HYDROLOGY / HYDRAULICS STUDY

FOR THE:
Pala Mesa Plaza
3233 Old Highway 395
Fallbrook, CA 92028
APN: 125-050-54-00

PREPARED FOR:
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Project No: 19-025

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1.0 PROJECT DESCRIPTION

1.1 Purpose of Study

The purpose of this study is to support the site redevelopment plans for an existing commercial property located in the jurisdictional boundary of the County of San Diego. This study will demonstrate that the post-development 100-year peak runoff will not exceed existing peak runoff rates.

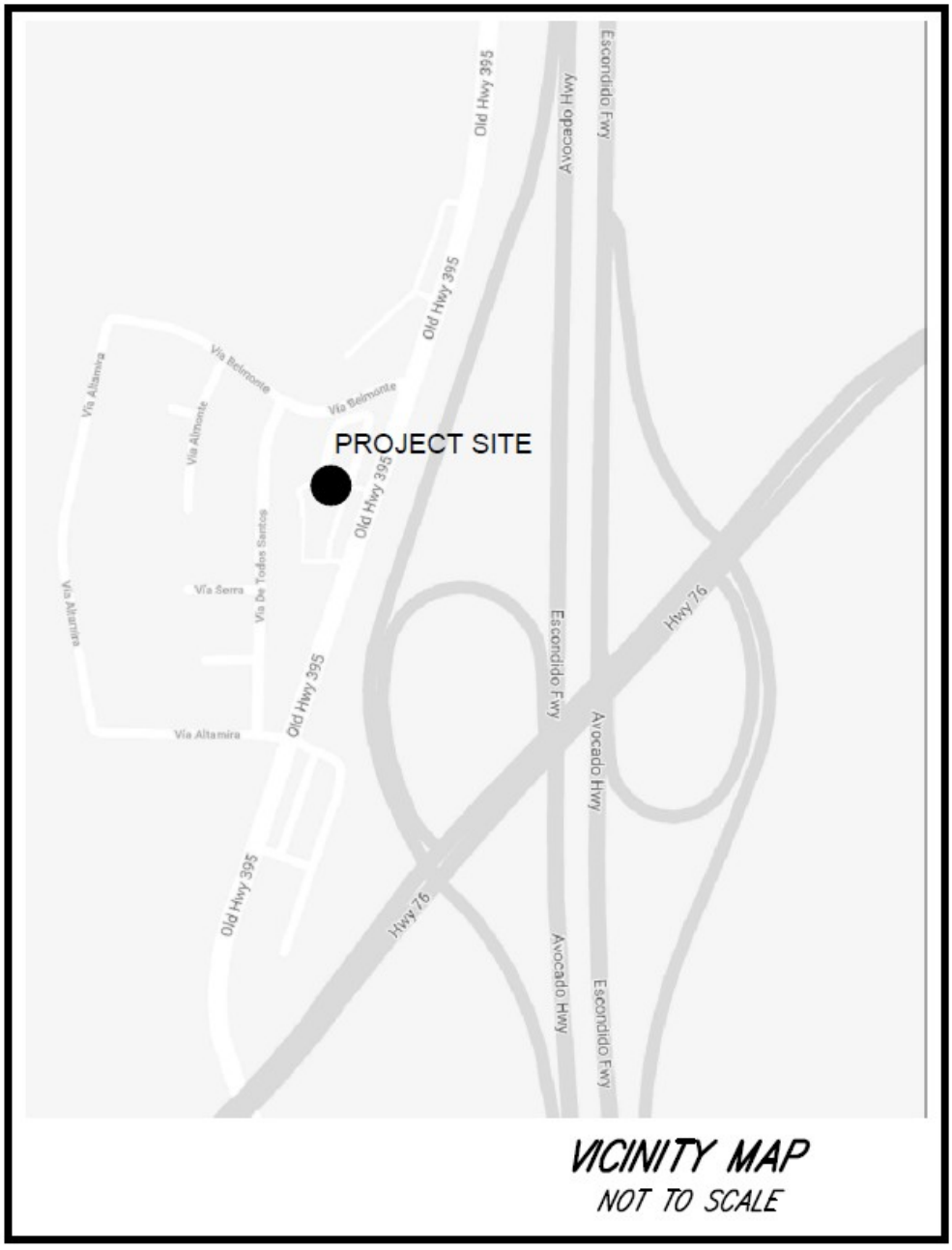
1.2 Project Description

The site is an existing low-density commercial site composed of a small grocery store market, a small hamburger restaurant, and an existing operating landscape nursery. The project fronts onto old highway 395 which bounds the project to the east.

The project proposes to retain the two existing buildings, add two new retail buildings near the northern portion of the site, and add a third convenience store building near the southern point of the site. The convenience store will include a six-pump fuel island. Along with the newly constructed buildings, the project proposes to add reconfigured parking spaces, drive isles and various patio areas and walkways throughout the site. The project will have two access points to Old Highway 395.

2.0 VICINITY MAP

The project is located on the western side of Old Highway 395 just north of the intersection of Interstate 15 and Highway 76 Pala Road, in the county of San Diego, California.



3.0 DESCRIPTION OF WATERSHED

3.1 Pre-Development Topography and Drainage Patterns

The site is an existing low-density commercial site composed of a small grocery store market, a small hamburger restaurant, and an existing operating landscape nursery. The project fronts onto old highway 395 which bounds the project to the east. The project is bounded by Via De Todos Santos to the west, and Via Belmonte to the north. The property drains primarily by overland flow to an existing drain inlet located at about the mid north/south point near the easterly boundary of the site along Old Highway 395. The site is relatively level with a small 2:l cut slope forming the rear of the property where it meets grade with Via De Todos Santos. According to the Web Soil Survey, the western 25% property is composed of Soils Type A (along the cut slope). The remainder of the property is Soil Type C. The site is well traveled, and compaction of topsoil is estimated to be high. The same runoff factors will be used for the overall project calculations.

