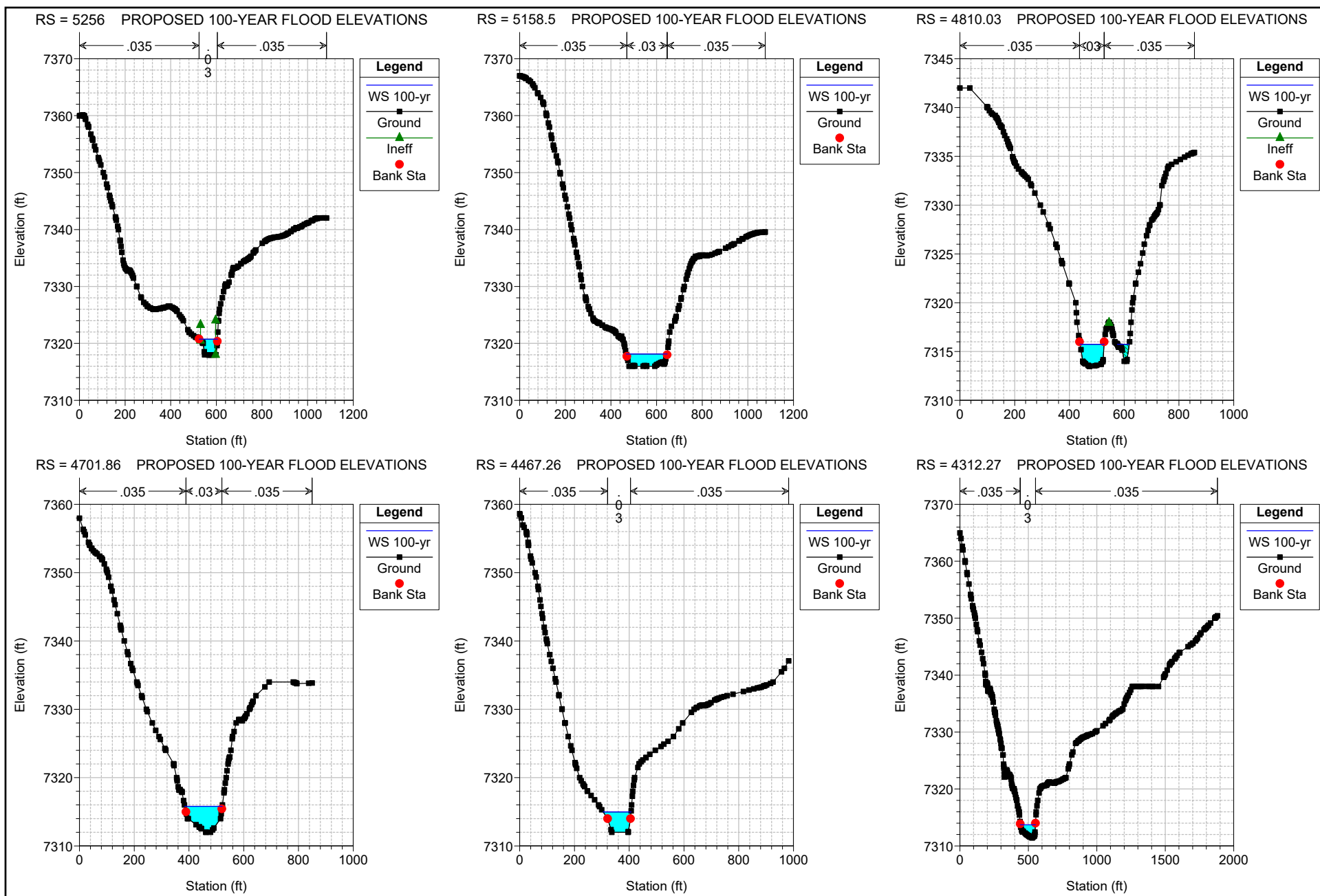




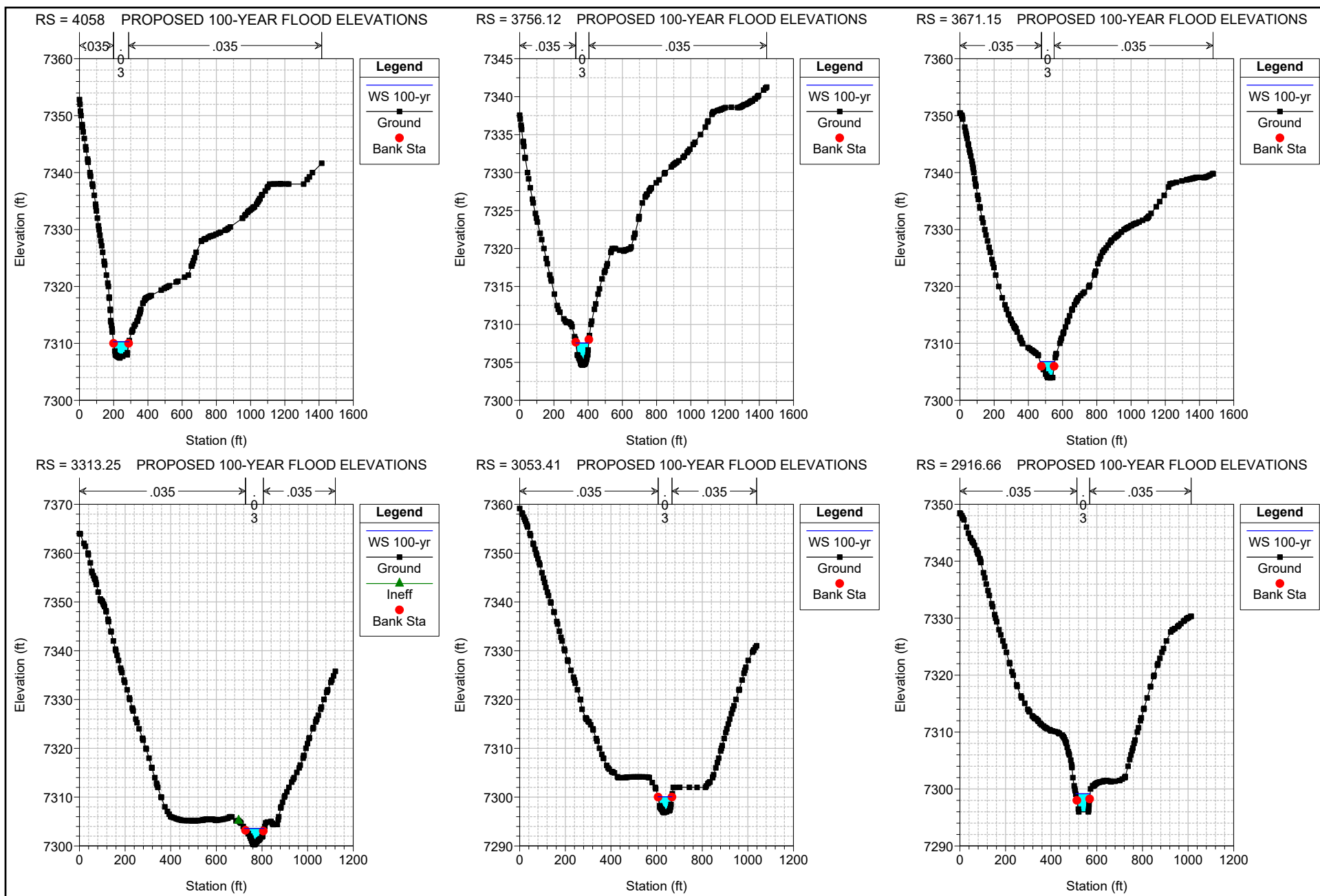




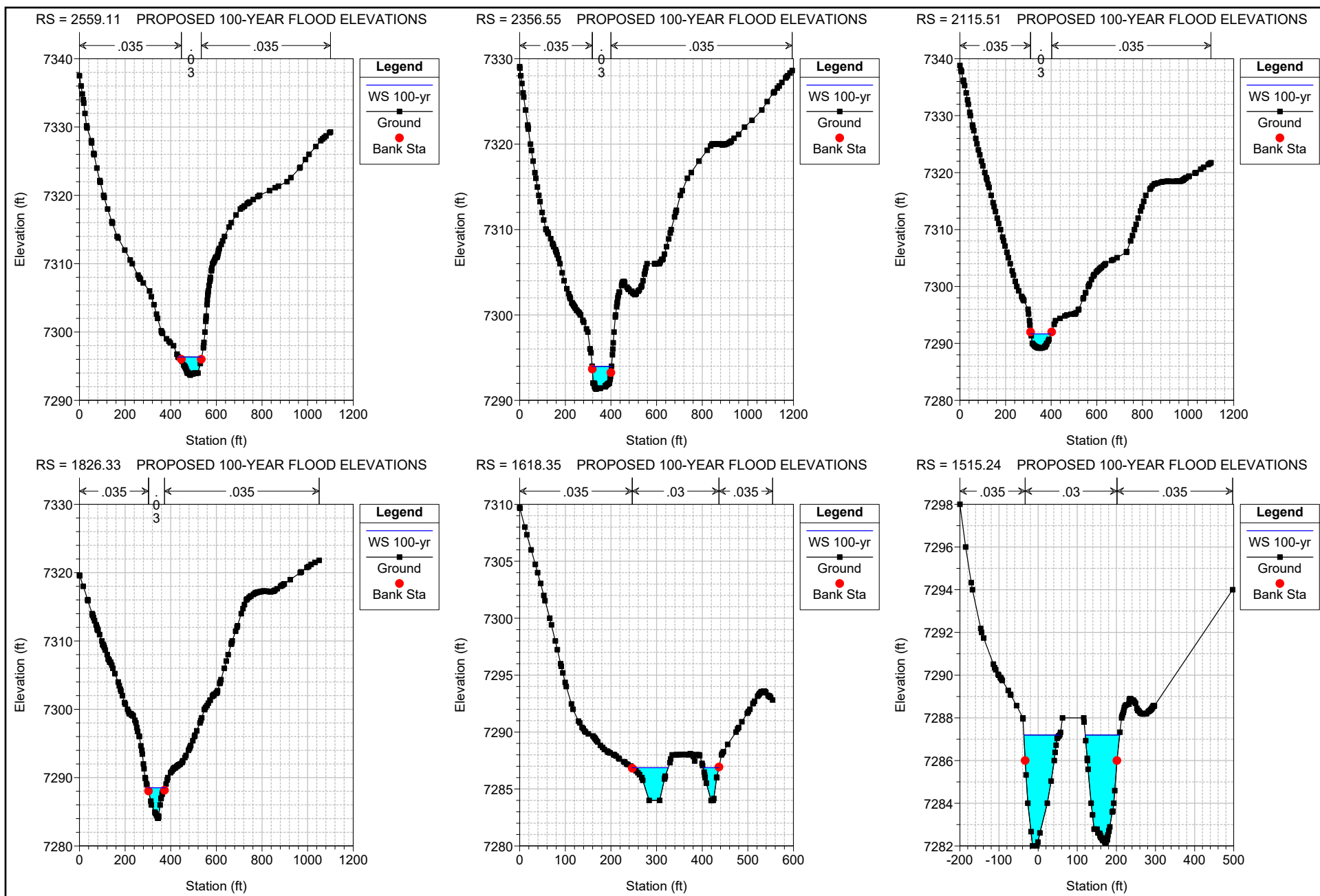




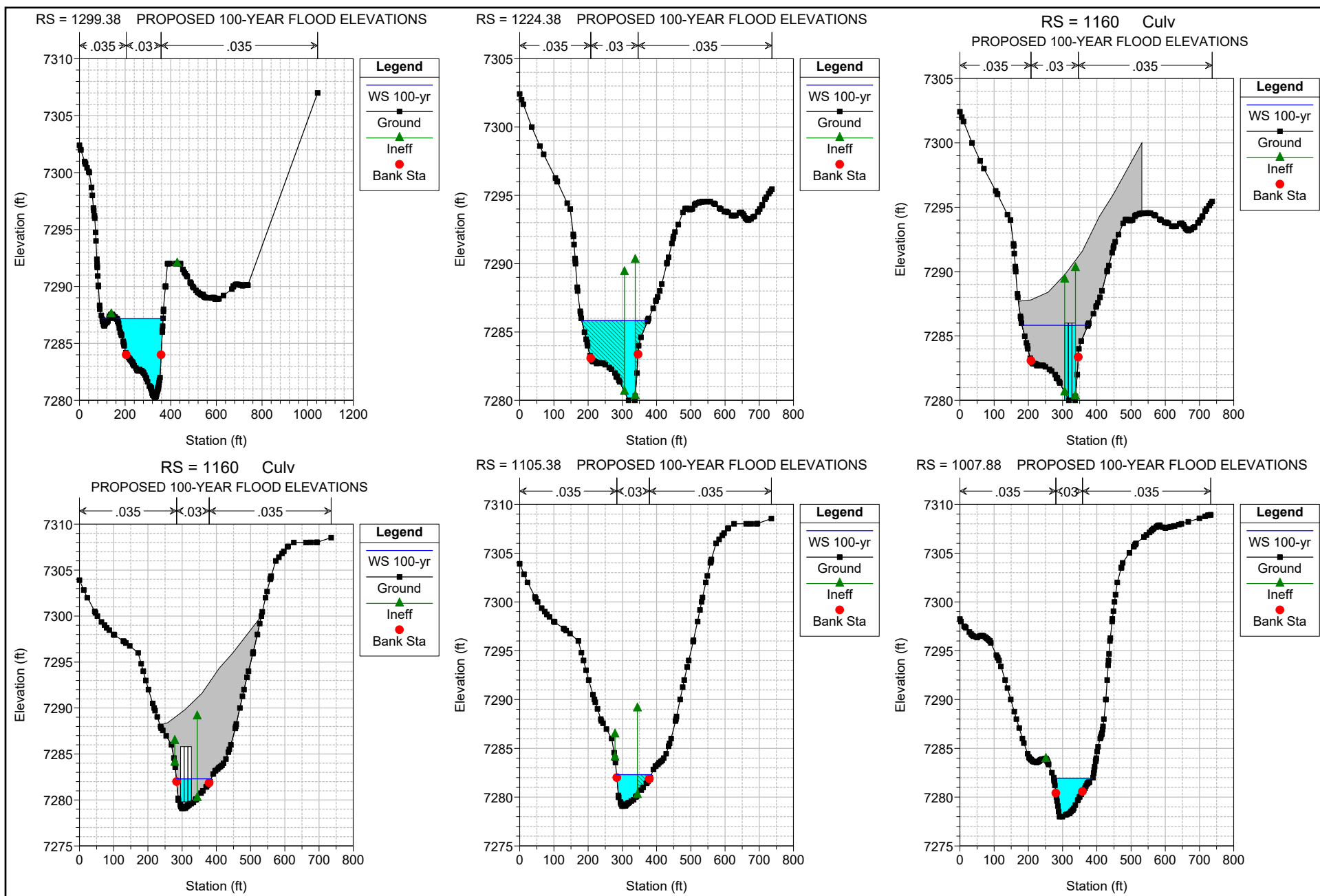






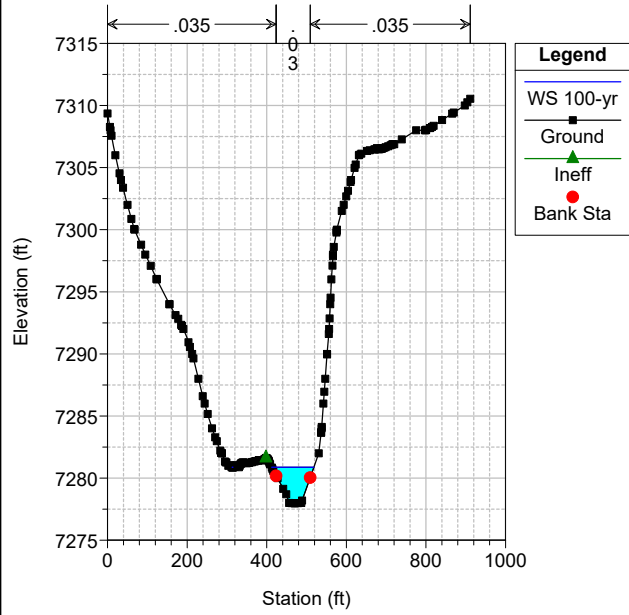




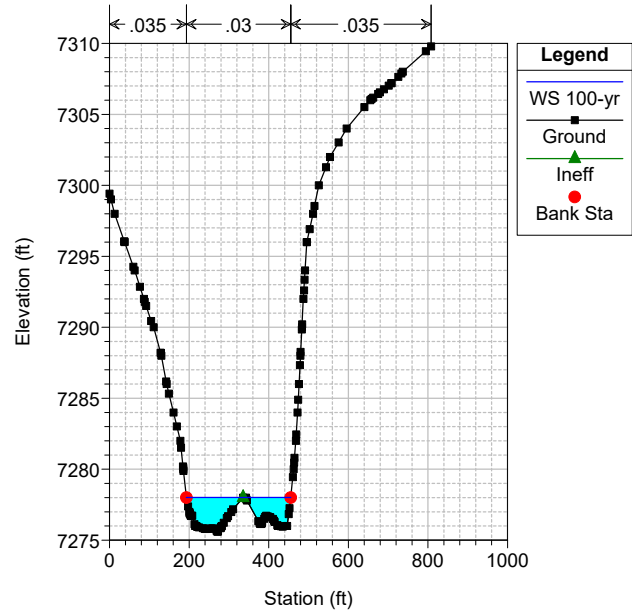




RS = 893.27 PROPOSED 100-YEAR FLOOD ELEVATIONS



RS = 678.43 PROPOSED 100-YEAR FLOOD ELEVATIONS





## **7.4 FIRM MAP**







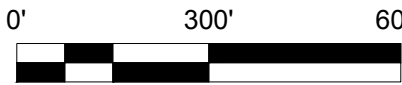
