

# **PRELIMINARY DRAINAGE STUDY**

FOR

COTTONWOOD COMMONS  
250 N. SANDERSON AVENUE  
SAN JACINTO, CA 92545

Prepared For:  
J & T Management, Inc.  
139 Radio Road  
Corona, CA 92879

Prepared By:  
SALEM Engineering Group  
11650 Mission Park Drive, Suite 108  
Rancho Cucamonga, CA 91730

Project No: 3-716-0515

Date: September 5, 2017

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Appendix G – Existing Offsite Hydrology Calculations

Appendix H – Proposed Offsite Hydrology Calculations

## I. Project Information

The project is located on the northwest corner of Sanderson Avenue and Cottonwood Avenue in San Jacinto, California in the County of Riverside. The site is approximately 6.28 acres. Currently, the land is undeveloped. There are no existing storm drain systems in this area and the storm water sheetflows southwest and west. The proposed work is to develop a gas station, convenience store, carwash, four (4) fast food restaurants, and two (2) retail stores.

## II. Design Conditions

Civild Software was utilized to obtain the existing and proposed flow rate. The software is programmed to follow the standards of the Riverside County Flood Control and Water Conservation District Hydrology Manual. The analysis was conducted for 10- and 100- year, 1 hour storm events. The soil type was determined using the Web Soil Survey tool, Appendix B.

## III. Existing Onsite Information

The existing runoff along the east portion of the property, approximately 0.4 acres, confluence at a low point on North Sanderson Avenue. The remaining runoff discharges to the west onto an undeveloped neighboring property.

100 year – 1 hour

Basin Number	T <sub>c</sub> (min)	A (acres)	Q (CFS)
EX-1	23.3	5.97	8.67

The total existing flow rate is 8.67 CFS.

## IV. Proposed Onsite Information

Two underground infiltration tanks are proposed to capture the stormwater runoff. Proposed Hydrology Exhibit, Appendix D, illustrates the surface flow and the pipe network of the proposed site. Drain inlets are placed at multiple locations throughout the site to direct the runoff to the underground tanks.

100 year – 1 hour

Basin Number	T <sub>c</sub> (min)	A (acres)	Q (CFS)
PR-1	9.48	3.03	7.68
PR-2	5.85	0.56	1.90
PR-3	5.21	1.03	3.42
PR-4	5.61	1.35	4.74
Total			17.74

The total proposed flow rate is 18.63 CFS.

## V. Offsite Hydrology Study

The proposed site will be graded along the eastern and southern boundary in an effort to keep off-site runoff from entering the site. The analysis for off-site runoff was considered from the existing property line to the proposed property line. All other off-site runoff has not been changed or affected.

100 year - Existing

Basin Number	T <sub>c</sub> (min)	A (acres)	Q (CFS)
EX-2	15.4	0.40	0.74
EX-3	20.2	0.22	0.35
		Total	1.09

100 year - Proposed

Basin Number	T <sub>c</sub> (min)	A (acres)	Q (CFS)
PR-3	11.5	0.22	0.53
PR-4	10.8	0.40	0.99
		Total	1.52

## VI. Conclusion

There is a difference of 9.07 CFS between the onsite existing runoff and the proposed. The runoff will be retained onsite through the use of the underground infiltration tanks. The underground tanks A and B shall meet the minimum required flow rate of 8.16 CFS and 9.58 CFS, respectively. Because no surface runoff will be directed onto neighboring lots or to the street, the hydraulic conditions of concern have been met. The post development off-site flow accounts for 0.43 CFS difference from existing conditions. The increase is due to the addition of sidewalks, which reduces the pervious area. The off-site stormwater will be directed to off-site stormwater conveyance facilities. The proposal for underground infiltration vaults will reduce the runoff to neighboring sites and public right-of-way to 0 CFS.



## VII. Declaration of Responsible Charge

I, hereby declare that I am the Engineer of Work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the City of San Jacinto is confined to a review only and does not relieve me, as Engineer of Work of my responsibility for project design.

### ENGINEER OF WORK:

SALEM ENGINEERING GROUP, INC.  
11650 Mission Park Drive, Suite 108  
Rancho Cucamonga, CA 91730

---

Name  
RCE

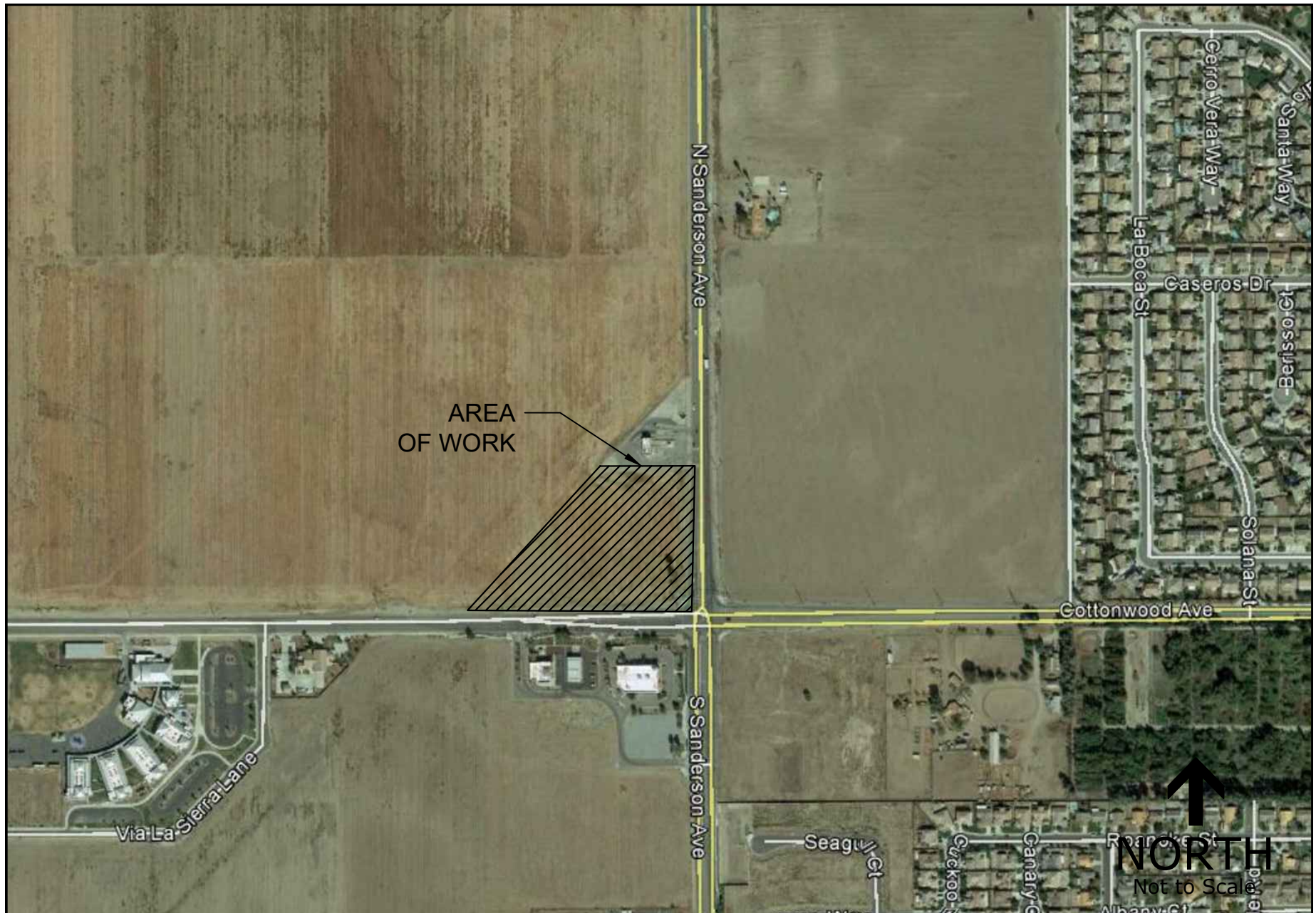
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Date

(STAMP)

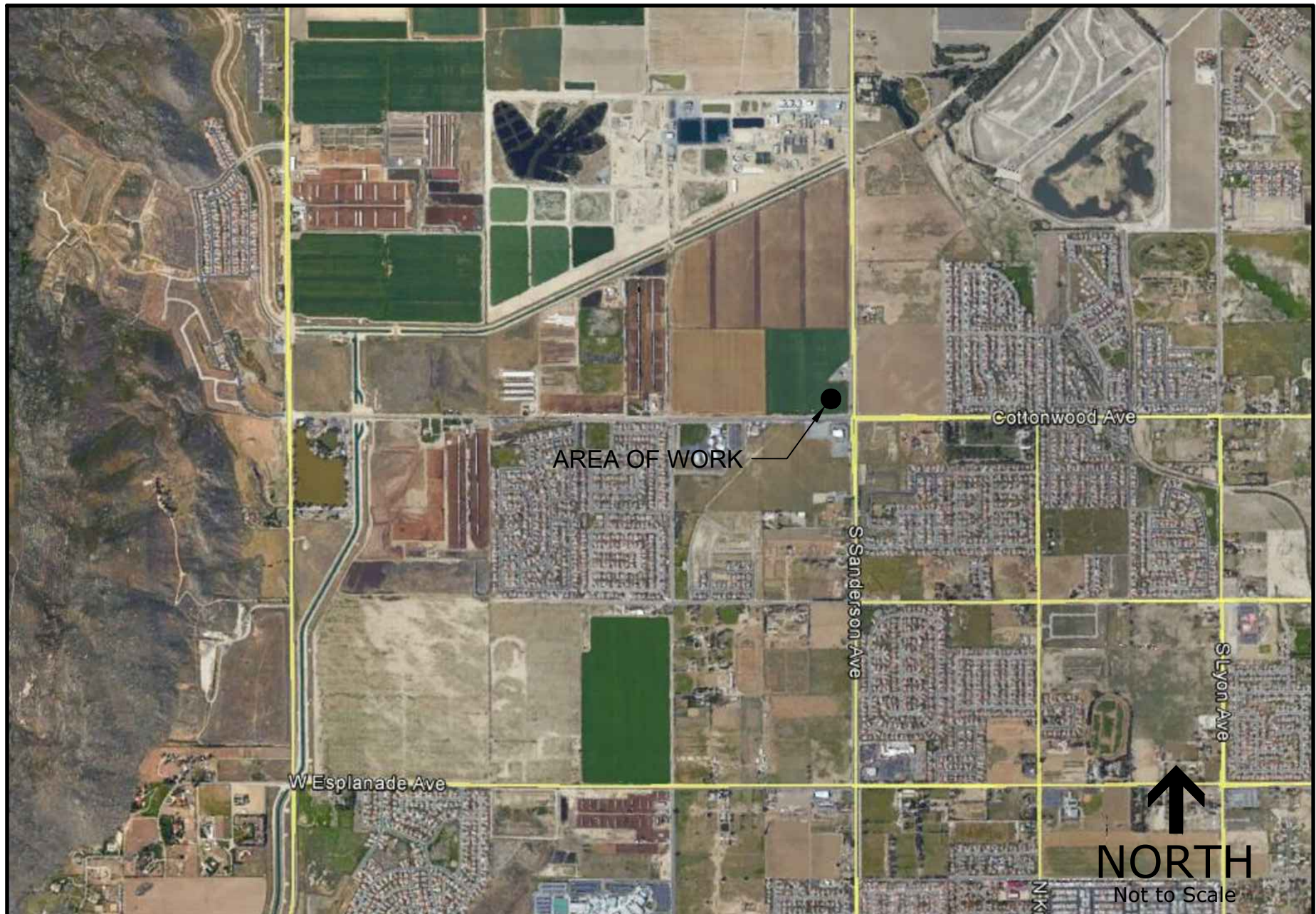
# A






VICINITY MAP	SCALE: NTS	DATE: MAR. 2017		<b>SALEM</b> engineering group, inc.
COTTONWOOD COMMONS NWC N. SANDERSON AVE & COTTOWOOD AVE.	DRAWN BY: KL	APPROVED BY: LCD		
SAN JACINTO, CALIFORNIA	PROJECT NO. 03-716-0725	FIGURE NO. 1A		





LOCATION MAP	SCALE: NTS	DATE: MAR. 2017	 <b>SALEM</b> engineering group, inc.
COTTONWOOD COMMONS NWC N. SANDERSON AVE & COTTOWOOD AVE. SAN JACINTO, CALIFORNIA	DRAWN BY: KL	APPROVED BY: LCD	
	PROJECT NO. 03-716-0725	FIGURE NO. 1B	

APPENDIX

# B





# Hydrologic Soil Group—Western Riverside Area, California



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





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

#### Soil Rating Lines

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

#### Soil Rating Points






 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Western Riverside Area, California  
 Survey Area Data: Version 9, Sep 12, 2016

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

Date(s) aerial images were photographed: May 25, 2010—Feb 4, 2015

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

Hydrologic Soil Group— Summary by Map Unit — Western Riverside Area, California (CA679)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
GoB	Grangeville loamy fine sand, drained, 0 to 5 percent slopes	A/D	6.3	97.2%
Tr2	Traver loamy fine sand, saline-alkali, eroded	B	0.2	2.8%
<b>Totals for Area of Interest</b>			<b>6.5</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.