The approximately average percentage of impervious of the existing site condition was estimated based on aerial photography and detailed aerial topographic mapping. The approximately average percentage of impervious of the existing site condition is 30%. From Table 3-l "RUNOFF COEFFICIENTS FOR URBAN AREA", values of runoff coefficient "C" for 30% impervious are used in the pre-development **onsite** runoff calculations. The Runoff Coefficient C value is chosen based on the percentage of impervious of the entire site.

There is a drainage pipe that crosses the site and meets the on-site discharge at the onsite drain inlet at the POC. The drainpipe conveys the discharge of a portion of Via Todos Santos and the tributary offsite area of approximately 5 acres of the neighboring residential subdivision. The approximately average percentage of impervious of this offsite drainage area is 40%. From table 3-l values of runoff coefficient "C" for 40% impervious are used in the pre-development **offsite** pass-through drainage calculations.

A pre-developed drainage map can be found as Attachment 2 in this report.

3.2 Post-Development Topography and Drainage Patterns

The project proposes to retain the two existing buildings and add two new retail buildings near the northern portion of the site, and a third convenience store building near the southern point of the site. The convenience store will include a six-pump fuel island. Along with the additional new buildings the project proposes to add reconfigured parking spaces, drive isles and various patio areas and walkways throughout the site. The project will have two access points to Old Highway 395.

The project proposed to install several biofiltration basins for storm water quality to incorporate the collection of storm water from the building and parking lot and

direct the storm water through storm water drainage pipes to POC, which is located at the east edge of the study site.

The average impervious square footage of the post-development was estimated based on aerial photography and detailed aerial topographic mapping to be approximately 80% of the site. From table 3-l "RUNOFF COEFFICIENTS FOR URBAN AREAs", runoff coefficients for 80% impervious will be used in the post-development runoff calculations.

A post-developed drainage map can be found as Attachment 2 in this report.

At node 107, the proposed connection to the public storm drain system, the flows provide an increase in runoff of 0.391 cfs, therefore, BMP-802 is being used for the peak flow detention. After mitigation, the flows at this proposed connection to the public storm system decreased by 1.378 cfs. Please see the mitigation calculations in Attachment 3g and Hydrograph report in Attachment 5 in this report.

3.3 Hydrologic Unit Contribution

The project is located in the Bonsall Hydrologic Sub Area of the Lower San Luis Rey Hydrologic Area of the San Luis Rey Hydrologic Unit (903.12). The project is tributary to a public storm drain system that discharges to the San Luis Rey River.

A map showing the project location with respect to the hydrologic basin areas can be found in Attachment 2 in this report.

4.0 METHODOLOGY

This report is prepared in accordance with the 2003 San Diego County Hydrology Manual (Hydrology Manual). Based on the overall tributary study area, calculations are based on the Rational Method.

4.1 Hydrology Software

The main program is the "San Diego County Rational Hydrology Program" by CIVILCADD/CIVILDESIGN Engineering Software, 1991-2004 Version 7.4, refereed hereafter as "CIVILD". This program specifically utilizes the methods prescribed in the County of San Diego Hydrology Manual and is one of the approved programs for the use in the San Diego area.

4.2 Routing Software

Hydraflow Hydrographs Extension for Autodesk Civil 3D, Version 2021is used for hydrologic routing of the entire project site. The hydrograph developed from the rational method is then manually entered into this software and routed into detention system. The hydrograph report can be found in Attachment 5 in this

report.

4.3 Soils Type Determination

The soils type for the project was determined by mapping the project limits on the EPA Web Soil Survey website. The Web Soil Survey indicates that the entire site is composed of soil types A and C. By observation, Appendix A of the Hydrology Manual supports the use of these two soil types in the calculations.

4.4 Isopluvial Value Determination

The isopluvial values for the l00-year 6 hour and 24-hour storm events were determined by plotting the project's location on the respective exhibits from Appendix B of the Hydrology Manual.

4.5 CEQA Requirements

The proposed project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. No significant alteration of any stream or river will occur on this site due to grading operations. All defined drainage channels are due to erosive effects of high velocity runoff from the uphill slopes. The development of the site will help mitigate further erosion downstream.

- The proposed project does not create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems. The flows from the project leave the site at less than predeveloped rates per the mitigated flow rates shown.

- The proposed project does not place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps. No housing is proposed, and no FIRM identified flood hazard areas are located on the parcel.

- The proposed project does not place structures within a 100-year flood hazard area which would impede or redirect flood flows. No FIRM identified flood hazard areas are located on the parcel.

- The proposed project does not expose people or structures to a significant risk of loss, injury or death involving flooding as a result of the failure of a levee or dam. No levees or dams are proposed, and all runoff is being mitigated in properly designed flow control basins with redundancies. This will be noted in the conclusion.

5.0 CALCULATIONS

5.1 Determination of Drainage Area Parameters

The drainage area parameters are determined by delineating the extents and flow direction of runoff from each of the pre and post development drainage areas and measuring the respective changes in elevation, flow length and drainage area acreage. See Attachments **1** and 2 of this report for the respective drainage area exhibits.