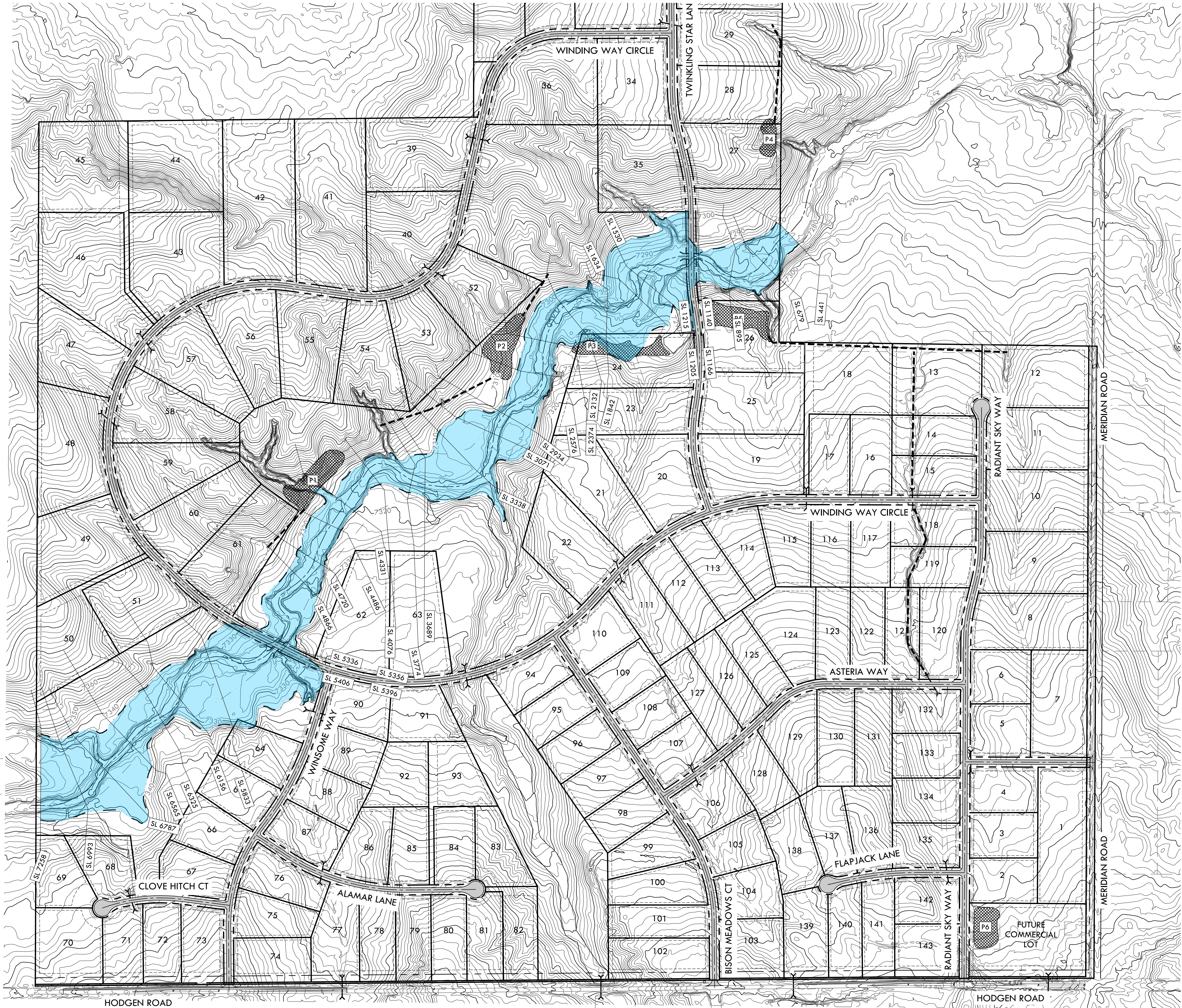
## **8.1 DAM FAILURE FLOODPLAIN EXHIBIT**



P:\Projects\49388\49388.dwg  
Wednesday, January 09, 2019 1:51:34 PM  
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DAM RISK ASSESSMENT  
WINSOME SUBDIVISION

A PARCEL OF PROPERTY LOCATED IN SECTIONS 13 & 24, TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH P.M. AND IN THE WEST HALF OF THE WEST HALF OF SECTION 19, TOWNSHIP 11 SOUTH, RANGE 64 WEST OF THE 6TH P.M., COUNTY OF EL PASO, STATE OF COLORADO



NO. REVISIONS	
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DATE: 1/4/19	1
DRAWN BY: JCP	
CHECKED BY: LPV	
JOB #: 49388	

9500 CFS DAM FAILURE FLOODPLAIN  
SITE: 17480 MERIDIAN ROAD  
ELBERT, COLORADO 80106  
FOR: PT MCCUNE, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