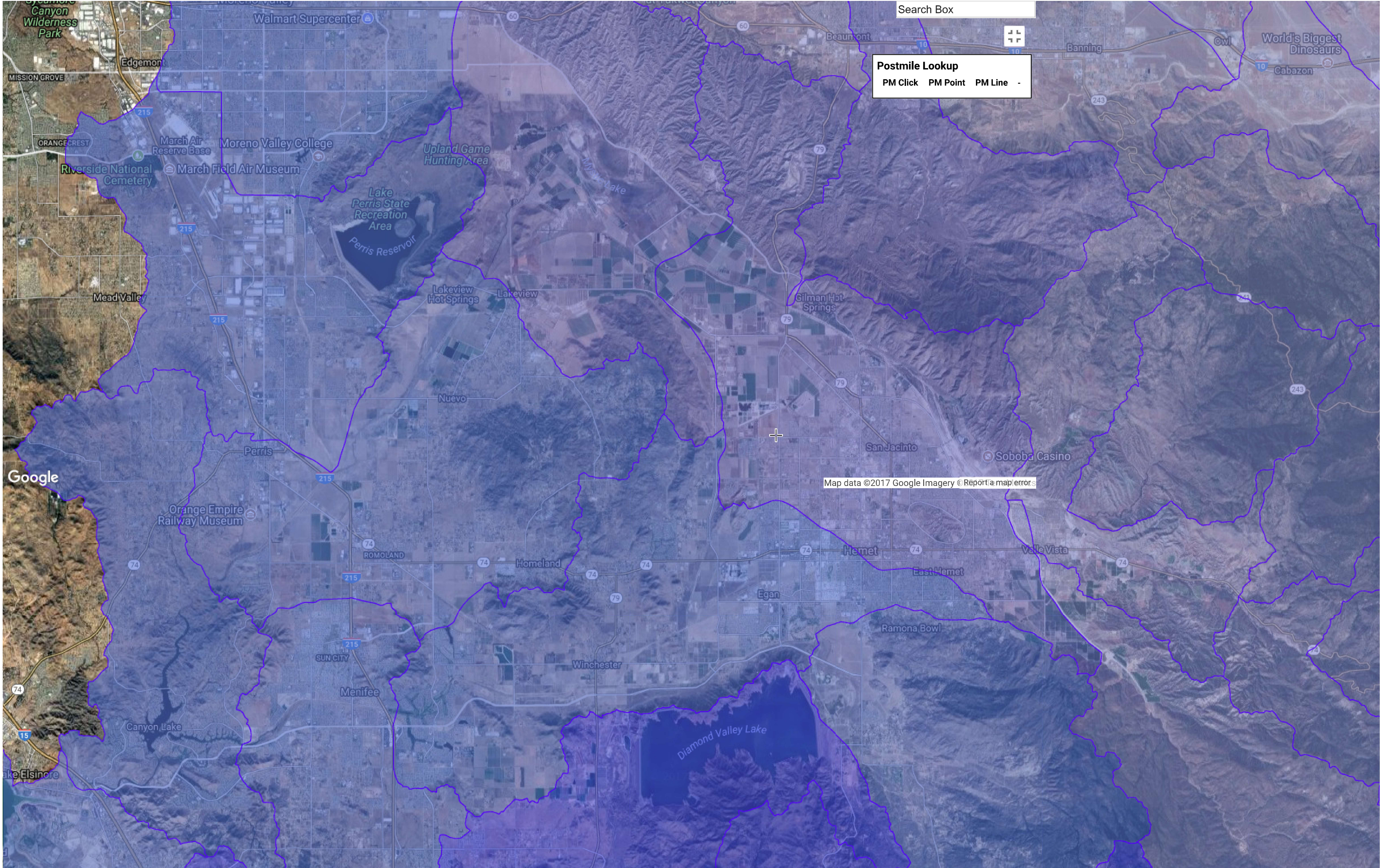
## Rating Options

*Aggregation Method:* Dominant Condition

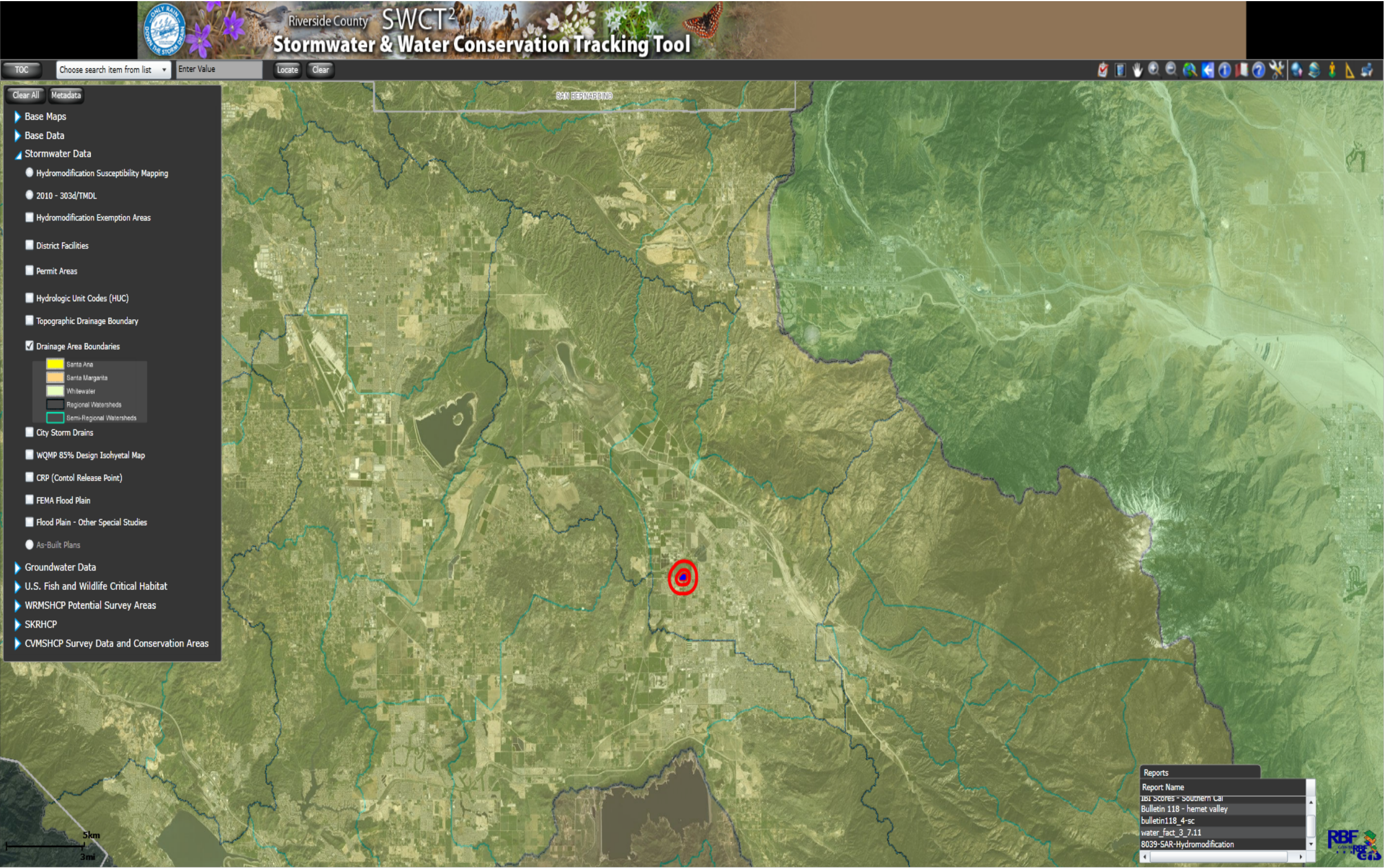
*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher









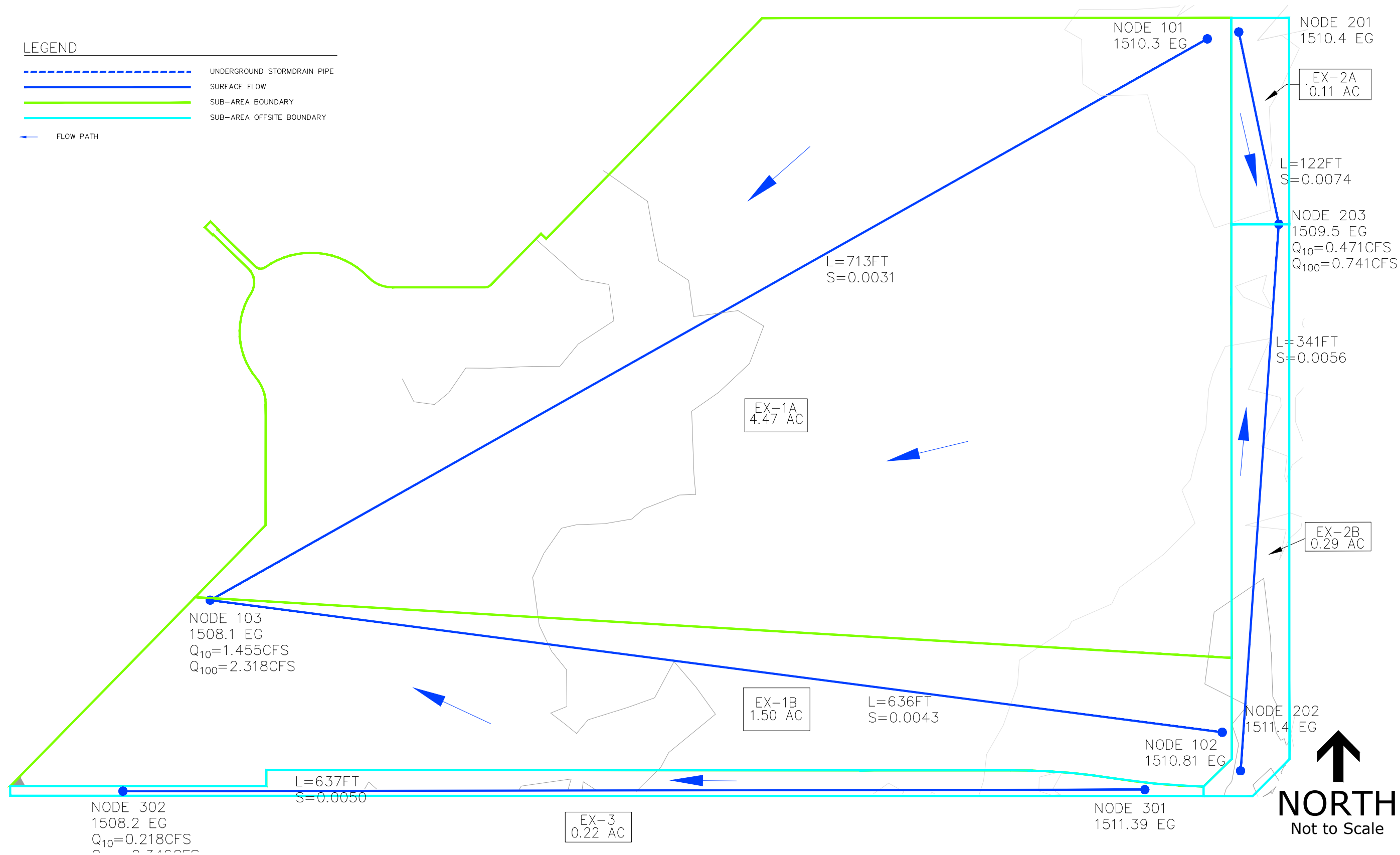


# C



LEGEND

- UNDERGROUND STORMDRAIN PIPE
- SURFACE FLOW
- SUB-AREA BOUNDARY
- SUB-AREA OFFSITE BOUNDARY
- ← FLOW PATH



EXISTING HYDROLOGY EXHIBIT

COTTONWOOD COMMONS DEVELOPMENT  
NWC OF SANDERSON AND COTTONWOOD AVENUES  
SAN JACINTO, CA 92582

PROJECT NO.  
3-716-0515

FIGURE NO.  
1

DRAWN BY:  
GQ

APPROVED BY:  
FVM

DATE:  
AUG. 2017

SCALE:  
1"=60'



**SALEM**  
engineering group, inc.

APPENDIX

D





# E





Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 10/26/17 File:COTTONWOODEX1.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++

Process from Point/Station 101.000 to Point/Station 103.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 713.000(Ft.)

Top (of initial area) elevation = 1510.300(Ft.)

Bottom (of initial area) elevation = 1508.100(Ft.)

Difference in elevation = 2.200(Ft.)

Slope = 0.00309 s(percent)= 0.31

TC =  $k(0.530)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$

Initial area time of concentration = 23.316 min.

Rainfall intensity = 1.299(In/Hr) for a 10.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.698

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 4.054(CFS)  
Total initial stream area = 4.470(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 101.000 to Point/Station 103.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 4.470(Ac.)  
Runoff from this stream = 4.054(CFS)  
Time of concentration = 23.32 min.  
Rainfall intensity = 1.299(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 102.000 to Point/Station 103.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 636.000(Ft.)  
Top (of initial area) elevation = 1510.810(Ft.)  
Bottom (of initial area) elevation = 1508.100(Ft.)  
Difference in elevation = 2.710(Ft.)  
Slope = 0.00426 s(percent)= 0.43  
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 20.881 min.  
Rainfall intensity = 1.373(In/Hr) for a 10.0 year storm  
UNDEVELOPED (poor cover) subarea  
Runoff Coefficient = 0.706  
Decimal fraction soil group A = 0.486  
Decimal fraction soil group B = 0.028  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.486  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 1.455(CFS)  
Total initial stream area = 1.500(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 102.000 to Point/Station 103.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 1.500(Ac.)

Runoff from this stream = 1.455(CFS)

Time of concentration = 20.88 min.

Rainfall intensity = 1.373(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	4.054	23.32	1.299
2	1.455	20.88	1.373

Largest stream flow has longer time of concentration

$Q_p = 4.054 + \text{sum of}$

$Q_b \quad I_a/I_b$

$1.455 * 0.946 = 1.377$

$Q_p = 5.431$

Total of 2 main streams to confluence:

Flow rates before confluence point:

4.054      1.455

Area of streams before confluence:

4.470      1.500

Results of confluence:

Total flow rate = 5.431(CFS)

Time of concentration = 23.316 min.

Effective stream area after confluence = 5.970(Ac.)

End of computations, total study area = 5.97 (Ac.)

The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 1.000

Area averaged RI index number = 78.0

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 10/26/17 File:COTTONWOODEX1.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++

Process from Point/Station 101.000 to Point/Station 103.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 713.000(Ft.)

Top (of initial area) elevation = 1510.300(Ft.)

Bottom (of initial area) elevation = 1508.100(Ft.)

Difference in elevation = 2.200(Ft.)

Slope = 0.00309 s(percent)= 0.31

$TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 23.316 min.