5.2 Runoff Coefficient

The runoff coefficients for each of the drainage areas are taken from Table 3-l of the Hydrology Manual. Based on the EPA Web Soil Survey, this project site is type A and type C soil. The runoff coefficients C are based on the %IMPER. for this project. The runoff coefficients for each of the drainage areas are taken from Table 3-l of the San Diego County Hydrology Manual. For this project, the approximately average percent of impervious of the post development is 80%.

Table 3-l is included in the CIVILD software, and the values chosen based on the program input parameters. The output file was checked to ensure that the correct C values are used.

In order to not have a negative impact on the post development downstream facilities, detention structure is needed in this project. The method we are using here on how to use the resulting values of the outflow hydrograph is recalculate the runoff coefficient C value based on fix values of the outflow hydrograph to achieve a C_{out}. The detailed description and calculation of the C_{out} value can be found in Attachment 5 in this report.

5.3 Manning Roughness Coefficient

Three values for the Manning Roughness Coefficient are used in the hydrology calculations. One for the overland flow travel time calculations, second for the pipe flow friction factor, and third for the street section/gutter flow calculations.

For the closed conduit calculations, the value for the roughness coefficient is taken from the Hydraulic Design Manual Table A-2. It is assumed that pipe material of Smooth Plastic Pipe (HPDE and PVC), Spiral Rib Pipe, Reinforced Concrete Pipe (RCP), or a similar material will be used on the project. The Manning's n factor for this class of pipe material is 0.0l3.

For the paved street surfaces and the gutter flow calculations, a value of 0.0l3 is used. This is taken from the hydraulic design manual, Table A-l and Table A-3.

5.4 Rational Method Calculation Summary

The peak runoff values for the 100-year storm are calculated according to the Hydrology Manual rational method. The calculations are performed using the CivilD software. A summary of the initial calculations is summarized in the table below:

Summary Table of Drainage diescharges from the Project							
	Node Number	Q100** (cfs)	Area (Acres)	Tc (Min)	V100 (ft/s)	C*	I* (in/hr)
PRE	POC Node 406	**34.46**	11.192	9.26	19.5	0.5	6.2
POST	POC Node 109	**34.17**	11.192	9.34	19.34	0.5	6.16
POST MITIGATION	POC Node 109	**32.795**	11.192	9.33	21.43	0.48	6.17

Table 1: Q-100 Analysis Results

Note: The comparison of our analysis is made about the same discharge points for the project. Drainage discharging from the project to the existing l8 inches pipe.

Note:

*Average rainfall intensity is calculated based on $I = 7.44*P_6T_c^{-O.645}$. Average runoff coefficient "C" is calculated based on Q = CIA.

** The total discharge here include the public road improvements.

Summary of Post Unmitigated Flows at Each BMP

Basin Node	Area (Acres)	Q100 (cfs)
BMP-103 Node-103	**1.020**	**3.125**
BMP-201 Node-202	**0.540**	**4.183**
BMP-302 Node-302	**0.310**	**2.230**
BMP-401 Node-402	**0.180**	**1.295**
BMP-503 Node-503	**0.566**	**2.554**
BMP-602 Node-602	**0.170**	**1.223**
BMP-702 Node-702	**0.320**	**1.743**
BMP-802 Node-802	**0.970**	**2.674**

Table 2: Q-100 flows at each basin node

Per Table 1 (see above) the post development flow of 34.17 cfs is lower than the pre-development flow of 34.46 cfs.

CivilD data and output files can be found in Attachment 3 of this report.

By observation of the results in the summary table, the proposed redevelopment of the site will have an overall decrease in the 100-year peak flow discharge from the site.

6.0 CONCLUSION

Based on the results of this report, the project does not increase the 100-year peak flow rate of the mitigated stormwater discharge from the site as flows are lower than those of the Pre-development. The project meets the County of San Diego standards for peak flow control and therefore can concluded that this project will not impact the existing downstream storm drainage facilities.

This project does not sit within a 100-year flood hazard zone as mapped on the federal Flood Insurance Rate maps for this area.

- The proposed project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. No significant alteration of any stream or river will occur on this site due to grading

operations. All defined drainage channels are due to erosive effects of high velocity runoff from the uphill slopes. The development of the site will help mitigate further erosion downstream.

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7.0 REFERENCES

County of San Diego Hydrology Manual, June 2003
San Diego County Hydraulic Design Manual, September 2014

8.0 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 codes, and that the design is consistent with current design.

I understand that the check of the project drawings and specifications by the City of San Marcos is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