VERTEX®

2420 W. 26th Avenue, Suite 100-D | Denver, CO 80211  
Main: 303.623.9116 | VERTEXENG.COM

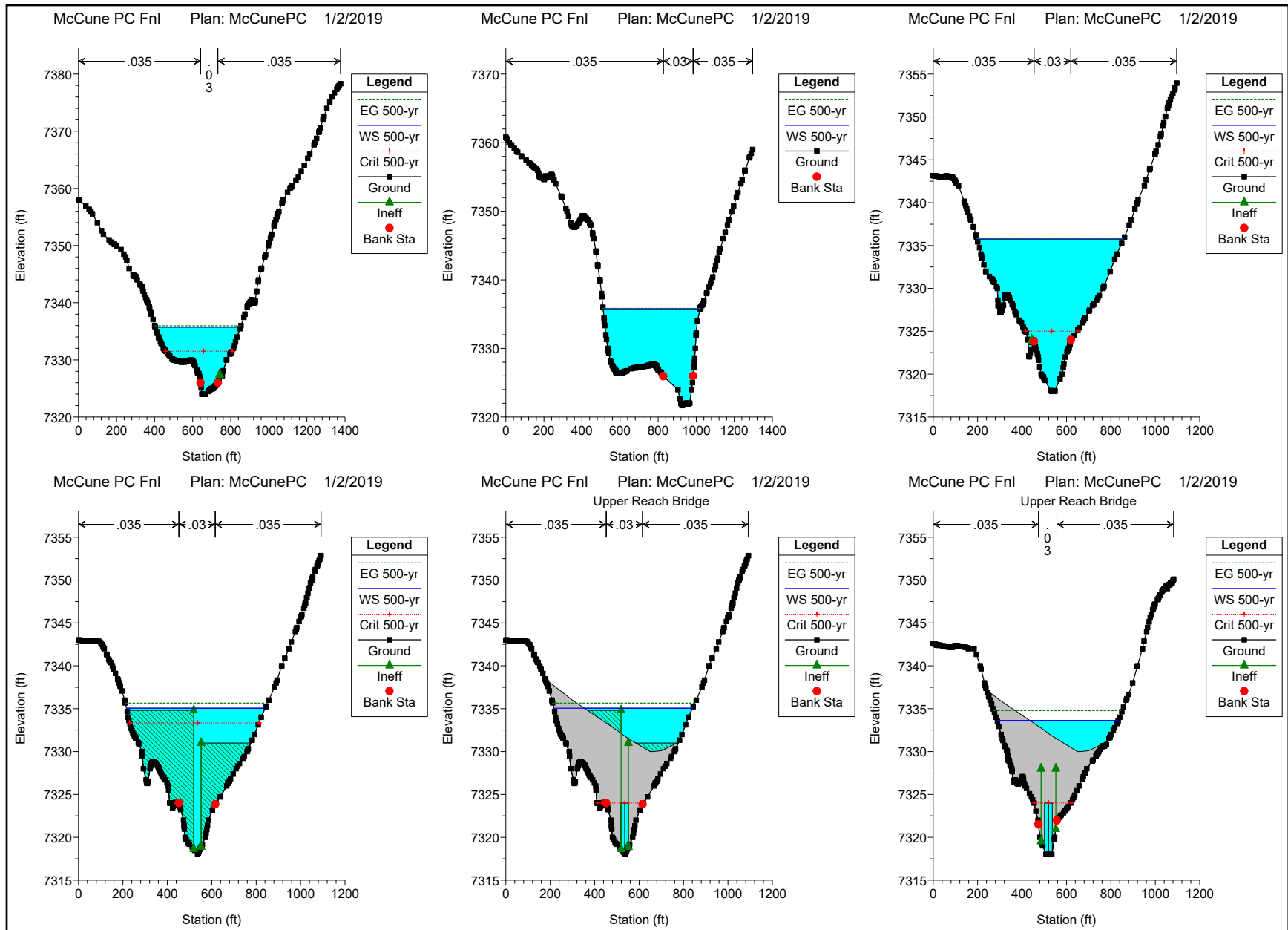


## **8.2 DAM FAILURE FLOODPLAIN SECTIONS**

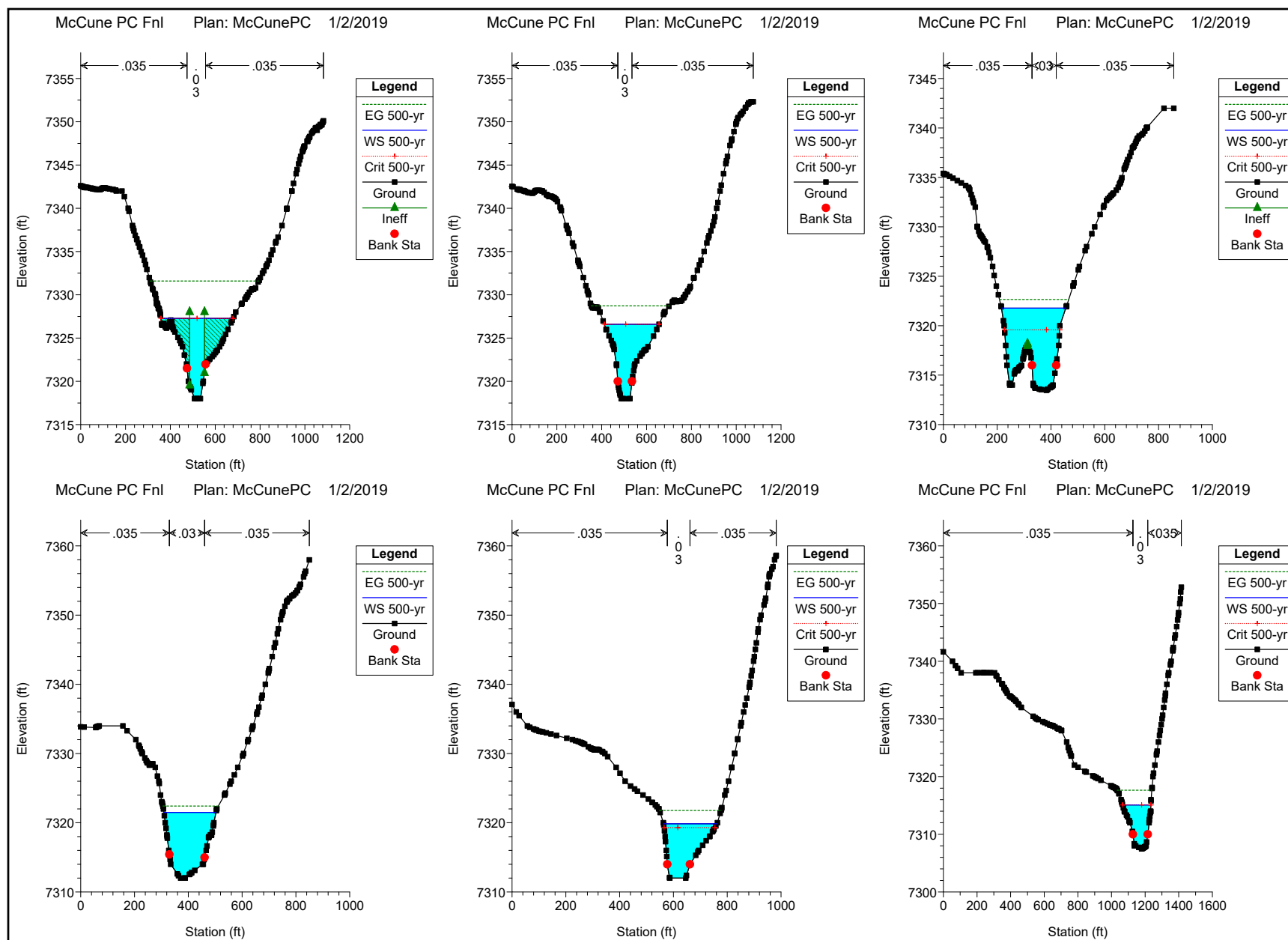


















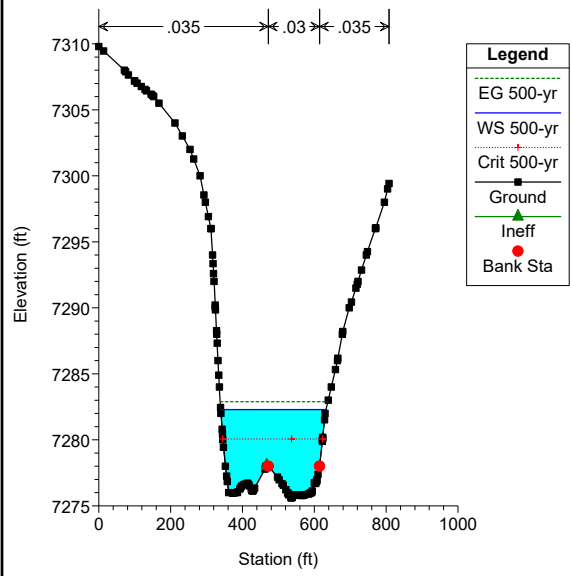




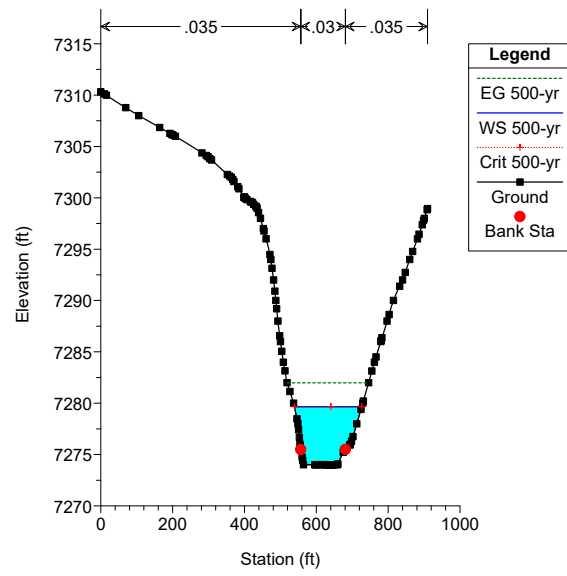




McCune PC Fnl Plan: McCunePC 1/2/2019



McCune PC Fnl Plan: McCunePC 1/2/2019





### **8.3 LETTER FROM COLORADO STATE DAM AUTHORITY**





**COLORADO**  
Division of Water Resources  
Department of Natural Resources

Dam Safety

Mr. Jason Priddy  
The Vertex Companies, Inc.  
2420 W. 26<sup>th</sup> Ave., Suite 100-D  
Denver, Colorado 80211  
[jpriddy@vertexeng.com](mailto:jpriddy@vertexeng.com)

When replying, please refer to:  
Kiowa Crk Wtrshd 1-N-10, DAMID 010318  
Kiowa Crk Wtrshd 1-P-10, DAMID 010319  
Kiowa Crk Wtrshd 1-P-20, DAMID 010320  
Water Division 1, Water District 01

January 22, 2019

**SUBJECT:** Winsome Subdivision - Planning Associated with Upstream Jurisdictional Dams

Dear Mr. Priddy:

I would like to start by thanking you for reaching out to me as part of your planning efforts for the Winsome Subdivision located in northeastern El Paso County, CO. The subject dams noted above are all currently registered as Low Hazard jurisdictional dams owned by the Kiowa Conservation District and are located just upstream of the planned Winsome Subdivision. Through coordination with this office, you completed hydraulic routing of a conservative peak dam breach discharge of 9,500 cfs through the planned development. This value was developed by this office in adherence to our *2010 Guidelines for Dam Breach Analysis* for the largest reservoir, 1-P-10. All three dams are situated on different drainages and do not cause cascading failure scenarios. There was concern that a failure of any one of the dams could both impact structures within the development and cause a hazard classification increase, requiring subsequent risk mitigation efforts by the dam owner.