Rainfall intensity = 1.925(In/Hr) for a 100.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.753

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 6.479(CFS)  
Total initial stream area = 4.470(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 101.000 to Point/Station 103.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

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The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 4.470(Ac.)  
Runoff from this stream = 6.479(CFS)  
Time of concentration = 23.32 min.  
Rainfall intensity = 1.925(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 102.000 to Point/Station 103.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 636.000(Ft.)  
Top (of initial area) elevation = 1510.810(Ft.)  
Bottom (of initial area) elevation = 1508.100(Ft.)  
Difference in elevation = 2.710(Ft.)  
Slope = 0.00426 s(percent)= 0.43  
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 20.881 min.  
Rainfall intensity = 2.034(In/Hr) for a 100.0 year storm  
UNDEVELOPED (poor cover) subarea  
Runoff Coefficient = 0.760  
Decimal fraction soil group A = 0.486  
Decimal fraction soil group B = 0.028  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.486  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 2.318(CFS)  
Total initial stream area = 1.500(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 102.000 to Point/Station 103.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 1.500(Ac.)

Runoff from this stream = 2.318(CFS)

Time of concentration = 20.88 min.

Rainfall intensity = 2.034(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	6.479	23.32	1.925
2	2.318	20.88	2.034

Largest stream flow has longer time of concentration

$$Q_p = 6.479 + \text{sum of } Q_b \text{ } I_a/I_b$$
$$2.318 * 0.946 = 2.193$$

$$Q_p = 8.672$$

Total of 2 main streams to confluence:

Flow rates before confluence point:

$$6.479 \quad 2.318$$

Area of streams before confluence:

$$4.470 \quad 1.500$$

Results of confluence:

Total flow rate = 8.672(CFS)

Time of concentration = 23.316 min.

Effective stream area after confluence = 5.970(Ac.)

End of computations, total study area = 5.97 (Ac.)

The following figures may be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 1.000

Area averaged RI index number = 78.0

APPENDIX

F



Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 11/06/17 File:COTTONWOODPR1.out

-----  
COTTONWOODPR1

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\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

-----  
Program License Serial Number 6390

-----  
Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++

Process from Point/Station 101.000 to Point/Station 102.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

-----  
Initial area flow distance = 230.000(Ft.)

Top (of initial area) elevation = 1509.640(Ft.)

Bottom (of initial area) elevation = 1508.300(Ft.)

Difference in elevation = 1.340(Ft.)

Slope = 0.00583 s(percent)= 0.58



$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
 Initial area time of concentration = 7.392 min.  
 Rainfall intensity = 2.308(In/Hr) for a 10.0 year storm  
 COMMERCIAL subarea type  
 Runoff Coefficient = 0.870  
 Decimal fraction soil group A = 0.486  
 Decimal fraction soil group B = 0.028  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.486  
 RI index for soil(AMC 2) = 53.57  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 1.245(CFS)  
 Total initial stream area = 0.620(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 102.000 to Point/Station 104.000  
 \*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1504.300(Ft.)  
 Downstream point/station elevation = 1504.030(Ft.)  
 Pipe length = 55.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 1.245(CFS)  
 Nearest computed pipe diameter = 12.00(In.)  
 Calculated individual pipe flow = 1.245(CFS)  
 Normal flow depth in pipe = 5.99(In.)  
 Flow top width inside pipe = 12.00(In.)  
 Critical Depth = 5.65(In.)  
 Pipe flow velocity = 3.18(Ft/s)  
 Travel time through pipe = 0.29 min.  
 Time of concentration (TC) = 7.68 min.

++++++  
 Process from Point/Station 102.000 to Point/Station 104.000  
 \*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:  
 In Main Stream number: 1  
 Stream flow area = 0.620(Ac.)  
 Runoff from this stream = 1.245(CFS)  
 Time of concentration = 7.68 min.  
 Rainfall intensity = 2.264(In/Hr)  
 Program is now starting with Main Stream No. 2

++++++  
 Process from Point/Station 103.000 to Point/Station 104.000  
 \*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 311.000(Ft.)  
 Top (of initial area) elevation = 1510.540(Ft.)  
 Bottom (of initial area) elevation = 1508.080(Ft.)  
 Difference in elevation = 2.460(Ft.)  
 Slope = 0.00791 s(percent)= 0.79  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
 Initial area time of concentration = 7.845 min.  
 Rainfall intensity = 2.240(In/Hr) for a 10.0 year storm  
 COMMERCIAL subarea type  
 Runoff Coefficient = 0.869  
 Decimal fraction soil group A = 0.500  
 Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 2) = 53.50  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 0.993(CFS)  
 Total initial stream area = 0.510(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 103.000 to Point/Station 104.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.510(Ac.)  
 Runoff from this stream = 0.993(CFS)  
 Time of concentration = 7.84 min.  
 Rainfall intensity = 2.240(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	1.245	7.68	2.264
2	0.993	7.84	2.240

Largest stream flow has longer or shorter time of concentration

$Q_p = 1.245 + \text{sum of}$   
 $\quad Q_a \quad T_b/T_a$   
 $\quad 0.993 * 0.979 = 0.972$   
 $Q_p = 2.217$

Total of 2 main streams to confluence:

Flow rates before confluence point:

1.245    0.993

Area of streams before confluence:

0.620    0.510

Results of confluence:

Total flow rate = 2.217(CFS)

Time of concentration = 7.680 min.

Effective stream area after confluence = 1.130(Ac.)

+++++  
Process from Point/Station 104.000 to Point/Station 106.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.030(Ft.)  
Downstream point/station elevation = 1503.650(Ft.)  
Pipe length = 76.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 2.217(CFS)  
Nearest computed pipe diameter = 12.00(In.)  
Calculated individual pipe flow = 2.217(CFS)  
Normal flow depth in pipe = 8.74(In.)  
Flow top width inside pipe = 10.67(In.)  
Critical Depth = 7.64(In.)  
Pipe flow velocity = 3.62(Ft/s)  
Travel time through pipe = 0.35 min.  
Time of concentration (TC) = 8.03 min.

+++++  
Process from Point/Station 104.000 to Point/Station 106.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 1.130(Ac.)  
Runoff from this stream = 2.217(CFS)  
Time of concentration = 8.03 min.  
Rainfall intensity = 2.214(In/Hr)  
Program is now starting with Main Stream No. 2

+++++  
Process from Point/Station 105.000 to Point/Station 106.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 188.000(Ft.)  
Top (of initial area) elevation = 1510.330(Ft.)  
Bottom (of initial area) elevation = 1507.950(Ft.)  
Difference in elevation = 2.380(Ft.)  
Slope = 0.01266 s(percent)= 1.27  
TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$   
Initial area time of concentration = 5.838 min.  
Rainfall intensity = 2.597(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type  
 Runoff Coefficient = 0.872  
 Decimal fraction soil group A = 0.500  
 Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 2) = 53.50  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 1.608(CFS)  
 Total initial stream area = 0.710(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 105.000 to Point/Station 106.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.710(Ac.)  
 Runoff from this stream = 1.608(CFS)  
 Time of concentration = 5.84 min.  
 Rainfall intensity = 2.597(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	2.217	8.03	2.214
2	1.608	5.84	2.597

Largest stream flow has longer time of concentration

$Q_p = 2.217 + \text{sum of}$   
 $\quad \quad Q_b \quad I_a/I_b$   
 $\quad \quad 1.608 * 0.853 = 1.371$

$Q_p = 3.588$

Total of 2 main streams to confluence:

Flow rates before confluence point:

2.217      1.608

Area of streams before confluence:

1.130      0.710

Results of confluence:

Total flow rate = 3.588(CFS)

Time of concentration = 8.030 min.

Effective stream area after confluence = 1.840(Ac.)

+++++

Process from Point/Station 106.000 to Point/Station 110.000

\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1503.650(Ft.)  
Downstream point/station elevation = 1502.470(Ft.)  
Pipe length = 236.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 3.588(CFS)  
Nearest computed pipe diameter = 15.00(In.)  
Calculated individual pipe flow = 3.588(CFS)  
Normal flow depth in pipe = 10.02(In.)  
Flow top width inside pipe = 14.13(In.)  
Critical Depth = 9.18(In.)  
Pipe flow velocity = 4.12(Ft/s)  
Travel time through pipe = 0.95 min.  
Time of concentration (TC) = 8.98 min.

+++++

Process from Point/Station 106.000 to Point/Station 110.000

\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 1

Stream flow area = 1.840(Ac.)

Runoff from this stream = 3.588(CFS)

Time of concentration = 8.98 min.

Rainfall intensity = 2.093(In/Hr)

Program is now starting with Main Stream No. 2

+++++

Process from Point/Station 107.000 to Point/Station 110.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 95.000(Ft.)

Top (of initial area) elevation = 1509.530(Ft.)

Bottom (of initial area) elevation = 1508.430(Ft.)

Difference in elevation = 1.100(Ft.)

Slope = 0.01158 s(percent)= 1.16

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.874

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.500

RI index for soil(AMC 2) = 53.50

Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.466(CFS)  
Total initial stream area = 0.190(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 107.000 to Point/Station 110.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 2  
Stream flow area = 0.190(Ac.)  
Runoff from this stream = 0.466(CFS)  
Time of concentration = 5.00 min.  
Rainfall intensity = 2.806(In/Hr)  
Program is now starting with Main Stream No. 3

++++  
Process from Point/Station 108.000 to Point/Station 109.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 177.000(Ft.)  
Top (of initial area) elevation = 1510.780(Ft.)  
Bottom (of initial area) elevation = 1508.230(Ft.)  
Difference in elevation = 2.550(Ft.)  
Slope = 0.01441 s(percent)= 1.44  
TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$   
Initial area time of concentration = 5.554 min.  
Rainfall intensity = 2.662(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.873  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.906(CFS)  
Total initial stream area = 0.390(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 109.000 to Point/Station 110.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1503.440(Ft.)  
Downstream point/station elevation = 1502.470(Ft.)

Pipe length = 48.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 0.906(CFS)  
 Nearest computed pipe diameter = 9.00(In.)  
 Calculated individual pipe flow = 0.906(CFS)  
 Normal flow depth in pipe = 3.88(In.)  
 Flow top width inside pipe = 8.91(In.)  
 Critical Depth = 5.22(In.)  
 Pipe flow velocity = 4.98(Ft/s)  
 Travel time through pipe = 0.16 min.  
 Time of concentration (TC) = 5.71 min.

++++++  
 Process from Point/Station 109.000 to Point/Station 110.000  
 \*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

The following data inside Main Stream is listed:

In Main Stream number: 3  
 Stream flow area = 0.390(Ac.)  
 Runoff from this stream = 0.906(CFS)  
 Time of concentration = 5.71 min.  
 Rainfall intensity = 2.625(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	3.588	8.98	2.093
2	0.466	5.00	2.806
3	0.906	5.71	2.625

Largest stream flow has longer time of concentration

Qp = 3.588 + sum of  
     Qb      Ia/Ib  
     0.466 \* 0.746 = 0.347  
     Qb      Ia/Ib  
     0.906 \* 0.798 = 0.723

Qp = 4.658

Total of 3 main streams to confluence:

Flow rates before confluence point:

3.588    0.466    0.906

Area of streams before confluence:

1.840    0.190    0.390

Results of confluence:

Total flow rate = 4.658(CFS)

Time of concentration = 8.984 min.

Effective stream area after confluence = 2.420(Ac.)

+++++  
Process from Point/Station 110.000 to Point/Station 115.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1502.470(Ft.)  
Downstream point/station elevation = 1502.080(Ft.)  
Pipe length = 78.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 4.658(CFS)  
Nearest computed pipe diameter = 18.00(In.)  
Calculated individual pipe flow = 4.658(CFS)  
Normal flow depth in pipe = 10.34(In.)  
Flow top width inside pipe = 17.80(In.)  
Critical Depth = 9.94(In.)  
Pipe flow velocity = 4.44(Ft/s)  
Travel time through pipe = 0.29 min.  
Time of concentration (TC) = 9.28 min.

+++++  
Process from Point/Station 110.000 to Point/Station 115.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 2.420(Ac.)  
Runoff from this stream = 4.658(CFS)  
Time of concentration = 9.28 min.  
Rainfall intensity = 2.060(In/Hr)  
Program is now starting with Main Stream No. 2

+++++  
Process from Point/Station 111.000 to Point/Station 112.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 119.000(Ft.)  
Top (of initial area) elevation = 1509.520(Ft.)  
Bottom (of initial area) elevation = 1508.460(Ft.)  
Difference in elevation = 1.060(Ft.)  
Slope = 0.00891 s(percent)= 0.89  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 5.217 min.  
Rainfall intensity = 2.747(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.873  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50



Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.936(CFS)  
Total initial stream area = 0.390(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 112.000 to Point/Station 114.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.230(Ft.)  
Downstream point/station elevation = 1502.400(Ft.)  
Pipe length = 18.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.936(CFS)  
Nearest computed pipe diameter = 6.00(In.)  
Calculated individual pipe flow = 0.936(CFS)  
Normal flow depth in pipe = 3.08(In.)  
Flow top width inside pipe = 6.00(In.)  
Critical Depth = 5.58(In.)  
Pipe flow velocity = 9.22(Ft/s)  
Travel time through pipe = 0.03 min.  
Time of concentration (TC) = 5.25 min.

++++  
Process from Point/Station 112.000 to Point/Station 114.000  
\*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 2 in normal stream number 1  
Stream flow area = 0.390(Ac.)  
Runoff from this stream = 0.936(CFS)  
Time of concentration = 5.25 min.  
Rainfall intensity = 2.739(In/Hr)

++++  
Process from Point/Station 113.000 to Point/Station 114.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 112.000(Ft.)  
Top (of initial area) elevation = 1509.310(Ft.)  
Bottom (of initial area) elevation = 1508.710(Ft.)  
Difference in elevation = 0.600(Ft.)  
Slope = 0.00536 s(percent)= 0.54  
TC =  $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 5.637 min.  
Rainfall intensity = 2.643(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.873  
Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 2) = 53.50  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 0.461(CFS)  
 Total initial stream area = 0.200(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 113.000 to Point/Station 114.000  
 \*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 2 in normal stream number 1  
 Stream flow area = 0.200(Ac.)  
 Runoff from this stream = 0.461(CFS)  
 Time of concentration = 5.64 min.  
 Rainfall intensity = 2.643(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.461	5.64	2.643
---	-------	------	-------

Largest stream flow has longer time of concentration  
 $Q_p = 0.461 + \text{sum of}$   
 $Q_p = 0.461$

Total of 1 streams to confluence:  
 Flow rates before confluence point:  
 0.461  
 Area of streams before confluence:  
 0.200

Results of confluence:  
 Total flow rate = 0.461(CFS)  
 Time of concentration = 5.637 min.  
 Effective stream area after confluence = 0.200(Ac.)