ENGINEER OF WORK
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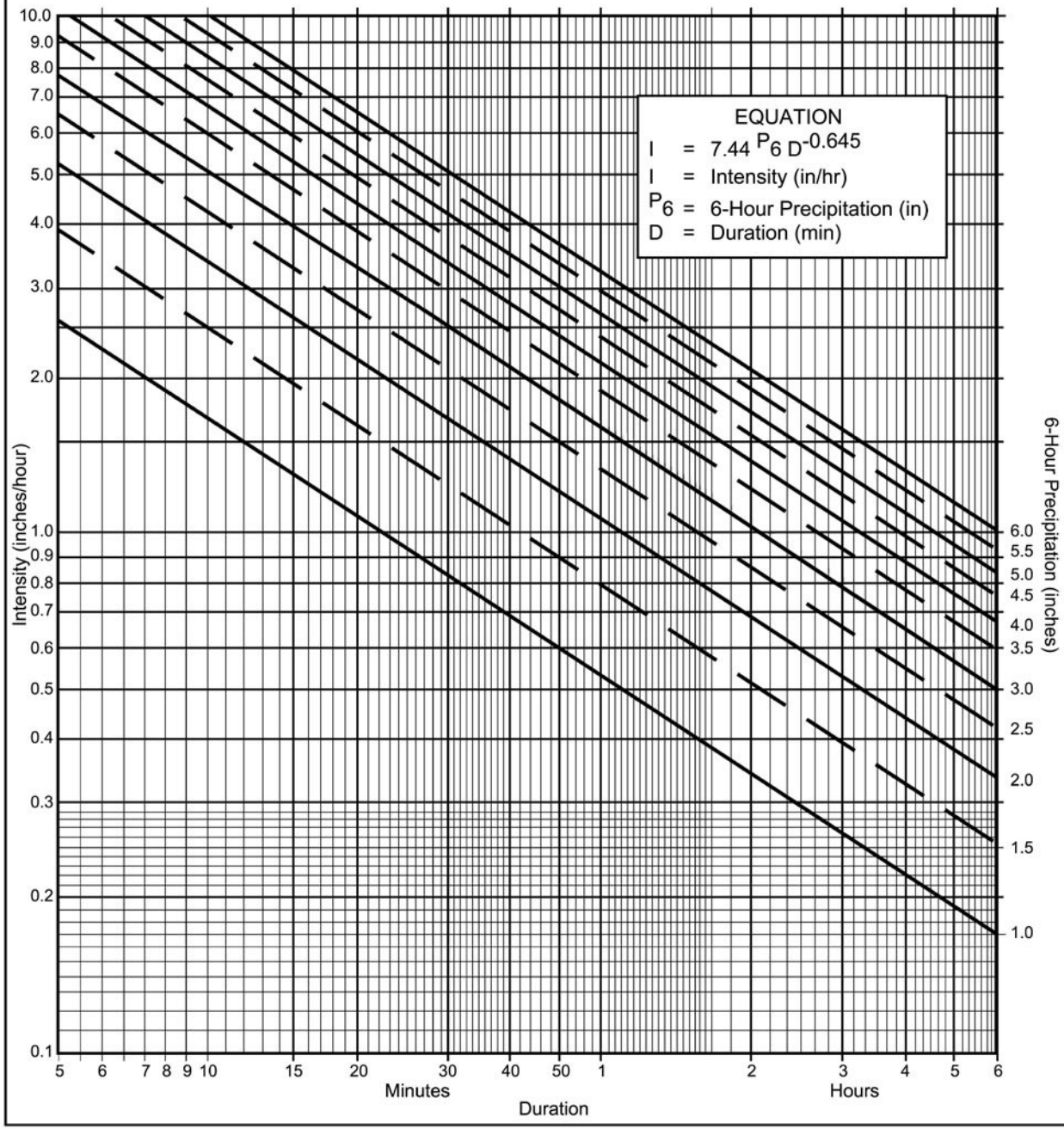
Project Number: 19-025

Robert D. Dentino, RCE 45629
Registration Expire: December 31, 2024

4/07/23
Date

ATTACHMENT 1



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency _____ year

(b) P_6 = _____ in., P_{24} = _____, $\frac{P_6}{P_{24}}$ = _____ %(2)

(c) Adjusted P_6(2) = _____ in.

(d) t_x = _____ min.

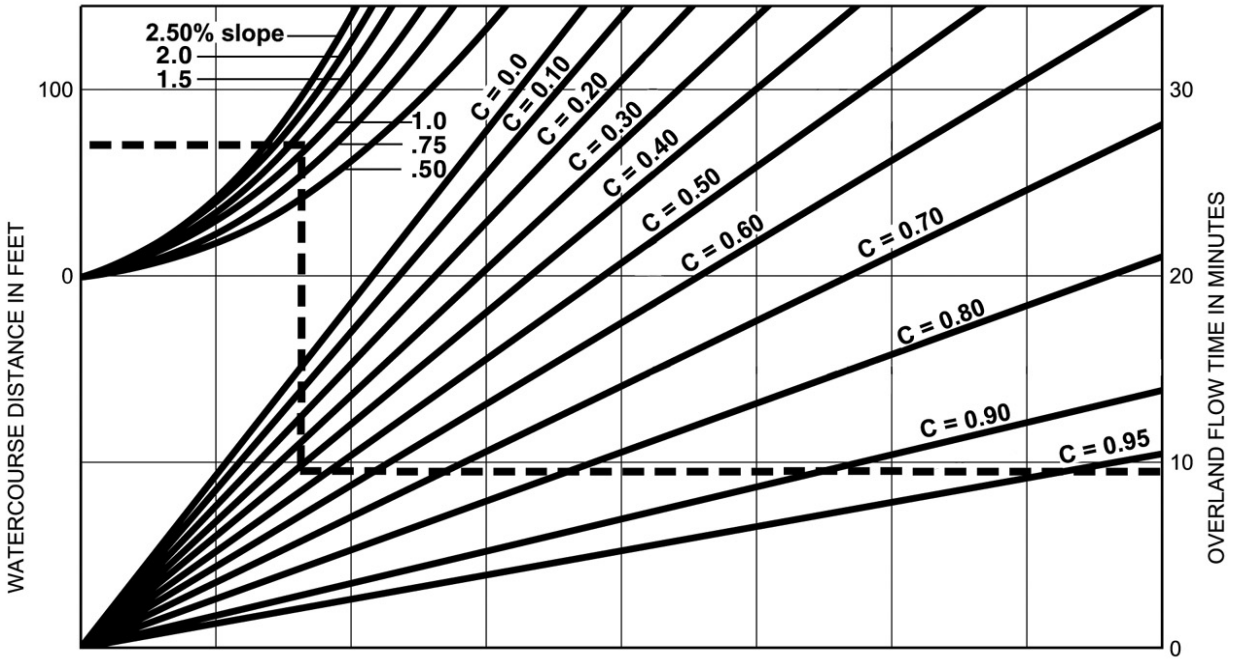
(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