This office has reviewed your floodplain analysis routing the peak dam break failure through the planned development. We understand that the modelling indicates the majority of the lots were not impacted at all by the peak breach. Your modelling indicates that corner of two lots (24 and 64) were within the wetted perimeter at depths less than 2 feet. To be conservative, you have chosen to place these portions of the two lots in "no-build" areas. We have reviewed the HEC-RAS model used to develop the hydraulic analysis and have no objections with the model assumptions and the slight alteration to the planned subdivision lot usage.

In conclusion, this office believes that your foresight in planning development at Winsome will retain Low Hazard classifications for the above-referenced dams. In other words, there is no risk posed by the dams to the structures of the planned development and the owner can continue to monitor and operate these in accordance with our requirements for Low Hazard dams.





Mr. Jason Priddy  
Winsome Subdivision - Dam Hazard Impact Review  
January 22, 2019  
Page 2 of 2

Please contact me if you have questions or comments regarding the information contained in the report or if you require assistance with any dam-safety related issues.

Sincerely,



John Hunyadi, P.E.  
Dam Safety Engineer

ec: Bill McCormick, Chief Dam Safety  
Gilbert LaForce, El Paso County, [gilbertlaforce@elpasoco.com](mailto:gilbertlaforce@elpasoco.com)  
Linda Pollick, NRCS, [linda.pollick@co.usda.gov](mailto:linda.pollick@co.usda.gov)  
Pam Brewster, Kiowa Conservation District, [pam.brewster@co.nacdnet.net](mailto:pam.brewster@co.nacdnet.net)





## **9.0 SITE PHOTOGRAPHS**

















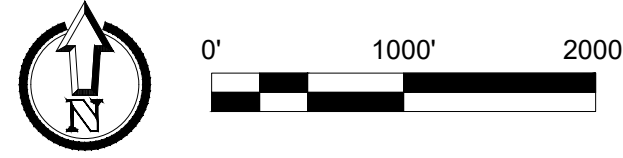






## **10.0 DRAINAGE PLANS**



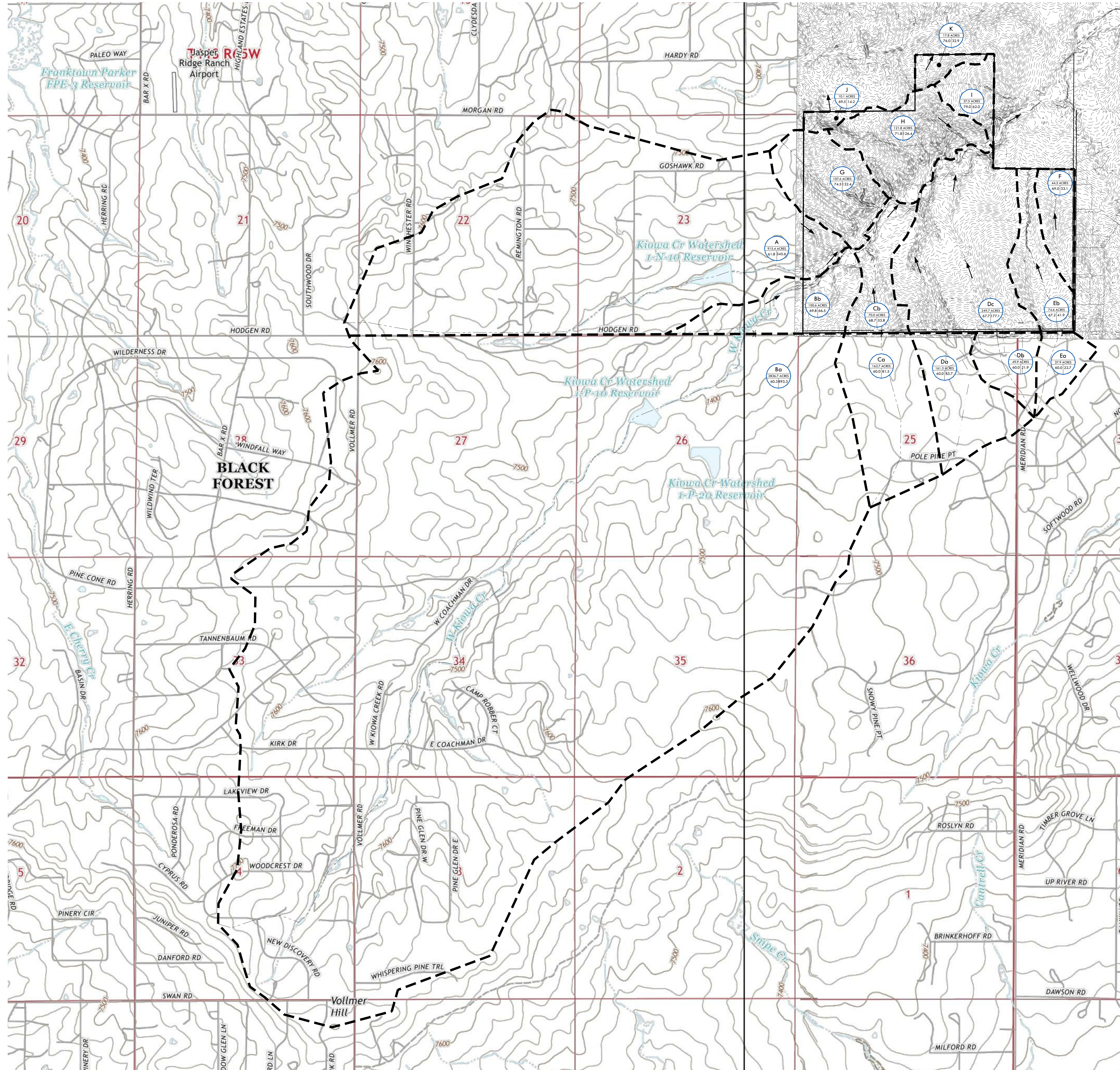
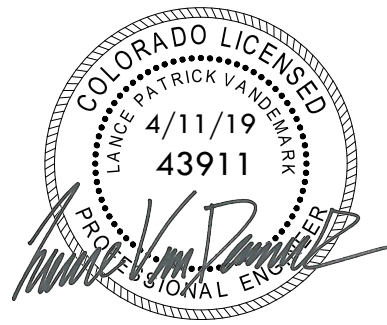


PRELIMINARY PLAN SET  
**WINSOME SUBDIVISION**

A PARCEL OF PROPERTY LOCATED IN SECTIONS 13 & 24, TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH P.M. AND IN THE WEST HALF OF THE WEST HALF OF SECTION 19, TOWNSHIP 11 SOUTH, RANGE 64 WEST OF THE 6TH P.M., COUNTY OF EL PASO, STATE OF COLORADO



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**EXISTING STORMWATER RUNOFF TABLE**