++++++  
 Process from Point/Station 114.000 to Point/Station 115.000  
 \*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1502.400(Ft.)  
 Downstream point/station elevation = 1502.080(Ft.)  
 Pipe length = 55.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 0.461(CFS)  
 Nearest computed pipe diameter = 9.00(In.)  
 Calculated individual pipe flow = 0.461(CFS)

Normal flow depth in pipe = 3.76(In.)  
 Flow top width inside pipe = 8.88(In.)  
 Critical Depth = 3.67(In.)  
 Pipe flow velocity = 2.63(Ft/s)  
 Travel time through pipe = 0.35 min.  
 Time of concentration (TC) = 5.98 min.

++++++  
 Process from Point/Station 114.000 to Point/Station 115.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.200(Ac.)  
 Runoff from this stream = 0.461(CFS)  
 Time of concentration = 5.98 min.  
 Rainfall intensity = 2.565(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	4.658	9.28	2.060
2	0.461	5.98	2.565

Largest stream flow has longer time of concentration  
 $Q_p = 4.658 + \text{sum of}$   
 $\quad \quad \quad Q_b \quad I_a/I_b$   
 $\quad \quad \quad 0.461 * 0.803 = 0.370$   
 $Q_p = 5.029$

Total of 2 main streams to confluence:

Flow rates before confluence point:

4.658    0.461

Area of streams before confluence:

2.420    0.200

Results of confluence:

Total flow rate = 5.029(CFS)

Time of concentration = 9.277 min.

Effective stream area after confluence = 2.620(Ac.)

++++++  
 Process from Point/Station 115.000 to Point/Station 118.000  
 \*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

Upstream point/station elevation = 1502.080(Ft.)

Downstream point/station elevation = 1501.620(Ft.)

Pipe length = 95.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 5.029(CFS)  
Nearest computed pipe diameter = 18.00(In.)  
Calculated individual pipe flow = 5.029(CFS)  
Normal flow depth in pipe = 10.97(In.)  
Flow top width inside pipe = 17.56(In.)  
Critical Depth = 10.36(In.)  
Pipe flow velocity = 4.46(Ft/s)  
Travel time through pipe = 0.36 min.  
Time of concentration (TC) = 9.63 min.

++++  
Process from Point/Station 115.000 to Point/Station 116.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 2.620(Ac.)  
Runoff from this stream = 5.029(CFS)  
Time of concentration = 9.63 min.  
Rainfall intensity = 2.022(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 116.000 to Point/Station 117.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 20.000(Ft.)  
Top (of initial area) elevation = 1509.000(Ft.)  
Bottom (of initial area) elevation = 1508.910(Ft.)  
Difference in elevation = 0.090(Ft.)  
Slope = 0.00450 s(percent)= 0.45  
TC =  $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.  
Initial area time of concentration = 5.000 min.  
Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.874  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.049(CFS)  
Total initial stream area = 0.020(Ac.)  
Pervious area fraction = 0.100

+++++  
 Process from Point/Station 117.000 to Point/Station 118.000  
 \*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1503.000(Ft.)  
 Downstream point/station elevation = 1501.620(Ft.)  
 Pipe length = 28.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 0.049(CFS)  
 Nearest computed pipe diameter = 3.00(In.)  
 Calculated individual pipe flow = 0.049(CFS)  
 Normal flow depth in pipe = 1.01(In.)  
 Flow top width inside pipe = 2.84(In.)  
 Critical Depth = 1.60(In.)  
 Pipe flow velocity = 3.31(Ft/s)  
 Travel time through pipe = 0.14 min.  
 Time of concentration (TC) = 5.14 min.

+++++  
 Process from Point/Station 117.000 to Point/Station 118.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.020(Ac.)  
 Runoff from this stream = 0.049(CFS)  
 Time of concentration = 5.14 min.  
 Rainfall intensity = 2.767(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	5.029	9.63	2.022
2	0.049	5.14	2.767

Largest stream flow has longer time of concentration  
 $Q_p = 5.029 + \text{sum of}$   
 $\quad Q_b \quad I_a/I_b$   
 $\quad 0.049 * 0.731 = 0.036$   
 $Q_p = 5.065$

Total of 2 main streams to confluence:  
 Flow rates before confluence point:  
 5.029 0.049  
 Area of streams before confluence:  
 2.620 0.020

Results of confluence:

Total flow rate = 5.065(CFS)  
Time of concentration = 9.632 min.  
Effective stream area after confluence = 2.640(Ac.)

+++++

Process from Point/Station 118.000 to Point/Station 119.000

\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1501.620(Ft.)  
Downstream point/station elevation = 1501.520(Ft.)  
Pipe length = 20.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 5.065(CFS)  
Nearest computed pipe diameter = 18.00(In.)  
Calculated individual pipe flow = 5.065(CFS)  
Normal flow depth in pipe = 10.90(In.)  
Flow top width inside pipe = 17.59(In.)  
Critical Depth = 10.39(In.)  
Pipe flow velocity = 4.52(Ft/s)  
Travel time through pipe = 0.07 min.  
Time of concentration (TC) = 9.71 min.  
End of computations, total study area = 3.03 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.5

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR2.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 201.000 to Point/Station 202.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 166.000(Ft.)

Top (of initial area) elevation = 1509.540(Ft.)

Bottom (of initial area) elevation = 1507.830(Ft.)

Difference in elevation = 1.710(Ft.)

Slope = 0.01030 s(percent)= 1.03

TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$

Initial area time of concentration = 5.789 min.

Rainfall intensity = 2.608(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.872

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 1.274(CFS)  
Total initial stream area = 0.560(Ac.)  
Pervious area fraction = 0.100

+++++  
Process from Point/Station 202.000 to Point/Station 203.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1501.000(Ft.)  
Downstream point/station elevation = 1500.930(Ft.)  
Pipe length = 13.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 1.274(CFS)  
Nearest computed pipe diameter = 12.00(In.)  
Calculated individual pipe flow = 1.274(CFS)  
Normal flow depth in pipe = 5.91(In.)  
Flow top width inside pipe = 12.00(In.)  
Critical Depth = 5.72(In.)  
Pipe flow velocity = 3.31(Ft/s)  
Travel time through pipe = 0.07 min.  
Time of concentration (TC) = 5.85 min.  
End of computations, total study area = 0.56 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.5



Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR3.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 301.000 to Point/Station 302.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 52.000(Ft.)

Top (of initial area) elevation = 1510.240(Ft.)

Bottom (of initial area) elevation = 1509.190(Ft.)

Difference in elevation = 1.050(Ft.)

Slope = 0.02019 s(percent)= 2.02

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.874  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.417(CFS)  
Total initial stream area = 0.170(Ac.)  
Pervious area fraction = 0.100

+++++

Process from Point/Station 302.000 to Point/Station 306.000

\*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1505.190(Ft.)  
Downstream point/station elevation = 1504.550(Ft.)  
Pipe length = 127.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.417(CFS)  
Nearest computed pipe diameter = 9.00(In.)  
Calculated individual pipe flow = 0.417(CFS)  
Normal flow depth in pipe = 3.70(In.)  
Flow top width inside pipe = 8.86(In.)  
Critical Depth = 3.48(In.)  
Pipe flow velocity = 2.43(Ft/s)  
Travel time through pipe = 0.87 min.  
Time of concentration (TC) = 5.87 min.

+++++

Process from Point/Station 302.000 to Point/Station 306.000

\*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 1  
Stream flow area = 0.170(Ac.)  
Runoff from this stream = 0.417(CFS)  
Time of concentration = 5.87 min.  
Rainfall intensity = 2.590(In/Hr)  
Program is now starting with Main Stream No. 2

+++++

Process from Point/Station 303.000 to Point/Station 304.000

\*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 122.000(Ft.)  
Top (of initial area) elevation = 1508.980(Ft.)  
Bottom (of initial area) elevation = 1508.330(Ft.)  
Difference in elevation = 0.650(Ft.)  
Slope = 0.00533 s(percent)= 0.53  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 5.839 min.  
Rainfall intensity = 2.596(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.872  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.747(CFS)  
Total initial stream area = 0.330(Ac.)  
Pervious area fraction = 0.100

+++++  
Process from Point/Station 304.000 to Point/Station 306.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1505.160(Ft.)  
Downstream point/station elevation = 1504.550(Ft.)  
Pipe length = 31.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.747(CFS)  
Nearest computed pipe diameter = 6.00(In.)  
Calculated individual pipe flow = 0.747(CFS)  
Normal flow depth in pipe = 4.66(In.)  
Flow top width inside pipe = 4.99(In.)  
Critical Depth = 5.20(In.)  
Pipe flow velocity = 4.56(Ft/s)  
Travel time through pipe = 0.11 min.  
Time of concentration (TC) = 5.95 min.

+++++  
Process from Point/Station 304.000 to Point/Station 306.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 2  
Stream flow area = 0.330(Ac.)  
Runoff from this stream = 0.747(CFS)  
Time of concentration = 5.95 min.  
Rainfall intensity = 2.572(In/Hr)  
Program is now starting with Main Stream No. 3

+++++  
Process from Point/Station 305.000 to Point/Station 306.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 31.000(Ft.)  
Top (of initial area) elevation = 1509.230(Ft.)  
Bottom (of initial area) elevation = 1508.110(Ft.)

Difference in elevation = 1.120(Ft.)  
 Slope = 0.03613 s(percent)= 3.61  
 TC =  $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
 Warning: TC computed to be less than 5 min.; program is assuming the  
 time of concentration is 5 minutes.  
 Initial area time of concentration = 5.000 min.  
 Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm  
 COMMERCIAL subarea type  
 Runoff Coefficient = 0.874  
 Decimal fraction soil group A = 0.500  
 Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 2) = 53.50  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 1.299(CFS)  
 Total initial stream area = 0.530(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 305.000 to Point/Station 306.000  
 \*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 3  
 Stream flow area = 0.530(Ac.)  
 Runoff from this stream = 1.299(CFS)  
 Time of concentration = 5.00 min.  
 Rainfall intensity = 2.806(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.417	5.87	2.590
2	0.747	5.95	2.572
3	1.299	5.00	2.806

Largest stream flow has longer or shorter time of concentration

Qp = 1.299 + sum of  

$$\begin{array}{l} Q_a \quad T_b/T_a \\ 0.417 * 0.852 = 0.355 \\ Q_a \quad T_b/T_a \\ 0.747 * 0.840 = 0.628 \end{array}$$
 Qp = 2.282

Total of 3 main streams to confluence:

Flow rates before confluence point:

0.417    0.747    1.299

Area of streams before confluence:

0.170    0.330    0.530

Results of confluence:

Total flow rate = 2.282(CFS)

Time of concentration = 5.000 min.

Effective stream area after confluence = 1.030(Ac.)

+++++

Process from Point/Station 306.000 to Point/Station 307.000

\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.550(Ft.)

Downstream point/station elevation = 1504.280(Ft.)

Pipe length = 53.00(Ft.) Manning's N = 0.013

No. of pipes = 1 Required pipe flow = 2.282(CFS)

Nearest computed pipe diameter = 12.00(In.)

Calculated individual pipe flow = 2.282(CFS)

Normal flow depth in pipe = 8.88(In.)

Flow top width inside pipe = 10.52(In.)

Critical Depth = 7.75(In.)

Pipe flow velocity = 3.66(Ft/s)

Travel time through pipe = 0.24 min.

Time of concentration (TC) = 5.24 min.

End of computations, total study area = 1.03 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100

Area averaged RI index number = 53.5

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR4.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 401.000 to Point/Station 402.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 64.000(Ft.)

Top (of initial area) elevation = 1510.830(Ft.)

Bottom (of initial area) elevation = 1509.440(Ft.)

Difference in elevation = 1.390(Ft.)

Slope = 0.02172 s(percent)= 2.17

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.874  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.441(CFS)  
Total initial stream area = 0.180(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 402.000 to Point/Station 403.000  
\*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1505.440(Ft.)  
Downstream point/station elevation = 1505.010(Ft.)  
Pipe length = 78.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.441(CFS)  
Nearest computed pipe diameter = 9.00(In.)  
Calculated individual pipe flow = 0.441(CFS)  
Normal flow depth in pipe = 3.73(In.)  
Flow top width inside pipe = 8.87(In.)  
Critical Depth = 3.59(In.)  
Pipe flow velocity = 2.55(Ft/s)  
Travel time through pipe = 0.51 min.  
Time of concentration (TC) = 5.51 min.

++++  
Process from Point/Station 402.000 to Point/Station 403.000  
\*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.180(Ac.)  
Runoff from this stream = 0.441(CFS)  
Time of concentration = 5.51 min.  
Rainfall intensity = 2.673(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 403.000 to Point/Station 404.000  
\*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 108.000(Ft.)  
Top (of initial area) elevation = 1510.710(Ft.)  
Bottom (of initial area) elevation = 1509.280(Ft.)  
Difference in elevation = 1.430(Ft.)  
Slope = 0.01324 s(percent)= 1.32  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.874

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.500

RI index for soil(AMC 2) = 53.50

Pervious area fraction = 0.100; Impervious fraction = 0.900

Initial subarea runoff = 1.201(CFS)

Total initial stream area = 0.490(Ac.)

Pervious area fraction = 0.100

+++++  
Process from Point/Station 403.000 to Point/Station 404.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 0.490(Ac.)

Runoff from this stream = 1.201(CFS)

Time of concentration = 5.00 min.

Rainfall intensity = 2.806(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.441	5.51	2.673
---	-------	------	-------

2	1.201	5.00	2.806
---	-------	------	-------

Largest stream flow has longer or shorter time of concentration

$Q_p = 1.201 + \text{sum of}$

$\frac{Q_a}{T_b/T_a}$

$0.441 * 0.908 = 0.400$

$Q_p = 1.602$

Total of 2 main streams to confluence:

Flow rates before confluence point:

0.441 1.201

Area of streams before confluence:

0.180 0.490

Results of confluence:

Total flow rate = 1.602(CFS)

Time of concentration = 5.000 min.