3-3

Rational Formula - Overland Time of Flow Nomograph

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

Table A-2 Average Manning Roughness Coefficients for Closed Conduits[3]

Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe and Pipe Arch	
2-3/8 x 1/2 inch Corrugations	
Unlined	0.024
Half Lined	
Full Flow	0.018
d/D>=0.60	0.016
d/D<0.60	0.013
Fully Lined	0.013
3 x 1 inch Corrugations	0.027
6 x 2 inch Corrugations	0.032
Spiral Rib Pipe	0.013
Helically Wound Pipe	
18-inch	0.015
24-inch	0.017
30-inch	0.019
36-inch	0.021
42-inch	0.022
48-inch	0.023
Plastic Pipe (HPDE and PVC)	
Smooth	0.013
Corrugated	0.024
Vitrified Clay Pipe	0.014
Cast-Iron Pipe (Uncoated)	0.013
Steel Pipe	0.011
Brick	0.017
Cast-In-Place Concrete Pipe	
Rough Wood Forms	0.017
Smooth Wood or Steel Forms	0.014

[3] Based on materials and workmanship required by standard specifications.

Table A-5

Table A-5 Average Manning Roughness Coefficients for Natural Channels

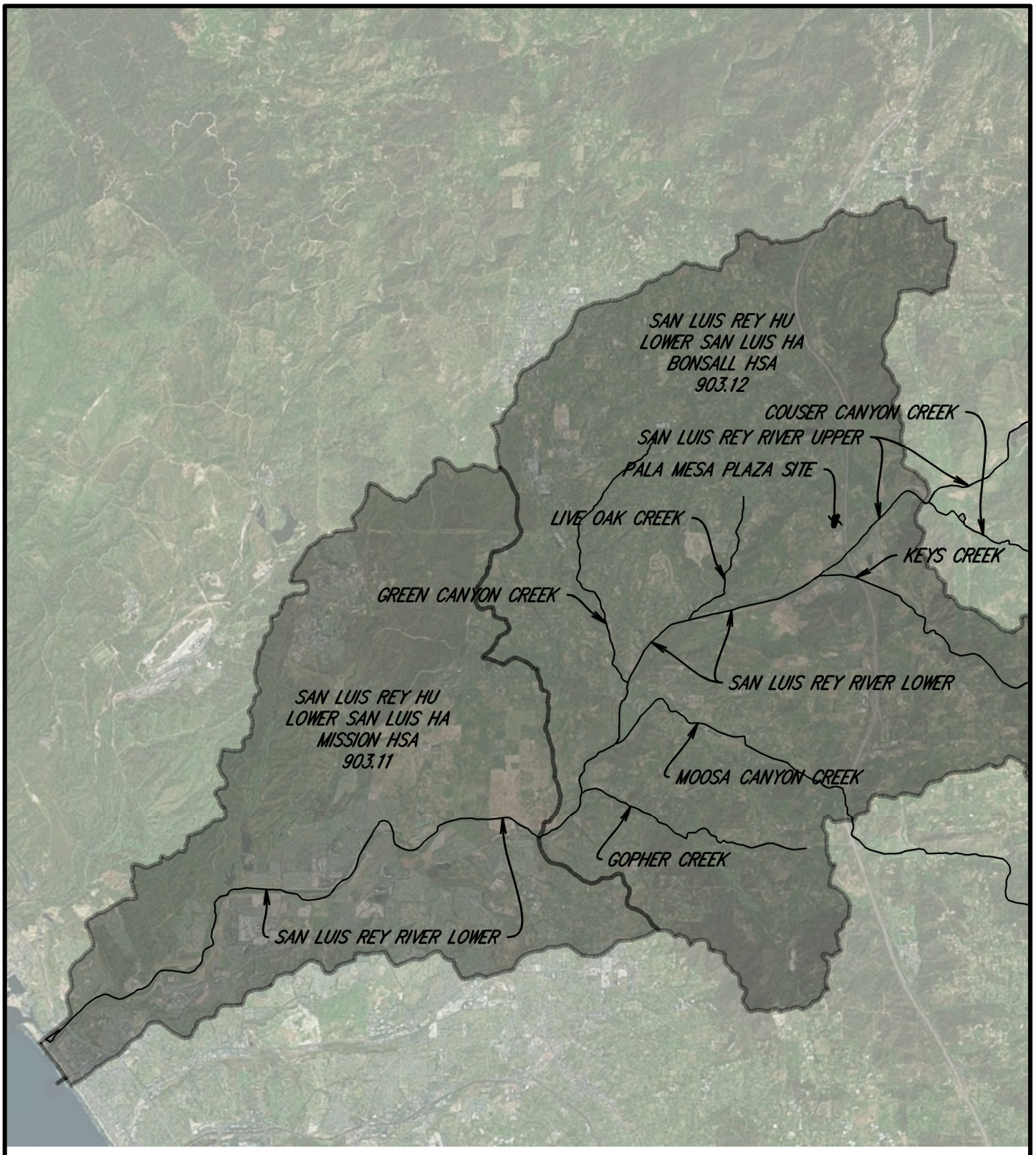
Minor Streams (Surface Width at Flood Stage < 100 ft)