BASIN	BASIN AREA (ACRES)	T <sub>c</sub>	CURVE NUMBER	Q <sub>100</sub>
A	915.4	53:00	61.8	345.6
Ba	3836.7	1:29:33	60.3	893.3
Bb	100.6	40:00	69.8	66.5
Ca	162.7	37:12	60.0	81.5
Cb	70.0	37:25	68.7	53.8
Da	161.3	36:59	60.0	83.7
Db	49.9	44:12	60.0	21.9
Dc	249.7	40:56	67.7	177.1
Ea	37.9	30:30	60.0	22.7
Eb	74.6	38:15	67.2	41.9
F	44.5	37:43	69.0	33.1
G	107.6	33:55	74.5	132.4
H	121.8	33:39	71.8	126.4
I	37.5	31:48	79.0	62.0
J	10.1	22:55	69.5	14.2
K	17.8	24:06	76.0	32.9
	5998.1			

**LEGEND**

- PROPERTY BOUNDARY LINE
- EXISTING CONTOUR
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN FLOW PATH

- BASIN NAME
- DRAINAGE BASIN SIZE
- 100-YEAR RUNOFF
- CURVE NUMBER
- FLOW ARROWS

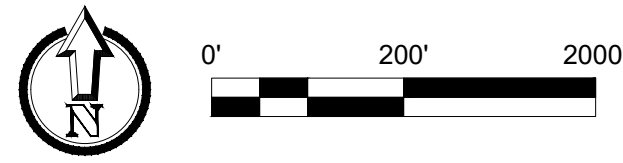
EXISTING DRAINAGE PLAN - OVERALL  
SITE: 17480 MERIDIAN ROAD  
ELBERT, COLORADO 80106  
FOR: PT MCCUNE, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

NO.	REVISIONS
1	1/11/19 PRELIMINARY RESUBMITTAL
2	3/8/19 PRELIMINARY RESUBMITTAL
3	4/11/19 PRELIMINARY RESUBMITTAL
4	
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DATE: 1/11/19  
DRAWN BY: JCP  
CHECKED BY: LPV  
JOB #: 49388

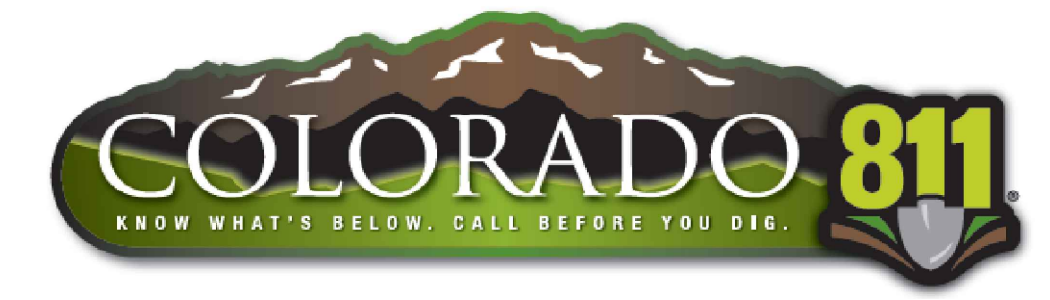
C1.1





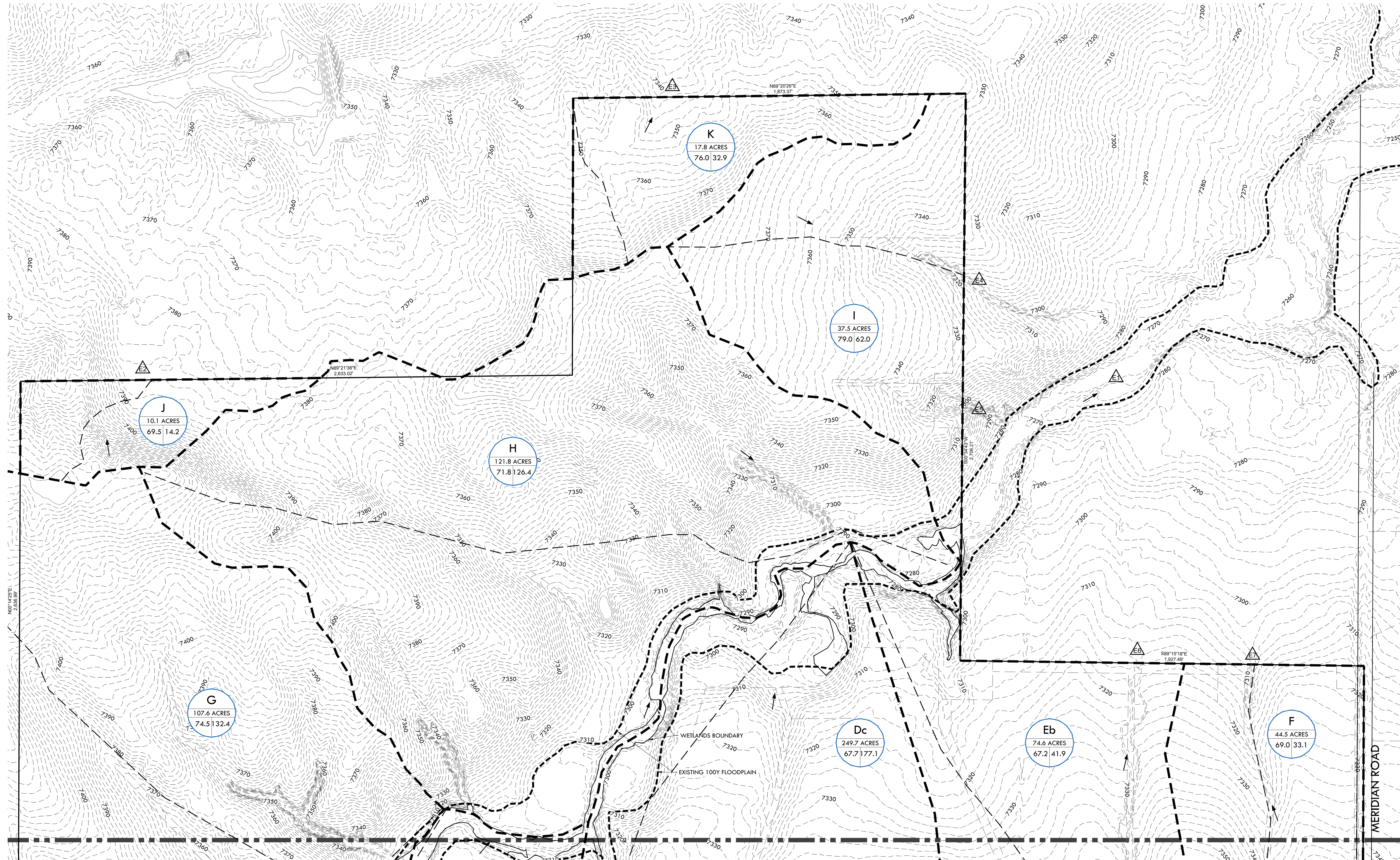
PRELIMINARY PLAN SET  
**WINSOME SUBDIVISION**

A PARCEL OF PROPERTY LOCATED IN SECTIONS 13 & 24, TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH P.M. AND IN THE WEST HALF OF THE WEST HALF OF SECTION 19, TOWNSHIP 11 SOUTH, RANGE 64 WEST OF THE 6TH P.M., COUNTY OF EL PASO, STATE OF COLORADO



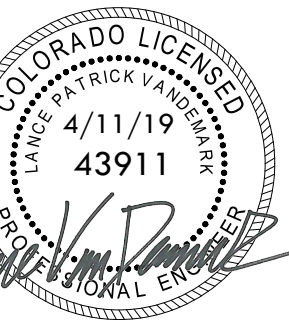
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- E2** OFFSITE FLOW Q5=2.5CFS Q100=13.4CFS
- E3** OFFSITE FLOW Q5=9.1CFS Q100=32.9CFS
- E4 + E5** OFFSITE FLOW Q5=17.6CFS Q100=62.0CFS
- E6** OFFSITE FLOW Q5=5.8CFS Q100=64.6CFS
- E7** OFFSITE FLOW Q5=3.8CFS Q100=33.1CFS

NOTES:  
1. EXISTING FLOODPLAIN AS SHOWN BASED ON FIRM MAP #08041C0350G PANEL 350 REVISED 12/7/2018, GENERATED BY GRAPHICAL OVERLAY.