Effective stream area after confluence = 0.670(Ac.)



+++++  
Process from Point/Station 404.000 to Point/Station 406.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1505.010(Ft.)  
Downstream point/station elevation = 1504.790(Ft.)  
Pipe length = 43.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 1.602(CFS)  
Nearest computed pipe diameter = 12.00(In.)  
Calculated individual pipe flow = 1.602(CFS)  
Normal flow depth in pipe = 6.90(In.)  
Flow top width inside pipe = 11.87(In.)  
Critical Depth = 6.44(In.)  
Pipe flow velocity = 3.43(Ft/s)  
Travel time through pipe = 0.21 min.  
Time of concentration (TC) = 5.21 min.

+++++  
Process from Point/Station 404.000 to Point/Station 406.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.670(Ac.)  
Runoff from this stream = 1.602(CFS)  
Time of concentration = 5.21 min.  
Rainfall intensity = 2.749(In/Hr)  
Program is now starting with Main Stream No. 2

+++++  
Process from Point/Station 405.000 to Point/Station 406.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 43.000(Ft.)  
Top (of initial area) elevation = 1511.620(Ft.)  
Bottom (of initial area) elevation = 1509.930(Ft.)  
Difference in elevation = 1.690(Ft.)  
Slope = 0.03930 s(percent)= 3.93  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.  
Initial area time of concentration = 5.000 min.  
Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.874  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50

Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.319(CFS)  
Total initial stream area = 0.130(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 405.000 to Point/Station 406.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
Stream flow area = 0.130(Ac.)  
Runoff from this stream = 0.319(CFS)  
Time of concentration = 5.00 min.  
Rainfall intensity = 2.806(In/Hr)  
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	1.602	5.21	2.749
2	0.319	5.00	2.806

Largest stream flow has longer time of concentration

Qp = 1.602 + sum of  
Qb Ia/Ib  
0.319 \* 0.980 = 0.312

Qp = 1.914

Total of 2 main streams to confluence:

Flow rates before confluence point:

1.602 0.319

Area of streams before confluence:

0.670 0.130

Results of confluence:

Total flow rate = 1.914(CFS)

Time of concentration = 5.209 min.

Effective stream area after confluence = 0.800(Ac.)

++++  
Process from Point/Station 406.000 to Point/Station 413.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.790(Ft.)

Downstream point/station elevation = 1504.320(Ft.)

Pipe length = 91.00(Ft.) Manning's N = 0.013

No. of pipes = 1 Required pipe flow = 1.914(CFS)

Nearest computed pipe diameter = 12.00(In.)

Calculated individual pipe flow = 1.914(CFS)

Normal flow depth in pipe = 7.73(In.)  
Flow top width inside pipe = 11.49(In.)  
Critical Depth = 7.08(In.)  
Pipe flow velocity = 3.58(Ft/s)  
Travel time through pipe = 0.42 min.  
Time of concentration (TC) = 5.63 min.

++++  
Process from Point/Station 406.000 to Point/Station 413.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.800(Ac.)  
Runoff from this stream = 1.914(CFS)  
Time of concentration = 5.63 min.  
Rainfall intensity = 2.644(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 407.000 to Point/Station 413.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 72.000(Ft.)  
Top (of initial area) elevation = 1511.130(Ft.)  
Bottom (of initial area) elevation = 1510.200(Ft.)  
Difference in elevation = 0.930(Ft.)  
Slope = 0.01292 s(percent)= 1.29  
TC =  $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.  
Initial area time of concentration = 5.000 min.  
Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.874  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.466(CFS)  
Total initial stream area = 0.190(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 407.000 to Point/Station 413.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
Stream flow area = 0.190(Ac.)  
Runoff from this stream = 0.466(CFS)  
Time of concentration = 5.00 min.  
Rainfall intensity = 2.806(In/Hr)  
Program is now starting with Main Stream No. 3

+++++  
Process from Point/Station 409.000 to Point/Station 410.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 133.000(Ft.)  
Top (of initial area) elevation = 1511.600(Ft.)  
Bottom (of initial area) elevation = 1510.400(Ft.)  
Difference in elevation = 1.200(Ft.)  
Slope = 0.00902 s(percent)= 0.90  
TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$   
Initial area time of concentration = 5.440 min.  
Rainfall intensity = 2.690(In/Hr) for a 10.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.873  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.352(CFS)  
Total initial stream area = 0.150(Ac.)  
Pervious area fraction = 0.100

+++++  
Process from Point/Station 410.000 to Point/Station 412.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1506.400(Ft.)  
Downstream point/station elevation = 1505.500(Ft.)  
Pipe length = 66.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.352(CFS)  
Nearest computed pipe diameter = 6.00(In.)  
Calculated individual pipe flow = 0.352(CFS)  
Normal flow depth in pipe = 3.13(In.)  
Flow top width inside pipe = 5.99(In.)  
Critical Depth = 3.61(In.)  
Pipe flow velocity = 3.40(Ft/s)  
Travel time through pipe = 0.32 min.  
Time of concentration (TC) = 5.76 min.

+++++  
Process from Point/Station 410.000 to Point/Station 412.000

\*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 3 in normal stream number 1

Stream flow area = 0.150(Ac.)

Runoff from this stream = 0.352(CFS)

Time of concentration = 5.76 min.

Rainfall intensity = 2.613(In/Hr)

+++++

Process from Point/Station 411.000 to Point/Station 412.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 48.000(Ft.)

Top (of initial area) elevation = 1510.410(Ft.)

Bottom (of initial area) elevation = 1509.820(Ft.)

Difference in elevation = 0.590(Ft.)

Slope = 0.01229 s(percent)= 1.23

TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 2.806(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.874

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.500

RI index for soil(AMC 2) = 53.50

Pervious area fraction = 0.100; Impervious fraction = 0.900

Initial subarea runoff = 0.515(CFS)

Total initial stream area = 0.210(Ac.)

Pervious area fraction = 0.100

+++++

Process from Point/Station 411.000 to Point/Station 412.000

\*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 3 in normal stream number 2

Stream flow area = 0.210(Ac.)

Runoff from this stream = 0.515(CFS)

Time of concentration = 5.00 min.

Rainfall intensity = 2.806(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.352	5.76	2.613
---	-------	------	-------

2	0.515	5.00	2.806
---	-------	------	-------

Largest stream flow has longer or shorter time of concentration

$$Q_p = 0.515 + \text{sum of} \\ Q_a \quad T_b/T_a \\ 0.352 * 0.867 = 0.306 \\ Q_p = 0.820$$

Total of 2 streams to confluence:

Flow rates before confluence point:

$$0.352 \quad 0.515$$

Area of streams before confluence:

$$0.150 \quad 0.210$$

Results of confluence:

Total flow rate = 0.820(CFS)

Time of concentration = 5.000 min.

Effective stream area after confluence = 0.360(Ac.)

+++++  
Process from Point/Station 412.000 to Point/Station 413.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1505.500(Ft.)  
Downstream point/station elevation = 1504.320(Ft.)  
Pipe length = 117.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.820(CFS)  
Nearest computed pipe diameter = 9.00(In.)  
Calculated individual pipe flow = 0.820(CFS)  
Normal flow depth in pipe = 4.46(In.)  
Flow top width inside pipe = 9.00(In.)  
Critical Depth = 4.96(In.)  
Pipe flow velocity = 3.75(Ft/s)  
Travel time through pipe = 0.52 min.  
Time of concentration (TC) = 5.52 min.

+++++  
Process from Point/Station 412.000 to Point/Station 413.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 3

Stream flow area = 0.360(Ac.)

Runoff from this stream = 0.820(CFS)

Time of concentration = 5.52 min.

Rainfall intensity = 2.670(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	1.914	5.63	2.644
2	0.466	5.00	2.806

3      0.820      5.52      2.670

Largest stream flow has longer time of concentration

Qp = 1.914 + sum of

Qb      Ia/Ib

0.466 \* 0.942 = 0.439

Qb      Ia/Ib

0.820 \* 0.990 = 0.812

Qp = 3.165

Total of 3 main streams to confluence:

Flow rates before confluence point:

1.914      0.466      0.820

Area of streams before confluence:

0.800      0.190      0.360

Results of confluence:

Total flow rate = 3.165(CFS)

Time of concentration = 5.633 min.

Effective stream area after confluence = 1.350(Ac.)

+++++

Process from Point/Station 413.000 to Point/Station 414.000

\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.320(Ft.)

Downstream point/station elevation = 1504.270(Ft.)

Pipe length = 10.00(Ft.) Manning's N = 0.013

No. of pipes = 1 Required pipe flow = 3.165(CFS)

Nearest computed pipe diameter = 15.00(In.)

Calculated individual pipe flow = 3.165(CFS)

Normal flow depth in pipe = 9.19(In.)

Flow top width inside pipe = 14.62(In.)

Critical Depth = 8.59(In.)

Pipe flow velocity = 4.02(Ft/s)

Travel time through pipe = 0.04 min.

Time of concentration (TC) = 5.67 min.

End of computations, total study area = 1.35 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100

Area averaged RI index number = 53.5

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 11/06/17 File:COTTONWOODPR1.out

-----  
COTTONWOODPR1

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\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

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Program License Serial Number 6390

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Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

++++  
Process from Point/Station 101.000 to Point/Station 102.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

-----  
Initial area flow distance = 230.000(Ft.)

Top (of initial area) elevation = 1509.640(Ft.)

Bottom (of initial area) elevation = 1508.300(Ft.)

Difference in elevation = 1.340(Ft.)

Slope = 0.00583 s(percent)= 0.58



$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
 Initial area time of concentration = 7.392 min.  
 Rainfall intensity = 3.419(In/Hr) for a 100.0 year storm  
 COMMERCIAL subarea type  
 Runoff Coefficient = 0.889  
 Decimal fraction soil group A = 0.486  
 Decimal fraction soil group B = 0.028  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.486  
 RI index for soil(AMC 3) = 72.86  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 1.884(CFS)  
 Total initial stream area = 0.620(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 102.000 to Point/Station 104.000  
 \*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1504.300(Ft.)  
 Downstream point/station elevation = 1504.030(Ft.)  
 Pipe length = 55.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 1.884(CFS)  
 Nearest computed pipe diameter = 12.00(In.)  
 Calculated individual pipe flow = 1.884(CFS)  
 Normal flow depth in pipe = 7.78(In.)  
 Flow top width inside pipe = 11.46(In.)  
 Critical Depth = 7.02(In.)  
 Pipe flow velocity = 3.49(Ft/s)  
 Travel time through pipe = 0.26 min.  
 Time of concentration (TC) = 7.65 min.

++++++  
 Process from Point/Station 102.000 to Point/Station 104.000  
 \*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:  
 In Main Stream number: 1  
 Stream flow area = 0.620(Ac.)  
 Runoff from this stream = 1.884(CFS)  
 Time of concentration = 7.65 min.  
 Rainfall intensity = 3.360(In/Hr)  
 Program is now starting with Main Stream No. 2

++++++  
 Process from Point/Station 103.000 to Point/Station 104.000  
 \*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 311.000(Ft.)  
 Top (of initial area) elevation = 1510.540(Ft.)  
 Bottom (of initial area) elevation = 1508.080(Ft.)  
 Difference in elevation = 2.460(Ft.)  
 Slope = 0.00791 s(percent)= 0.79  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
 Initial area time of concentration = 7.845 min.  
 Rainfall intensity = 3.319(In/Hr) for a 100.0 year storm  
 COMMERCIAL subarea type  
 Runoff Coefficient = 0.888  
 Decimal fraction soil group A = 0.500  
 Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 3) = 72.80  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 1.503(CFS)  
 Total initial stream area = 0.510(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 103.000 to Point/Station 104.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.510(Ac.)  
 Runoff from this stream = 1.503(CFS)  
 Time of concentration = 7.84 min.  
 Rainfall intensity = 3.319(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	1.884	7.65	3.360
2	1.503	7.84	3.319

Largest stream flow has longer or shorter time of concentration

$Q_p = 1.884 + \text{sum of}$   
 $\quad Q_a \quad T_b/T_a$   
 $\quad 1.503 * 0.976 = 1.467$   
 $Q_p = 3.350$

Total of 2 main streams to confluence:

Flow rates before confluence point:

1.884 1.503

Area of streams before confluence:

0.620 0.510

Results of confluence:

Total flow rate = 3.350(CFS)

Time of concentration = 7.654 min.

Effective stream area after confluence = 1.130(Ac.)

+++++  
Process from Point/Station 104.000 to Point/Station 106.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.030(Ft.)  
Downstream point/station elevation = 1503.650(Ft.)  
Pipe length = 76.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 3.350(CFS)  
Nearest computed pipe diameter = 15.00(In.)  
Calculated individual pipe flow = 3.350(CFS)  
Normal flow depth in pipe = 9.54(In.)  
Flow top width inside pipe = 14.43(In.)  
Critical Depth = 8.85(In.)  
Pipe flow velocity = 4.07(Ft/s)  
Travel time through pipe = 0.31 min.  
Time of concentration (TC) = 7.97 min.

+++++  
Process from Point/Station 104.000 to Point/Station 106.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 1.130(Ac.)  
Runoff from this stream = 3.350(CFS)  
Time of concentration = 7.97 min.  
Rainfall intensity = 3.293(In/Hr)  
Program is now starting with Main Stream No. 2

+++++  
Process from Point/Station 105.000 to Point/Station 106.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 188.000(Ft.)  
Top (of initial area) elevation = 1510.330(Ft.)  
Bottom (of initial area) elevation = 1507.950(Ft.)  
Difference in elevation = 2.380(Ft.)  
Slope = 0.01266 s(percent)= 1.27  
TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$   
Initial area time of concentration = 5.838 min.  
Rainfall intensity = 3.847(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type  
 Runoff Coefficient = 0.890  
 Decimal fraction soil group A = 0.500  
 Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 3) = 72.80  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 2.430(CFS)  
 Total initial stream area = 0.710(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 105.000 to Point/Station 106.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.710(Ac.)  
 Runoff from this stream = 2.430(CFS)  
 Time of concentration = 5.84 min.  
 Rainfall intensity = 3.847(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	3.350	7.97	3.293
2	2.430	5.84	3.847

Largest stream flow has longer time of concentration  
 $Q_p = 3.350 + \text{sum of}$   
 $\quad Q_b \quad I_a/I_b$   
 $\quad 2.430 * 0.856 = 2.080$   
 $Q_p = 5.431$

Total of 2 main streams to confluence:  
 Flow rates before confluence point:  
 3.350 2.430  
 Area of streams before confluence:  
 1.130 0.710

Results of confluence:  
 Total flow rate = 5.431(CFS)  
 Time of concentration = 7.966 min.  
 Effective stream area after confluence = 1.840(Ac.)