- Fairly Regular Section
  - (A) Some Grass and Weeds, Little or No Brush 0.030
  - (B) Dense Growth of Weeds, Depth of Flow Materially Greater Than Weed Height 0.040
  - (C) Some Weeds, Light Brush on Banks 0.040
  - (D) Some Weeds, Heavy Brush on Banks 0.060
  - (E) For Trees within Channel with Branches Submerged at High Stage, Increase All Above Values By 0.015
- Irregular Section, with Pools, Slight Channel Meander
  - Channels (A) to (E) Above, Increase All Values By 0.015
- Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage
  - (A) Bottom, Gravel, Cobbles and Few Boulders 0.050
  - (B) Bottom, Cobbles with Large Boulders 0.060

Flood Plains (Adjacent To Natural Streams)

- Pasture, No Brush
  - (A) Short Grass 0.030
  - (B) High Grass 0.040
- Cultivated Areas
  - (A) No Crop 0.040
  - (B) Mature Row Crops 0.040
  - (C) Mature Field Crops 0.050
- Heavy Weeds, Scattered Brush 0.050
- Light Brush and Trees 0.060
- Medium To Dense Brush 0.090
- Dense Willows 0.170
- Cleared Land with Tree Stumps, 100-150 Per Acre 0.060
- Heavy Stand of Timber, Little Undergrowth
  - (A) Flood Depth below Branches 0.110
  - (B) Flood Depth Reaches Branches 0.140

ATTACHMENT 2



PALA MESA PLAZA
HYDROLOGIC AREAS

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

FALLBROOK GAS

SAY i6 = 3.5 in

SITE

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

OCEANSIDE

VISTA

CARLSBAD

ESCONDIDO

ENCINITAS

SOLANA BEACH

DEL MAR

POWAY

S.D. COUNTY

SANTEE

SAN DIEGO

EL CAJON

LA MESA

LEMON GROVE

CORONADO

SD

CHULA VISTA

IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'

33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

FALLBROOK GAS
SAY i24 = 6 in
SITE

Orange County
Riverside County
Imperial County
Pacific Ocean
Mexico

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
SD
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles

Hydrologic Soil Group—San Diego County Area, California
(19025 Location)

Map Scale: 1:1,640 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 14, Sep 16, 2019

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

Date(s) aerial images were photographed: Dec 31, 2009—Oct 22, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
GrC	Greenfield sandy loam, 5 to 9 percent slopes	A	0.9	19.7%
RaB	Ramona sandy loam, 2 to 5 percent slopes	C	3.5	80.3%
Totals for Area of Interest			**4.4**	**100.0%**

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

PALA MESA PLAZA
HYDROLOGY PRE DEVELOPMENT EXHIBIT

EXCEL ENGINEERING
LAND PLANNING • ENGINEERING • SURVEYING
440 STATE PLACE, ESCONDIDO, CA 92029
PH (760)745-8118 FX (760)745-1890

VIA DE TODOS SANTOS (PUBLIC)

OLD HWY 395 (PUBLIC)

VIA BELAMONTE (PUBLIC)

0.6004 ACRES

0.81 ACRES

0.11 ACRES

0.16 ACRES

0.13 ACRES

0.04 ACRES

0.03 ACRES

0.04ACRES

0.01 ACRES

0.12 ACRES

0.14 ACRES

0.07 ACRES

0.50 ACRES

0.66 ACRES

0.27 ACRES

0.28 ACRES

0.397 ACRES

0.71 ACRES

0.07 ACRES

0.09 ACRES

3.83 ACRES

1.09 ACRES

0.4502B ACRES

0.838' ACRES

0.0338 ACRES

BASIN 802
Q_{100}=2.694 CFS

BASIN 702
Q_{100}=1.741 CFS

BASIN 602
Q_{100}=1.223 CFS

BASIN 502
Q_{100}=2.554 CFS

BASIN 402
Q_{100}=1.295 CFS

BASIN 202
Q_{100}=4.180 CFS

BASIN 102
Q_{100}=2.280 CFS

BASIN 103
Q_{100}=3.119 CFS

Q_{100}OFFSITE=13.794 CFS
TC=8.75 MIN
AREA OFFSITE=5 ACRES

POST Q_{100}=34.170 CFS
V100=19.34 FT/S
TC=9.26 MIN
$AREA_{TOTAL}$=11.192 ACRES
PRE Q_{100}=34.460 CFS
POST MITIGATION
Q_{100}=32.795 CFS