MATCH LINE - SEE SHEET C1.3 - EXISTING DRAINAGE PLAN - SOUTH

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EXISTING DRAINAGE PLAN - NORTH  
SITE: 17480 MERIDIAN ROAD  
ELBERT, COLORADO 80106  
FOR: PT MCCUNE, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

NO.	REVISIONS
1	1/11/19 PRELIMINARY RESUBMITAL
2	3/8/19 PRELIMINARY RESUBMITAL
3	4/11/19 PRELIMINARY RESUBMITAL
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DRAWN BY: JCP  
CHECKED BY: LPV  
JOB #: 49388

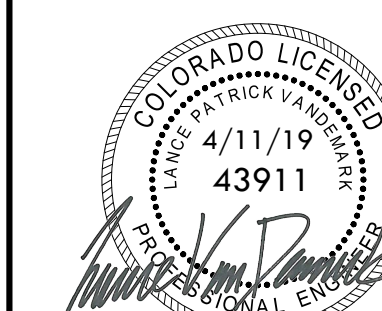
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PCD FILE NO SP-18-006





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MONUMENT, COLORADO 80132

DATE: 1/11/19	<b>C1.3</b>
DRAWN BY: JCP	
CHECKED BY: LPV	
JOB #: 49388	

Topographic map showing wetland boundaries, floodplains, and contour lines. The map includes labels for 'WETLANDS BOUNDARY', 'EXISTING 100Y FLOODPLAIN', and 'MERIDIAN ROAD'. Contour lines are marked with elevations such as 7300, 7320, 7340, 7360, 7380, 7400, 7420, 7440, 7460, 7480, 7500, 7520, 7540, 7560, 7580, 7600, 7620, 7640, 7660, 7680, 7700, 7720, 7740, 7760, 7780, 7800, 7820, 7840, 7860, 7880, 7900, 7920, 7940, 7960, 7980, 8000, 8020, 8040, 8060, 8080, 8100, 8120, 8140, 8160, 8180, 8200, 8220, 8240, 8260, 8280, 8300, 8320, 8340, 8360, 8380, 8400, 8420, 8440, 8460, 8480, 8500, 8520, 8540, 8560, 8580, 8600, 8620, 8640, 8660, 8680, 8700, 8720, 8740, 8760, 8780, 8800, 8820, 8840, 8860, 8880, 8900, 8920, 8940, 8960, 8980, 9000, 9020, 9040, 9060, 9080, 9100, 9120, 9140, 9160, 9180, 9200, 9220, 9240, 9260, 9280, 9300, 9320, 9340, 9360, 9380, 9400, 9420, 9440, 9460, 9480, 9500, 9520, 9540, 9560, 9580, 9600, 9620, 9640, 9660, 9680, 9700, 9720, 9740, 9760, 9780, 9800, 9820, 9840, 9860, 9880, 9900, 9920, 9940, 9960, 9980, 10000. The map also shows a series of wetland boundaries and floodplains. The sections are defined by dashed lines and are labeled with their respective acreages and coordinates.

Section	Area (Acres)	Coordinates
Ca	162.7	60.0 81.5
Cb	70.0	68.7 53.8
Da	161.3	60.0 83.7
Db	49.9	60.0 21.9
Ea	37.9	60.0 22.7
Dc	249.7	67.7 177.1
Eb	74.6	67.2 41.9
F	44.5	69.0 33.1

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PCD FILE NO. SP-18-006

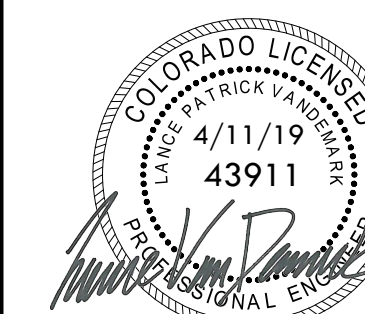




## DETENTION POND SUMMARY

POND NUMBER	PROPOSED VOLUME	FLOW EXITING POND
1	8.0 AC-FT	31.9 CFS
2	7.4 AC-FT	35.1 CFS
3	7.1 AC-FT	126.8 CFS
4	1.5 AC-FT	30.6 CFS
5	9.7 AC-FT	120.0 CFS
6	4.0 AC-FT	18.0 CFS

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ELBERT, COLORADO 80106

**FOR:** PT MCCUNE, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

NO.	REVISIONS
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2	3/8/19 PRELIMINARY RESUBMITTA
3	4/11/19 PRELIMINARY RESUBMITTA
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DRAWN BY: JO  
CHECKED BY: LF  
JOB #: 49388

C2.1

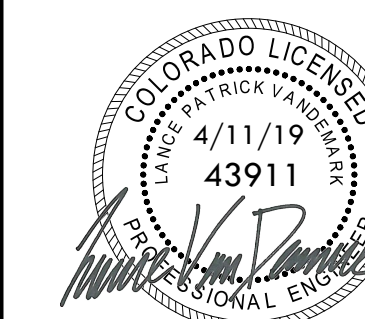
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PROPOSED DRAINAGE PLAN - NORTH

SITE: 17480 MERIDIAN ROAD  
ELBERT, COLORADO 80106









FOR: PT MCCUNE, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

NO.	REVISIONS
1	1/11/19 PRELIMINARY RESUBMITTAL
2	3/8/19 PRELIMINARY RESUBMITTAL
3	4/11/19 PRELIMINARY RESUBMITTAL
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DRAWN BY: J  
CHECKED BY: L  
JOB #: 49388