+++++

Process from Point/Station 106.000 to Point/Station 110.000

\*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1503.650(Ft.)  
Downstream point/station elevation = 1502.470(Ft.)  
Pipe length = 236.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 5.431(CFS)  
Nearest computed pipe diameter = 18.00(In.)  
Calculated individual pipe flow = 5.431(CFS)  
Normal flow depth in pipe = 11.43(In.)  
Flow top width inside pipe = 17.33(In.)  
Critical Depth = 10.79(In.)  
Pipe flow velocity = 4.59(Ft/s)  
Travel time through pipe = 0.86 min.  
Time of concentration (TC) = 8.82 min.

+++++

Process from Point/Station 106.000 to Point/Station 110.000

\*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 1  
Stream flow area = 1.840(Ac.)  
Runoff from this stream = 5.431(CFS)  
Time of concentration = 8.82 min.  
Rainfall intensity = 3.129(In/Hr)  
Program is now starting with Main Stream No. 2

+++++

Process from Point/Station 107.000 to Point/Station 110.000

\*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 95.000(Ft.)  
Top (of initial area) elevation = 1509.530(Ft.)  
Bottom (of initial area) elevation = 1508.430(Ft.)  
Difference in elevation = 1.100(Ft.)  
Slope = 0.01158 s(percent)= 1.16  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.  
Initial area time of concentration = 5.000 min.  
Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.890  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 3) = 72.80

Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.703(CFS)  
Total initial stream area = 0.190(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 107.000 to Point/Station 110.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 2  
Stream flow area = 0.190(Ac.)  
Runoff from this stream = 0.703(CFS)  
Time of concentration = 5.00 min.  
Rainfall intensity = 4.157(In/Hr)  
Program is now starting with Main Stream No. 3

++++  
Process from Point/Station 108.000 to Point/Station 109.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 177.000(Ft.)  
Top (of initial area) elevation = 1510.780(Ft.)  
Bottom (of initial area) elevation = 1508.230(Ft.)  
Difference in elevation = 2.550(Ft.)  
Slope = 0.01441 s(percent)= 1.44  
TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$   
Initial area time of concentration = 5.554 min.  
Rainfall intensity = 3.944(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.890  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 3) = 72.80  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 1.369(CFS)  
Total initial stream area = 0.390(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 109.000 to Point/Station 110.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1503.440(Ft.)  
Downstream point/station elevation = 1502.470(Ft.)

Pipe length = 48.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 1.369(CFS)  
 Nearest computed pipe diameter = 9.00(In.)  
 Calculated individual pipe flow = 1.369(CFS)  
 Normal flow depth in pipe = 4.93(In.)  
 Flow top width inside pipe = 8.96(In.)  
 Critical Depth = 6.47(In.)  
 Pipe flow velocity = 5.53(Ft/s)  
 Travel time through pipe = 0.14 min.  
 Time of concentration (TC) = 5.70 min.

++++++  
 Process from Point/Station 109.000 to Point/Station 110.000  
 \*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

The following data inside Main Stream is listed:

In Main Stream number: 3  
 Stream flow area = 0.390(Ac.)  
 Runoff from this stream = 1.369(CFS)  
 Time of concentration = 5.70 min.  
 Rainfall intensity = 3.894(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	5.431	8.82	3.129
2	0.703	5.00	4.157
3	1.369	5.70	3.894

Largest stream flow has longer time of concentration  
 $Q_p = 5.431 + \text{sum of}$   

$$\begin{array}{l} Q_b \quad I_a/I_b \\ 0.703 * 0.753 = 0.529 \\ Q_b \quad I_a/I_b \\ 1.369 * 0.804 = 1.100 \end{array}$$
  
 $Q_p = 7.060$

Total of 3 main streams to confluence:

Flow rates before confluence point:

5.431    0.703    1.369

Area of streams before confluence:

1.840    0.190    0.390

Results of confluence:

Total flow rate = 7.060(CFS)

Time of concentration = 8.823 min.

Effective stream area after confluence = 2.420(Ac.)

+++++  
Process from Point/Station 110.000 to Point/Station 115.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1502.470(Ft.)  
Downstream point/station elevation = 1502.080(Ft.)  
Pipe length = 78.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 7.060(CFS)  
Nearest computed pipe diameter = 18.00(In.)  
Calculated individual pipe flow = 7.060(CFS)  
Normal flow depth in pipe = 14.02(In.)  
Flow top width inside pipe = 14.95(In.)  
Critical Depth = 12.35(In.)  
Pipe flow velocity = 4.78(Ft/s)  
Travel time through pipe = 0.27 min.  
Time of concentration (TC) = 9.09 min.

+++++  
Process from Point/Station 110.000 to Point/Station 115.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 2.420(Ac.)  
Runoff from this stream = 7.060(CFS)  
Time of concentration = 9.09 min.  
Rainfall intensity = 3.082(In/Hr)  
Program is now starting with Main Stream No. 2

+++++  
Process from Point/Station 111.000 to Point/Station 112.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 119.000(Ft.)  
Top (of initial area) elevation = 1509.520(Ft.)  
Bottom (of initial area) elevation = 1508.460(Ft.)  
Difference in elevation = 1.060(Ft.)  
Slope = 0.00891 s(percent)= 0.89  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 5.217 min.  
Rainfall intensity = 4.070(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.890  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 3) = 72.80



Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 1.413(CFS)  
Total initial stream area = 0.390(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 112.000 to Point/Station 114.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.230(Ft.)  
Downstream point/station elevation = 1502.400(Ft.)  
Pipe length = 18.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 1.413(CFS)  
Nearest computed pipe diameter = 6.00(In.)  
Calculated individual pipe flow = 1.413(CFS)  
Normal flow depth in pipe = 4.02(In.)  
Flow top width inside pipe = 5.64(In.)  
Critical depth could not be calculated.  
Pipe flow velocity = 10.10(Ft/s)  
Travel time through pipe = 0.03 min.  
Time of concentration (TC) = 5.25 min.

++++  
Process from Point/Station 112.000 to Point/Station 114.000  
\*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 2 in normal stream number 1  
Stream flow area = 0.390(Ac.)  
Runoff from this stream = 1.413(CFS)  
Time of concentration = 5.25 min.  
Rainfall intensity = 4.058(In/Hr)

++++  
Process from Point/Station 113.000 to Point/Station 114.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 112.000(Ft.)  
Top (of initial area) elevation = 1509.310(Ft.)  
Bottom (of initial area) elevation = 1508.710(Ft.)  
Difference in elevation = 0.600(Ft.)  
Slope = 0.00536 s(percent)= 0.54  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 5.637 min.  
Rainfall intensity = 3.915(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.890  
Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 3) = 72.80  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 0.697(CFS)  
 Total initial stream area = 0.200(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 113.000 to Point/Station 114.000  
 \*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 2 in normal stream number 1  
 Stream flow area = 0.200(Ac.)  
 Runoff from this stream = 0.697(CFS)  
 Time of concentration = 5.64 min.  
 Rainfall intensity = 3.915(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.697	5.64	3.915
---	-------	------	-------

Largest stream flow has longer time of concentration  
 $Q_p = 0.697 + \text{sum of}$   
 $Q_p = 0.697$

Total of 1 streams to confluence:  
 Flow rates before confluence point:  
 0.697  
 Area of streams before confluence:  
 0.200

Results of confluence:  
 Total flow rate = 0.697(CFS)  
 Time of concentration = 5.637 min.  
 Effective stream area after confluence = 0.200(Ac.)

++++++  
 Process from Point/Station 114.000 to Point/Station 115.000  
 \*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1502.400(Ft.)  
 Downstream point/station elevation = 1502.080(Ft.)  
 Pipe length = 55.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 0.697(CFS)  
 Nearest computed pipe diameter = 9.00(In.)  
 Calculated individual pipe flow = 0.697(CFS)

Normal flow depth in pipe = 4.78(In.)  
 Flow top width inside pipe = 8.98(In.)  
 Critical Depth = 4.56(In.)  
 Pipe flow velocity = 2.93(Ft/s)  
 Travel time through pipe = 0.31 min.  
 Time of concentration (TC) = 5.95 min.

++++++  
 Process from Point/Station 114.000 to Point/Station 115.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.200(Ac.)  
 Runoff from this stream = 0.697(CFS)  
 Time of concentration = 5.95 min.  
 Rainfall intensity = 3.811(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	7.060	9.09	3.082
2	0.697	5.95	3.811

Largest stream flow has longer time of concentration  
 $Q_p = 7.060 + \text{sum of}$   
 $\quad Q_b \quad I_a/I_b$   
 $\quad 0.697 * 0.809 = 0.564$   
 $Q_p = 7.624$

Total of 2 main streams to confluence:

Flow rates before confluence point:

7.060 0.697

Area of streams before confluence:

2.420 0.200

Results of confluence:

Total flow rate = 7.624(CFS)

Time of concentration = 9.095 min.

Effective stream area after confluence = 2.620(Ac.)

++++++  
 Process from Point/Station 115.000 to Point/Station 118.000  
 \*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

Upstream point/station elevation = 1502.080(Ft.)

Downstream point/station elevation = 1501.620(Ft.)

Pipe length = 95.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 7.624(CFS)  
 Nearest computed pipe diameter = 21.00(In.)  
 Calculated individual pipe flow = 7.624(CFS)  
 Normal flow depth in pipe = 12.84(In.)  
 Flow top width inside pipe = 20.47(In.)  
 Critical Depth = 12.27(In.)  
 Pipe flow velocity = 4.95(Ft/s)  
 Travel time through pipe = 0.32 min.  
 Time of concentration (TC) = 9.41 min.

++++++  
 Process from Point/Station 115.000 to Point/Station 116.000  
 \*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:  
 In Main Stream number: 1  
 Stream flow area = 2.620(Ac.)  
 Runoff from this stream = 7.624(CFS)  
 Time of concentration = 9.41 min.  
 Rainfall intensity = 3.029(In/Hr)  
 Program is now starting with Main Stream No. 2

++++++  
 Process from Point/Station 116.000 to Point/Station 117.000  
 \*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 20.000(Ft.)  
 Top (of initial area) elevation = 1509.000(Ft.)  
 Bottom (of initial area) elevation = 1508.910(Ft.)  
 Difference in elevation = 0.090(Ft.)  
 Slope = 0.00450 s(percent)= 0.45  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
 Warning: TC computed to be less than 5 min.; program is assuming the  
 time of concentration is 5 minutes.  
 Initial area time of concentration = 5.000 min.  
 Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm  
 COMMERCIAL subarea type  
 Runoff Coefficient = 0.890  
 Decimal fraction soil group A = 0.500  
 Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 3) = 72.80  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 0.074(CFS)  
 Total initial stream area = 0.020(Ac.)  
 Pervious area fraction = 0.100

+++++  
 Process from Point/Station 117.000 to Point/Station 118.000  
 \*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1503.000(Ft.)  
 Downstream point/station elevation = 1501.620(Ft.)  
 Pipe length = 28.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 0.074(CFS)  
 Nearest computed pipe diameter = 3.00(In.)  
 Calculated individual pipe flow = 0.074(CFS)  
 Normal flow depth in pipe = 1.27(In.)  
 Flow top width inside pipe = 2.96(In.)  
 Critical Depth = 1.98(In.)  
 Pipe flow velocity = 3.71(Ft/s)  
 Travel time through pipe = 0.13 min.  
 Time of concentration (TC) = 5.13 min.

+++++  
 Process from Point/Station 117.000 to Point/Station 118.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.020(Ac.)  
 Runoff from this stream = 0.074(CFS)  
 Time of concentration = 5.13 min.  
 Rainfall intensity = 4.106(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	7.624	9.41	3.029
2	0.074	5.13	4.106

Largest stream flow has longer time of concentration  
 $Q_p = 7.624 + \text{sum of}$   
 $\frac{Q_b}{Q_p} \frac{I_a}{I_b}$   
 $0.074 * 0.738 = 0.055$   
 $Q_p = 7.678$

Total of 2 main streams to confluence:  
 Flow rates before confluence point:  
 7.624 0.074  
 Area of streams before confluence:  
 2.620 0.020

Results of confluence:

Total flow rate = 7.678(CFS)  
Time of concentration = 9.415 min.  
Effective stream area after confluence = 2.640(Ac.)

+++++

Process from Point/Station 118.000 to Point/Station 119.000

\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1501.620(Ft.)  
Downstream point/station elevation = 1501.520(Ft.)  
Pipe length = 20.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 7.678(CFS)  
Nearest computed pipe diameter = 21.00(In.)  
Calculated individual pipe flow = 7.678(CFS)  
Normal flow depth in pipe = 12.77(In.)  
Flow top width inside pipe = 20.50(In.)  
Critical Depth = 12.32(In.)  
Pipe flow velocity = 5.02(Ft/s)  
Travel time through pipe = 0.07 min.  
Time of concentration (TC) = 9.48 min.  
End of computations, total study area = 3.03 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.5

# Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR2.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 201.000 to Point/Station 202.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 166.000(Ft.)

Top (of initial area) elevation = 1509.540(Ft.)

Bottom (of initial area) elevation = 1507.830(Ft.)

Difference in elevation = 1.710(Ft.)

Slope = 0.01030 s(percent)= 1.03

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 5.789 min.