PRE PIPE Q100 FLOW =26.305 CFS
POST PIPE Q100 FLOW =26.696 CFS
POST MITIGATION PIPE Q100 FLOW =25.318 CFS

(379.0) ES
(372.0) ES
(347.0) ES
(344.0) FL 18" PVC OUT
L=839'
(325.6) FL 18" PVC IN
(325.5) FL 18" PVC OUT
(323.5) EG
(322.0) FL 18"EXIST. PVC IN
(322.0) FL 18"EXIST. PVC IN
(333.1) EG
311.1 FL 18" PVC OUT
(327.5) EG
(334.9) EG
(336.7) EG
(321.0) EG
(316.3) EG
(318.0) EG
(310.8) EG
310.14 FL 18"PVC OUT
285.72 FL 18"PVC IN
POC
306.83 FL 12"PVC OUT
302.5 FL 18"PVC OUT
302.6 FL 18"PVC IN
302.6 FL 18"PVC IN
302.6 FL 18"PVC IN
302.8 FL 12"PVC OUT
302.8 FL 12"PVC IN
302.8 FL 12"PVC OUT
303.0 FL 12"PVC IN
303.0 FL 12"PVC IN
303.0 FL 12"PVC OUT
303.3 FL 12"PVC IN
303.3 FL 12"PVC IN
303.3 FL 12"PVC IN
303.3 FL 12"PVC OUT
304.3 FL 12"PVC IN
304.3 FL 12"PVC IN
304.3 FL 12"PVC OUT
304.6 FL 12"PVC OUT
304.2 FL 12"PVC OUT
12"PVC IN 316.3 FS
12"PVC OUT 316.5 FL
311.5 FS
315.8 FS
314.1 FS
315.6 FS
315.2 FS
316.7 FS
316.8 FS
315.4 FS
316.0 FS
315.5 FS
312.2 FS
312.0 FS
312.1 FS
312.1 FS
316.1 FS
312.6 FS
311.0 FS
316.0 FS
315.2 FS
314.6 FS
313.2 FS
313.1 FS
309.2 FS
304.0 FS
316.3 FS
316.1 FS
L=240'
L=99'
L=68'
L=120'
L=34'
L=30'
L=311'
L=151'
L=191'
L=185'
L=100'
L=137'
L=59'
L=25'

LEGEND

- HYD BASIN BOUNDARY
- NODE NUMBER (100)
- SURFACE FLOW
- PIPE FLOW
- STREET FLOW

SCALE 1:60

0 60 120 180 240

HYDROLOGIC SOIL GROUP

THE HYROLOGICAL SOIL GROUPS FOR THIS SITE ARE TYPE (A & C)

NOTE:
APPROXIMATE DEPTH TO GROUNDWATER IS GREATER THAN 20'

PALA MESA PLAZA
HYDROLOGY POST DEVELOPMENT EXHIBIT

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PH (760)745-8118 FX (760)745-1890

ATTACHMENT 3

3a. CivilD Pre-Development Calculations

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 05/25/23
--------------------------------------------------------------------------
19025 Pre Dev
100 Year Study Onsite
19025Pre100Onsite
offsite ud to onsite
--------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

--------------------------------------------------------------------------


Program License Serial Number 6332

--------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Decimal fraction soil group A = 0.900
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(4.3 DU/A or Less       )
Impervious value, Ai = 0.300
Sub-Area C Value = 0.417
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  337.500(Ft.)
Lowest elevation =  319.900(Ft.)
Elevation difference =   17.600(Ft.) Slope = 17.600 %
Top of Initial Area Slope adjusted by User to 30.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  30.00 %, in a development type of
 4.3 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.96 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4170)*( 100.000^.5)/(  30.000^(1/3)]=   3.96
Calculated TC of    3.957 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.417
Subarea runoff =      0.769(CFS)
Total initial stream area =        0.200(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________________
```

```
Estimated mean flow rate at midpoint of channel =      4.801(CFS)
Depth of flow =   0.279(Ft.), Average velocity =   2.471(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.00
    2             25.00              0.00
    3             50.00              1.00
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      4.801(CFS)
  '     '    flow top width =     13.939(Ft.)
  '     '    velocity=    2.471(Ft/s)
  '     '    area =      1.943(Sq.Ft)
  '     '    Froude number =     1.166

Upstream point elevation =   319.900(Ft.)
Downstream point elevation =   308.700(Ft.)
Flow length =   325.000(Ft.)
Travel time  =    2.19 min.
Time of concentration =    6.15 min.
Depth of flow =   0.279(Ft.)
Average velocity =   2.471(Ft/s)
Total irregular channel flow =     4.801(CFS)
Irregular channel normal depth above invert elev. =   0.279(Ft.)
Average velocity of channel(s) =   2.471(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.070(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.200
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(4.3 DU/A or Less       )
Impervious value, Ai = 0.300
Sub-Area C Value = 0.466
Rainfall intensity =      8.070(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.462  CA =      1.085
Subarea runoff =      7.989(CFS) for      2.150(Ac.)
Total runoff =      8.758(CFS)  Total area =       2.350(Ac.)
Depth of flow =   0.349(Ft.), Average velocity =   2.871(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.350(Ac.)
Runoff from this stream =      8.758(CFS)
Time of concentration =    6.15 min.
Rainfall intensity =     8.070(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.550
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.450
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(4.3 DU/A or Less       )
Impervious value, Ai = 0.300
Sub-Area C Value = 0.442
Initial subarea total flow distance  =  100.000(Ft.)
```

```
Highest elevation =  326.000(Ft.)
Lowest elevation =  313.000(Ft.)
Elevation difference =   13.000(Ft.) Slope = 13.000 %
Top of Initial Area Slope adjusted by User to 30.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  30.00 %, in a development type of
 4.3 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.81 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4415)*( 100.000^.5)/(  30.000^(1/3)]=   3.81
Calculated TC of    3.815 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.442
Subarea runoff =      0.896(CFS)
Total initial stream area =        0.220(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

____________________________________________________________________
Estimated mean flow rate at midpoint of channel =      3.343(CFS)
Depth of flow =   0.306(Ft.), Average velocity =   1.425(Ft/s)
    ******* Irregular Channel Data ***********
-------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.00
    2             25.00              0.00
    3             50.00              1.00
Manning's 'N' friction factor =   0.030
-------------------------------------------------------------------
Sub-Channel flow  =      3.343(CFS)
  '     '    flow top width =     15.314(Ft.)
  '     '    velocity=    1.425(Ft/s)
  '     '    area =      2.345(Sq.Ft)
  '     '    Froude number =     0.642