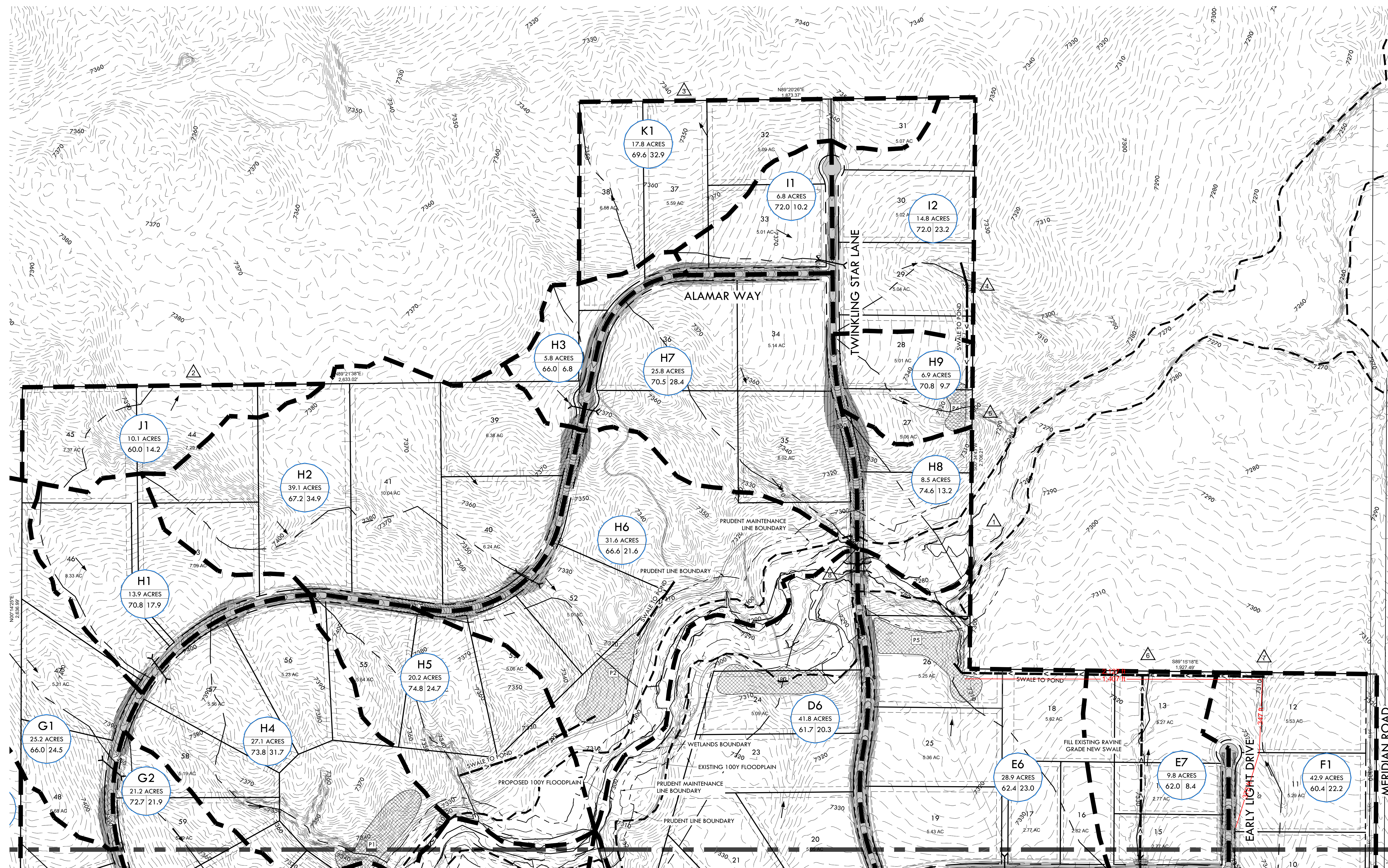
C2.2

6 JOB #: 49388

- |           |                                 |   |  |
|-----------|---------------------------------|---|--|
| <b>P1</b> | OUTFALL Q5=1.5CFS Q100=31.9CFS  |  | MAIN OUTFALL Q5=311.7CFS Q100=1587.9CFS  |
| <b>P2</b> | OUTFALL Q5=0.9CFS Q100=35.1CFS  |  | OFFSITE FLOW Q5=2.5CFS Q100=14.2CFS      |
| <b>P3</b> | OUTFALL Q5=1.4CFS Q100=126.8CFS |  | OFFSITE FLOW Q5=9.1CFS Q100=32.9CFS      |
| <b>P4</b> | OUTFALL Q5=1.3CFS Q100=30.6CFS  |  | OFFSITE FLOW DIRECTED TO POND P4         |
| <b>P5</b> | OUTFALL Q5=1.9CFS Q100=120.0CFS |  | P4 OUTFALL Q5=1.3CFS Q100=30.6CFS        |
| <b>P6</b> | OUTFALL Q5=0.7CFS Q100=18.0CFS  |  | OFFSITE FLOW DIRECTED TO POND P5         |
|           |                                 |  | OFFSITE FLOW DIRECTED TO POND P5         |
|           |                                 |  | BOX CULVERT 2 Q5=293.6CFS Q100=1492.8CFS |

NOTES:

1. EXISTING FLOODPLAIN AS SHOWN BASED ON FIRM MAP #08041C0350G  
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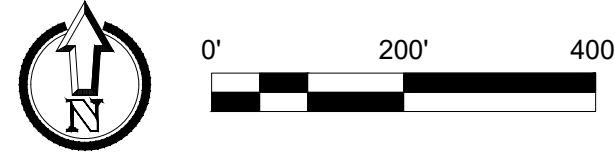


MATCH LINE - SEE SHEET C2.3 - PROPOSED DRAINAGE PLAN - SOUTH

PCD FILE NO SP-18-00

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Thursday, April 11, 2019 2:07:01 PM  
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# PRELIMINARY PLAN SET WINSOME SUBDIVISION

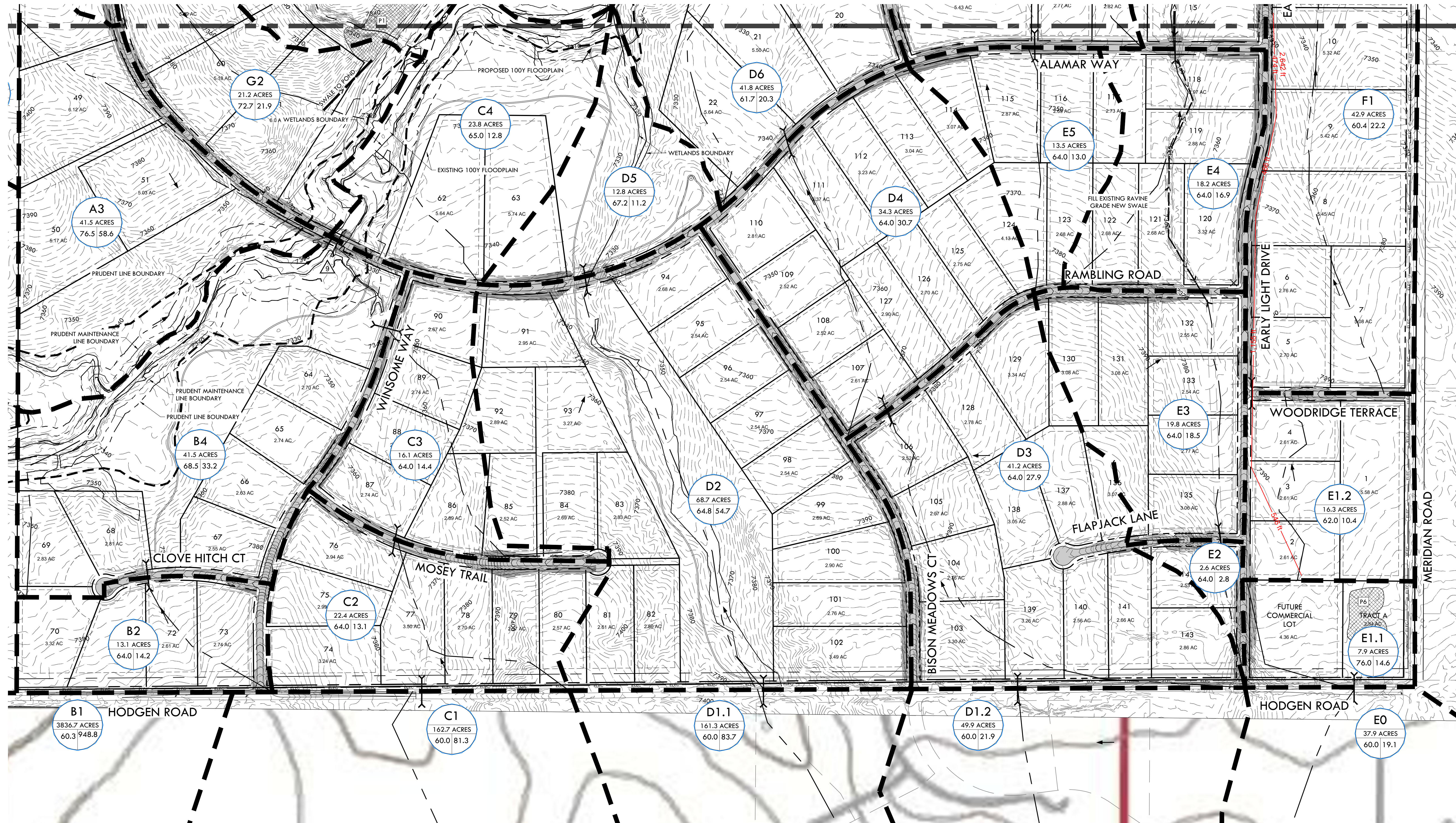
A PARCEL OF PROPERTY LOCATED IN SECTIONS 13 & 24, TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH P.M. AND IN THE WEST HALF OF THE WEST HALF OF SECTION 19, TOWNSHIP 11 SOUTH, RANGE 64 WEST OF THE 6TH P.M., COUNTY OF EL PASO, STATE OF COLORADO



- P1 OUTFALL Q5=1.5CFS Q100=31.9CFS  
P2 OUTFALL Q5=0.9CFS Q100=35.1CFS  
P3 OUTFALL Q5=1.4CFS Q100=126.8CFS  
P4 OUTFALL Q5=1.3CFS Q100=30.6CFS  
P5 OUTFALL Q5=1.9CFS Q100=120.0CFS  
P6 OUTFALL Q5=0.7CFS Q100=18.0CFS
- BOX CULVERT 1 Q5=254.9CFS Q100=1283.4CFS

NOTES:  
1. EXISTING FLOODPLAIN AS SHOWN BASED ON FIRM MAP #08041C0350G  
PANEL 350 REVISED 12/7/2018, GENERATED BY GRAPHICAL OVERLAY.

MATCH LINE - SEE SHEET C2.2 - PROPOSED DRAINAGE PLAN - NORTH



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PROPOSED DRAINAGE PLAN - SOUTH  
SITE: 17480 MERIDIAN ROAD  
ELBERT, COLORADO 80106  
FOR: PT MCCUNE, LLC  
1864 WOODMORE DR, SUITE 100  
MONUMENT, COLORADO 80132

NO.	REVISIONS
1	1/11/19 PRELIMINARY RESUBMITAL
2	3/8/19 PRELIMINARY RESUBMITAL
3	4/11/19 PRELIMINARY RESUBMITAL
4	
5	
6	
7	
8	
9	
10	

DATE: 1/11/19  
DRAWN BY: JCP  
CHECKED BY: LPV  
JOB #: 49388

**C2.3**

PCD FILE NO: SP-18-006