Rainfall intensity = 3.863(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.879

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 1.902(CFS)  
Total initial stream area = 0.560(Ac.)  
Pervious area fraction = 0.100

+++++  
Process from Point/Station 202.000 to Point/Station 203.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1501.000(Ft.)  
Downstream point/station elevation = 1500.930(Ft.)  
Pipe length = 13.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 1.902(CFS)  
Nearest computed pipe diameter = 12.00(In.)  
Calculated individual pipe flow = 1.902(CFS)  
Normal flow depth in pipe = 7.59(In.)  
Flow top width inside pipe = 11.57(In.)  
Critical Depth = 7.06(In.)  
Pipe flow velocity = 3.63(Ft/s)  
Travel time through pipe = 0.06 min.  
Time of concentration (TC) = 5.85 min.  
End of computations, total study area = 0.56 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.5



# Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR3.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++

Process from Point/Station 301.000 to Point/Station 302.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 52.000(Ft.)

Top (of initial area) elevation = 1510.240(Ft.)

Bottom (of initial area) elevation = 1509.190(Ft.)

Difference in elevation = 1.050(Ft.)

Slope = 0.02019 s(percent)= 2.02

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.880  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.622(CFS)  
Total initial stream area = 0.170(Ac.)  
Pervious area fraction = 0.100

+++++

Process from Point/Station 302.000 to Point/Station 306.000

\*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1505.190(Ft.)  
Downstream point/station elevation = 1504.550(Ft.)  
Pipe length = 127.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.622(CFS)  
Nearest computed pipe diameter = 9.00(In.)  
Calculated individual pipe flow = 0.622(CFS)  
Normal flow depth in pipe = 4.66(In.)  
Flow top width inside pipe = 8.99(In.)  
Critical Depth = 4.30(In.)  
Pipe flow velocity = 2.70(Ft/s)  
Travel time through pipe = 0.78 min.  
Time of concentration (TC) = 5.78 min.

+++++

Process from Point/Station 302.000 to Point/Station 306.000

\*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 1  
Stream flow area = 0.170(Ac.)  
Runoff from this stream = 0.622(CFS)  
Time of concentration = 5.78 min.  
Rainfall intensity = 3.865(In/Hr)  
Program is now starting with Main Stream No. 2

+++++

Process from Point/Station 303.000 to Point/Station 304.000

\*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 122.000(Ft.)  
Top (of initial area) elevation = 1508.980(Ft.)  
Bottom (of initial area) elevation = 1508.330(Ft.)  
Difference in elevation = 0.650(Ft.)  
Slope = 0.00533 s(percent)= 0.53  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 5.839 min.  
Rainfall intensity = 3.847(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.879  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 1.116(CFS)  
Total initial stream area = 0.330(Ac.)  
Pervious area fraction = 0.100

+++++  
Process from Point/Station 304.000 to Point/Station 306.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1505.160(Ft.)  
Downstream point/station elevation = 1504.550(Ft.)  
Pipe length = 31.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 1.116(CFS)  
Nearest computed pipe diameter = 9.00(In.)  
Calculated individual pipe flow = 1.116(CFS)  
Normal flow depth in pipe = 4.40(In.)  
Flow top width inside pipe = 9.00(In.)  
Critical Depth = 5.83(In.)  
Pipe flow velocity = 5.20(Ft/s)  
Travel time through pipe = 0.10 min.  
Time of concentration (TC) = 5.94 min.

+++++  
Process from Point/Station 304.000 to Point/Station 306.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 2  
Stream flow area = 0.330(Ac.)  
Runoff from this stream = 1.116(CFS)  
Time of concentration = 5.94 min.  
Rainfall intensity = 3.814(In/Hr)  
Program is now starting with Main Stream No. 3

+++++  
Process from Point/Station 305.000 to Point/Station 306.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 31.000(Ft.)  
Top (of initial area) elevation = 1509.230(Ft.)  
Bottom (of initial area) elevation = 1508.110(Ft.)

Difference in elevation = 1.120(Ft.)  
 Slope = 0.03613 s(percent)= 3.61  
 TC =  $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
 Warning: TC computed to be less than 5 min.; program is assuming the  
 time of concentration is 5 minutes.  
 Initial area time of concentration = 5.000 min.  
 Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm  
 COMMERCIAL subarea type  
 Runoff Coefficient = 0.880  
 Decimal fraction soil group A = 0.500  
 Decimal fraction soil group B = 0.000  
 Decimal fraction soil group C = 0.000  
 Decimal fraction soil group D = 0.500  
 RI index for soil(AMC 2) = 53.50  
 Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 1.940(CFS)  
 Total initial stream area = 0.530(Ac.)  
 Pervious area fraction = 0.100

++++++  
 Process from Point/Station 305.000 to Point/Station 306.000  
 \*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 3  
 Stream flow area = 0.530(Ac.)  
 Runoff from this stream = 1.940(CFS)  
 Time of concentration = 5.00 min.  
 Rainfall intensity = 4.157(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.622	5.78	3.865
2	1.116	5.94	3.814
3	1.940	5.00	4.157

Largest stream flow has longer or shorter time of concentration

Qp = 1.940 + sum of  
     Qa      Tb/Ta  
     0.622 \* 0.864 = 0.538  
     Qa      Tb/Ta  
     1.116 \* 0.842 = 0.940  
 Qp = 3.417

Total of 3 main streams to confluence:

Flow rates before confluence point:

0.622    1.116    1.940

Area of streams before confluence:

0.170    0.330    0.530

Results of confluence:

Total flow rate = 3.417(CFS)

Time of concentration = 5.000 min.

Effective stream area after confluence = 1.030(Ac.)

+++++

Process from Point/Station 306.000 to Point/Station 307.000

\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.550(Ft.)

Downstream point/station elevation = 1504.280(Ft.)

Pipe length = 53.00(Ft.) Manning's N = 0.013

No. of pipes = 1 Required pipe flow = 3.417(CFS)

Nearest computed pipe diameter = 15.00(In.)

Calculated individual pipe flow = 3.417(CFS)

Normal flow depth in pipe = 9.61(In.)

Flow top width inside pipe = 14.39(In.)

Critical Depth = 8.94(In.)

Pipe flow velocity = 4.11(Ft/s)

Travel time through pipe = 0.21 min.

Time of concentration (TC) = 5.21 min.

End of computations, total study area = 1.03 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100

Area averaged RI index number = 53.5

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR4.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 401.000 to Point/Station 402.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 64.000(Ft.)

Top (of initial area) elevation = 1510.830(Ft.)

Bottom (of initial area) elevation = 1509.440(Ft.)

Difference in elevation = 1.390(Ft.)

Slope = 0.02172 s(percent)= 2.17

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.880  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.659(CFS)  
Total initial stream area = 0.180(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 402.000 to Point/Station 403.000  
\*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1505.440(Ft.)  
Downstream point/station elevation = 1505.010(Ft.)  
Pipe length = 78.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.659(CFS)  
Nearest computed pipe diameter = 9.00(In.)  
Calculated individual pipe flow = 0.659(CFS)  
Normal flow depth in pipe = 4.69(In.)  
Flow top width inside pipe = 8.99(In.)  
Critical Depth = 4.42(In.)  
Pipe flow velocity = 2.83(Ft/s)  
Travel time through pipe = 0.46 min.  
Time of concentration (TC) = 5.46 min.

++++  
Process from Point/Station 402.000 to Point/Station 403.000  
\*\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.180(Ac.)  
Runoff from this stream = 0.659(CFS)  
Time of concentration = 5.46 min.  
Rainfall intensity = 3.978(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 403.000 to Point/Station 404.000  
\*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 108.000(Ft.)  
Top (of initial area) elevation = 1510.710(Ft.)  
Bottom (of initial area) elevation = 1509.280(Ft.)  
Difference in elevation = 1.430(Ft.)  
Slope = 0.01324 s(percent)= 1.32  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.880

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.500

RI index for soil(AMC 2) = 53.50

Pervious area fraction = 0.100; Impervious fraction = 0.900

Initial subarea runoff = 1.793(CFS)

Total initial stream area = 0.490(Ac.)

Pervious area fraction = 0.100

+++++  
Process from Point/Station 403.000 to Point/Station 404.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 0.490(Ac.)

Runoff from this stream = 1.793(CFS)

Time of concentration = 5.00 min.

Rainfall intensity = 4.157(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.659	5.46	3.978
---	-------	------	-------

2	1.793	5.00	4.157
---	-------	------	-------

Largest stream flow has longer or shorter time of concentration

$Q_p = 1.793 + \text{sum of}$   
 $\frac{Q_a}{0.659} * \frac{T_b}{T_a} = 0.916 = 0.603$

$Q_p = 2.397$

Total of 2 main streams to confluence:

Flow rates before confluence point:

0.659 1.793

Area of streams before confluence:

0.180 0.490

Results of confluence:

Total flow rate = 2.397(CFS)

Time of concentration = 5.000 min.

Effective stream area after confluence = 0.670(Ac.)



+++++  
Process from Point/Station 404.000 to Point/Station 406.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1505.010(Ft.)  
Downstream point/station elevation = 1504.790(Ft.)  
Pipe length = 43.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 2.397(CFS)  
Nearest computed pipe diameter = 12.00(In.)  
Calculated individual pipe flow = 2.397(CFS)  
Normal flow depth in pipe = 9.25(In.)  
Flow top width inside pipe = 10.09(In.)  
Critical Depth = 7.96(In.)  
Pipe flow velocity = 3.69(Ft/s)  
Travel time through pipe = 0.19 min.  
Time of concentration (TC) = 5.19 min.

+++++  
Process from Point/Station 404.000 to Point/Station 406.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.670(Ac.)  
Runoff from this stream = 2.397(CFS)  
Time of concentration = 5.19 min.  
Rainfall intensity = 4.078(In/Hr)  
Program is now starting with Main Stream No. 2

+++++  
Process from Point/Station 405.000 to Point/Station 406.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 43.000(Ft.)  
Top (of initial area) elevation = 1511.620(Ft.)  
Bottom (of initial area) elevation = 1509.930(Ft.)  
Difference in elevation = 1.690(Ft.)  
Slope = 0.03930 s(percent)= 3.93  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.  
Initial area time of concentration = 5.000 min.  
Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.880  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50

Pervious area fraction = 0.100; Impervious fraction = 0.900  
 Initial subarea runoff = 0.476(CFS)  
 Total initial stream area = 0.130(Ac.)  
 Pervious area fraction = 0.100

++++  
 Process from Point/Station 405.000 to Point/Station 406.000  
 \*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
 Stream flow area = 0.130(Ac.)  
 Runoff from this stream = 0.476(CFS)  
 Time of concentration = 5.00 min.  
 Rainfall intensity = 4.157(In/Hr)  
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	2.397	5.19	4.078
2	0.476	5.00	4.157

Largest stream flow has longer time of concentration  
 $Q_p = 2.397 + \text{sum of}$   
 $\quad Q_b \quad I_a/I_b$   
 $\quad 0.476 * 0.981 = 0.467$   
 $Q_p = 2.863$

Total of 2 main streams to confluence:  
 Flow rates before confluence point:  
 2.397 0.476  
 Area of streams before confluence:  
 0.670 0.130

Results of confluence:  
 Total flow rate = 2.863(CFS)  
 Time of concentration = 5.194 min.  
 Effective stream area after confluence = 0.800(Ac.)

++++  
 Process from Point/Station 406.000 to Point/Station 413.000  
 \*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.790(Ft.)  
 Downstream point/station elevation = 1504.320(Ft.)  
 Pipe length = 91.00(Ft.) Manning's N = 0.013  
 No. of pipes = 1 Required pipe flow = 2.863(CFS)  
 Nearest computed pipe diameter = 15.00(In.)  
 Calculated individual pipe flow = 2.863(CFS)

Normal flow depth in pipe = 8.52(In.)  
Flow top width inside pipe = 14.86(In.)  
Critical Depth = 8.16(In.)  
Pipe flow velocity = 3.98(Ft/s)  
Travel time through pipe = 0.38 min.  
Time of concentration (TC) = 5.58 min.

++++  
Process from Point/Station 406.000 to Point/Station 413.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.800(Ac.)  
Runoff from this stream = 2.863(CFS)  
Time of concentration = 5.58 min.  
Rainfall intensity = 3.937(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 407.000 to Point/Station 413.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 72.000(Ft.)  
Top (of initial area) elevation = 1511.130(Ft.)  
Bottom (of initial area) elevation = 1510.200(Ft.)  
Difference in elevation = 0.930(Ft.)  
Slope = 0.01292 s(percent)= 1.29  
TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$   
Warning: TC computed to be less than 5 min.; program is assuming the  
time of concentration is 5 minutes.  
Initial area time of concentration = 5.000 min.  
Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.880  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.695(CFS)  
Total initial stream area = 0.190(Ac.)  
Pervious area fraction = 0.100

++++  
Process from Point/Station 407.000 to Point/Station 413.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2  
Stream flow area = 0.190(Ac.)  
Runoff from this stream = 0.695(CFS)  
Time of concentration = 5.00 min.  
Rainfall intensity = 4.157(In/Hr)  
Program is now starting with Main Stream No. 3

+++++  
Process from Point/Station 409.000 to Point/Station 410.000  
\*\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*\*

---

Initial area flow distance = 133.000(Ft.)  
Top (of initial area) elevation = 1511.600(Ft.)  
Bottom (of initial area) elevation = 1510.400(Ft.)  
Difference in elevation = 1.200(Ft.)  
Slope = 0.00902 s(percent)= 0.90  
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 5.440 min.  
Rainfall intensity = 3.985(In/Hr) for a 100.0 year storm  
COMMERCIAL subarea type  
Runoff Coefficient = 0.880  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.526(CFS)  
Total initial stream area = 0.150(Ac.)  
Pervious area fraction = 0.100

+++++  
Process from Point/Station 410.000 to Point/Station 412.000  
\*\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*\*

---

Upstream point/station elevation = 1506.400(Ft.)  
Downstream point/station elevation = 1505.500(Ft.)  
Pipe length = 66.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 0.526(CFS)  
Nearest computed pipe diameter = 6.00(In.)  
Calculated individual pipe flow = 0.526(CFS)  
Normal flow depth in pipe = 4.07(In.)  
Flow top width inside pipe = 5.61(In.)  
Critical Depth = 4.44(In.)  
Pipe flow velocity = 3.71(Ft/s)  
Travel time through pipe = 0.30 min.  
Time of concentration (TC) = 5.74 min.

+++++  
Process from Point/Station 410.000 to Point/Station 412.000

\*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 3 in normal stream number 1

Stream flow area = 0.150(Ac.)

Runoff from this stream = 0.526(CFS)

Time of concentration = 5.74 min.

Rainfall intensity = 3.881(In/Hr)

+++++

Process from Point/Station 411.000 to Point/Station 412.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 48.000(Ft.)

Top (of initial area) elevation = 1510.410(Ft.)

Bottom (of initial area) elevation = 1509.820(Ft.)

Difference in elevation = 0.590(Ft.)

Slope = 0.01229 s(percent)= 1.23

TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$

Warning: TC computed to be less than 5 min.; program is assuming the time of concentration is 5 minutes.

Initial area time of concentration = 5.000 min.

Rainfall intensity = 4.157(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.880

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.500

RI index for soil(AMC 2) = 53.50

Pervious area fraction = 0.100; Impervious fraction = 0.900

Initial subarea runoff = 0.769(CFS)

Total initial stream area = 0.210(Ac.)

Pervious area fraction = 0.100

+++++

Process from Point/Station 411.000 to Point/Station 412.000

\*\*\*\* CONFLUENCE OF MINOR STREAMS \*\*\*\*

---

Along Main Stream number: 3 in normal stream number 2

Stream flow area = 0.210(Ac.)

Runoff from this stream = 0.769(CFS)

Time of concentration = 5.00 min.

Rainfall intensity = 4.157(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.526	5.74	3.881
---	-------	------	-------

2	0.769	5.00	4.157
---	-------	------	-------

Largest stream flow has longer or shorter time of concentration

$$Q_p = 0.769 + \text{sum of} \\ Q_a \quad T_b/T_a \\ 0.526 * 0.872 = 0.458 \\ Q_p = 1.227$$

Total of 2 streams to confluence:

Flow rates before confluence point:

$$0.526 \quad 0.769$$

Area of streams before confluence:

$$0.150 \quad 0.210$$

Results of confluence:

Total flow rate = 1.227(CFS)

Time of concentration = 5.000 min.

Effective stream area after confluence = 0.360(Ac.)

+++++  
Process from Point/Station 412.000 to Point/Station 413.000  
\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1505.500(Ft.)  
Downstream point/station elevation = 1504.320(Ft.)  
Pipe length = 117.00(Ft.) Manning's N = 0.013  
No. of pipes = 1 Required pipe flow = 1.227(CFS)  
Nearest computed pipe diameter = 9.00(In.)  
Calculated individual pipe flow = 1.227(CFS)  
Normal flow depth in pipe = 5.75(In.)  
Flow top width inside pipe = 8.64(In.)  
Critical Depth = 6.12(In.)  
Pipe flow velocity = 4.11(Ft/s)  
Travel time through pipe = 0.47 min.  
Time of concentration (TC) = 5.47 min.

+++++  
Process from Point/Station 412.000 to Point/Station 413.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 3

Stream flow area = 0.360(Ac.)

Runoff from this stream = 1.227(CFS)

Time of concentration = 5.47 min.

Rainfall intensity = 3.973(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	2.863	5.58	3.937
2	0.695	5.00	4.157

3      1.227      5.47      3.973

Largest stream flow has longer time of concentration

Qp = 2.863 + sum of

Qb      Ia/Ib

0.695 \* 0.947 = 0.658

Qb      Ia/Ib

1.227 \* 0.991 = 1.216

Qp = 4.737

Total of 3 main streams to confluence:

Flow rates before confluence point:

2.863      0.695      1.227

Area of streams before confluence:

0.800      0.190      0.360

Results of confluence:

Total flow rate = 4.737(CFS)

Time of concentration = 5.575 min.

Effective stream area after confluence = 1.350(Ac.)

+++++

Process from Point/Station 413.000 to Point/Station 414.000

\*\*\*\* PIPEFLOW TRAVEL TIME (Program estimated size) \*\*\*\*

---

Upstream point/station elevation = 1504.320(Ft.)

Downstream point/station elevation = 1504.270(Ft.)

Pipe length = 10.00(Ft.) Manning's N = 0.013

No. of pipes = 1 Required pipe flow = 4.737(CFS)

Nearest computed pipe diameter = 18.00(In.)

Calculated individual pipe flow = 4.737(CFS)

Normal flow depth in pipe = 10.44(In.)

Flow top width inside pipe = 17.77(In.)

Critical Depth = 10.03(In.)

Pipe flow velocity = 4.46(Ft/s)

Travel time through pipe = 0.04 min.

Time of concentration (TC) = 5.61 min.

End of computations, total study area = 1.35 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100

Area averaged RI index number = 53.5

# G





Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODEX2.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 201.000 to Point/Station 203.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 122.000(Ft.)

Top (of initial area) elevation = 1510.400(Ft.)

Bottom (of initial area) elevation = 1509.500(Ft.)

Difference in elevation = 0.900(Ft.)

Slope = 0.00738 s(percent)= 0.74

TC =  $k(0.530)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$

Initial area time of concentration = 9.666 min.

Rainfall intensity = 2.018(In/Hr) for a 10.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.759

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 0.168(CFS)  
Total initial stream area = 0.110(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 201.000 to Point/Station 203.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.110(Ac.)  
Runoff from this stream = 0.168(CFS)  
Time of concentration = 9.67 min.  
Rainfall intensity = 2.018(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 202.000 to Point/Station 203.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 341.000(Ft.)  
Top (of initial area) elevation = 1511.400(Ft.)  
Bottom (of initial area) elevation = 1509.500(Ft.)  
Difference in elevation = 1.900(Ft.)  
Slope = 0.00557 s(percent)= 0.56  
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 15.423 min.  
Rainfall intensity = 1.598(In/Hr) for a 10.0 year storm  
UNDEVELOPED (poor cover) subarea  
Runoff Coefficient = 0.729  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 0.338(CFS)  
Total initial stream area = 0.290(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 202.000 to Point/Station 203.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 0.290(Ac.)

Runoff from this stream = 0.338(CFS)

Time of concentration = 15.42 min.

Rainfall intensity = 1.598(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.168	9.67	2.018
2	0.338	15.42	1.598

Largest stream flow has longer time of concentration

$Q_p = 0.338 + \text{sum of}$

$\frac{Q_b}{I_a/I_b}$

$0.168 * 0.792 = 0.133$

$Q_p = 0.471$

Total of 2 main streams to confluence:

Flow rates before confluence point:

0.168 0.338

Area of streams before confluence:

0.110 0.290

Results of confluence:

Total flow rate = 0.471(CFS)

Time of concentration = 15.423 min.

Effective stream area after confluence = 0.400(Ac.)

End of computations, total study area = 0.40 (Ac.)

The following figures may be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 1.000

Area averaged RI index number = 78.0

## Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 10/26/17 File:COTTONWOODEX3.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++

Process from Point/Station 301.000 to Point/Station 302.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 637.000(Ft.)

Top (of initial area) elevation = 1511.390(Ft.)

Bottom (of initial area) elevation = 1508.200(Ft.)

Difference in elevation = 3.190(Ft.)

Slope = 0.00501 s(percent)= 0.50

$TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 20.230 min.

Rainfall intensity = 1.395(In/Hr) for a 10.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.709

Decimal fraction soil group A = 0.486

Decimal fraction soil group B = 0.028  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.486  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 0.218(CFS)  
Total initial stream area = 0.220(Ac.)  
Pervious area fraction = 1.000  
End of computations, total study area = 0.22 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 1.000  
Area averaged RI index number = 78.0

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODEX2.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 201.000 to Point/Station 203.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 122.000(Ft.)

Top (of initial area) elevation = 1510.400(Ft.)

Bottom (of initial area) elevation = 1509.500(Ft.)

Difference in elevation = 0.900(Ft.)

Slope = 0.00738 s(percent)= 0.74

$TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 9.666 min.

Rainfall intensity = 2.990(In/Hr) for a 100.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.799

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 0.263(CFS)  
Total initial stream area = 0.110(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 201.000 to Point/Station 203.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:  
In Main Stream number: 1  
Stream flow area = 0.110(Ac.)  
Runoff from this stream = 0.263(CFS)  
Time of concentration = 9.67 min.  
Rainfall intensity = 2.990(In/Hr)  
Program is now starting with Main Stream No. 2

++++  
Process from Point/Station 202.000 to Point/Station 203.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

---

Initial area flow distance = 341.000(Ft.)  
Top (of initial area) elevation = 1511.400(Ft.)  
Bottom (of initial area) elevation = 1509.500(Ft.)  
Difference in elevation = 1.900(Ft.)  
Slope = 0.00557 s(percent)= 0.56  
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 15.423 min.  
Rainfall intensity = 2.367(In/Hr) for a 100.0 year storm  
UNDEVELOPED (poor cover) subarea  
Runoff Coefficient = 0.777  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 0.533(CFS)  
Total initial stream area = 0.290(Ac.)  
Pervious area fraction = 1.000

++++  
Process from Point/Station 202.000 to Point/Station 203.000  
\*\*\*\* CONFLUENCE OF MAIN STREAMS \*\*\*\*

---

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 0.290(Ac.)

Runoff from this stream = 0.533(CFS)

Time of concentration = 15.42 min.

Rainfall intensity = 2.367(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.263	9.67	2.990
2	0.533	15.42	2.367

Largest stream flow has longer time of concentration

$Q_p = 0.533 + \text{sum of}$

$Q_b \quad I_a/I_b$

$0.263 * 0.792 = 0.208$

$Q_p = 0.741$

Total of 2 main streams to confluence:

Flow rates before confluence point:

0.263      0.533

Area of streams before confluence:

0.110      0.290

Results of confluence:

Total flow rate = 0.741(CFS)

Time of concentration = 15.423 min.

Effective stream area after confluence = 0.400(Ac.)

End of computations, total study area = 0.40 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 1.000

Area averaged RI index number = 78.0



Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODEX3.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 301.000 to Point/Station 302.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 637.000(Ft.)

Top (of initial area) elevation = 1511.390(Ft.)

Bottom (of initial area) elevation = 1508.200(Ft.)

Difference in elevation = 3.190(Ft.)

Slope = 0.00501 s(percent)= 0.50

$TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 20.230 min.

Rainfall intensity = 2.067(In/Hr) for a 100.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.761

Decimal fraction soil group A = 0.486

Decimal fraction soil group B = 0.028  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.486  
RI index for soil(AMC 2) = 78.00  
Pervious area fraction = 1.000; Impervious fraction = 0.000  
Initial subarea runoff = 0.346(CFS)  
Total initial stream area = 0.220(Ac.)  
Pervious area fraction = 1.000  
End of computations, total study area = 0.22 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 1.000  
Area averaged RI index number = 78.0

APPENDIX

H



# Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR5.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 501.000 to Point/Station 502.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 637.000(Ft.)

Top (of initial area) elevation = 1511.390(Ft.)

Bottom (of initial area) elevation = 1508.200(Ft.)

Difference in elevation = 3.190(Ft.)

Slope = 0.00501 s(percent)= 0.50

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 11.451 min.

Rainfall intensity = 1.854(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.865

Decimal fraction soil group A = 0.486

Decimal fraction soil group B = 0.028  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.486  
RI index for soil(AMC 2) = 53.57  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.353(CFS)  
Total initial stream area = 0.220(Ac.)  
Pervious area fraction = 0.100  
End of computations, total study area = 0.22 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.6

## Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR6.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.810(In/Hr)

Slope of intensity duration curve = 0.5000

+++++

Process from Point/Station 601.000 to Point/Station 602.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 429.000(Ft.)

Top (of initial area) elevation = 1511.400(Ft.)

Bottom (of initial area) elevation = 1510.100(Ft.)

Difference in elevation = 1.300(Ft.)

Slope = 0.00303 s(percent)= 0.30

TC =  $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$

Initial area time of concentration = 10.810 min.

Rainfall intensity = 1.908(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.866

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.661(CFS)  
Total initial stream area = 0.400(Ac.)  
Pervious area fraction = 0.100  
End of computations, total study area = 0.40 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.5

# Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0

Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR5.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++

Process from Point/Station 501.000 to Point/Station 502.000

\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 637.000(Ft.)

Top (of initial area) elevation = 1511.390(Ft.)

Bottom (of initial area) elevation = 1508.200(Ft.)

Difference in elevation = 3.190(Ft.)

Slope = 0.00501 s(percent)= 0.50

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 11.451 min.

Rainfall intensity = 2.747(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.873

Decimal fraction soil group A = 0.486



Decimal fraction soil group B = 0.028  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.486  
RI index for soil(AMC 2) = 53.57  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.528(CFS)  
Total initial stream area = 0.220(Ac.)  
Pervious area fraction = 0.100  
End of computations, total study area = 0.22 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.6

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0  
Rational Hydrology Study Date: 10/26/17 File:COTTONWOODPR6.out

\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

English (in-lb) Units used in input data file

Program License Serial Number 6390

Rational Method Hydrology Program based on  
Riverside County Flood Control & Water Conservation District  
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [ San Jacinto ] area used.

10 year storm 10 minute intensity = 1.980(In/Hr)

10 year storm 60 minute intensity = 0.810(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

+++++  
Process from Point/Station 601.000 to Point/Station 602.000  
\*\*\*\* INITIAL AREA EVALUATION \*\*\*\*

Initial area flow distance = 429.000(Ft.)

Top (of initial area) elevation = 1511.400(Ft.)

Bottom (of initial area) elevation = 1510.100(Ft.)

Difference in elevation = 1.300(Ft.)

Slope = 0.00303 s(percent)= 0.30

$TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$

Initial area time of concentration = 10.810 min.

Rainfall intensity = 2.827(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.874

Decimal fraction soil group A = 0.500

Decimal fraction soil group B = 0.000  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.500  
RI index for soil(AMC 2) = 53.50  
Pervious area fraction = 0.100; Impervious fraction = 0.900  
Initial subarea runoff = 0.988(CFS)  
Total initial stream area = 0.400(Ac.)  
Pervious area fraction = 0.100  
End of computations, total study area = 0.40 (Ac.)  
The following figures may  
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction( $A_p$ ) = 0.100  
Area averaged RI index number = 53.5