Upstream point elevation =   313.000(Ft.)
Downstream point elevation =   308.700(Ft.)
Flow length =   425.000(Ft.)
Travel time  =    4.97 min.
Time of concentration =    8.78 min.
Depth of flow =   0.306(Ft.)
Average velocity =   1.425(Ft/s)
Total irregular channel flow =     3.343(CFS)
Irregular channel normal depth above invert elev. =   0.306(Ft.)
Average velocity of channel(s) =   1.425(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      6.411(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.200
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(4.3 DU/A or Less       )
Impervious value, Ai = 0.300
Sub-Area C Value = 0.466
Rainfall intensity =      6.411(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.463  CA =      0.889
Subarea runoff =      4.806(CFS) for      1.700(Ac.)
Total runoff =      5.702(CFS)  Total area =       1.920(Ac.)
Depth of flow =   0.374(Ft.), Average velocity =   1.629(Ft/s)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.920(Ac.)
Runoff from this stream =      5.702(CFS)
Time of concentration =    8.78 min.
Rainfall intensity =     6.411(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

----------------------------------------------------------------------------
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                 ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Rainfall intensity (I) =      6.428(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   8.75 min.  Rain intensity =       6.43(In/Hr)
Total area =        5.000(Ac.)  Total runoff =    13.794(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      103.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

----------------------------------------------------------------------------
Upstream point/station elevation =   311.100(Ft.)
Downstream point/station elevation =   302.200(Ft.)
Pipe length  =   208.00(Ft.) Slope =   0.0428  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.794(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
    29.453(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =     31.169(Ft.)
 Minor friction loss =      7.185(Ft.)  K-factor =   1.50
Pipe flow velocity =     17.56(Ft/s)
Travel time through pipe =    0.20 min.
Time of concentration (TC) =     8.95 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****

----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      5.000(Ac.)
Runoff from this stream =     13.794(CFS)
Time of concentration =    8.95 min.
Rainfall intensity =     6.336(In/Hr)
Summary of stream data:

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


1        8.758      6.15             8.070
2        5.702      8.78             6.411
3       13.794      8.95             6.336
Qmax(1) =
       1.000 *    1.000 *     8.758) +
       1.000 *    0.700 *     5.702) +
```

```
       1.000 *    0.687 *    13.794) + =      22.229
Qmax(2) =
       0.794 *    1.000 *     8.758) +
       1.000 *    1.000 *     5.702) +
       1.000 *    0.982 *    13.794) + =      26.203
Qmax(3) =
       0.785 *    1.000 *     8.758) +
       0.988 *    1.000 *     5.702) +
       1.000 *    1.000 *    13.794) + =      26.305

Total of 3 streams to confluence:
Flow rates before confluence point:
       8.758       5.702      13.794
Maximum flow rates at confluence using above data:
       22.229       26.203       26.305
Area of streams before confluence:
        2.350        1.920        5.000
Results of confluence:
Total flow rate =     26.305(CFS)
Time of concentration =     8.947 min.
Effective stream area after confluence =      9.270(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      309.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   302.200(Ft.)
Downstream point/station elevation =   301.800(Ft.)
Pipe length  =    27.00(Ft.) Slope =   0.0148  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.305(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     6.454(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.693(Ft.)
 Minor friction loss =      5.161(Ft.)  K-factor =   1.50
Pipe flow velocity =     14.89(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     8.98 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      309.000 to Point/Station      406.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   301.800(Ft.)
Downstream point/station elevation =   285.720(Ft.)
Pipe length  =   137.00(Ft.) Slope =   0.1174  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.305(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    26.305(CFS)
Normal flow depth in pipe =   11.43(In.)
Flow top width inside pipe =   17.33(In.)
Critical depth could not be calculated.
Pipe flow velocity =     22.23(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     9.08 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      406.000 to Point/Station      406.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      9.270(Ac.)
Runoff from this stream =     26.305(CFS)
Time of concentration =    9.08 min.
Rainfall intensity =     6.276(In/Hr)
```

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

----------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.810
Initial subarea total flow distance  =   94.000(Ft.)
Highest elevation =  318.000(Ft.)
Lowest elevation =  316.300(Ft.)
Elevation difference =    1.700(Ft.) Slope =  1.809 %
Top of Initial Area Slope adjusted by User to  1.400 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.40 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.61 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8100)*(  60.000^.5)/(   1.400^(1/3)]=   3.61
Calculated TC of    3.614 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.810
Subarea runoff =      0.254(CFS)
Total initial stream area =        0.034(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      404.000 to Point/Station      405.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

----------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      2.197(CFS)
Depth of flow =   0.242(Ft.), Average velocity =   1.791(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.31
    2             26.00              0.13
    3             27.50              0.00
    4             27.50              0.50
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      2.197(CFS)
  '     '    flow top width =     17.814(Ft.)
  '     '    velocity=    1.791(Ft/s)
  '     '    area =      1.227(Sq.Ft)
  '     '    Froude number =     1.203

Upstream point elevation =   316.300(Ft.)
Downstream point elevation =   310.800(Ft.)
Flow length =   621.000(Ft.)
Travel time  =    5.78 min.
Time of concentration =    9.39 min.
Depth of flow =   0.242(Ft.)
Average velocity =   1.791(Ft/s)
Total irregular channel flow =     2.197(CFS)
Irregular channel normal depth above invert elev. =   0.242(Ft.)
Average velocity of channel(s) =   1.791(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      6.140(In/Hr) for a   100.0 year storm
```

```
User specified 'C' value of 0.762 given for subarea
Rainfall intensity =      6.140(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.764  CA =      0.665
Subarea runoff =      3.831(CFS) for      0.837(Ac.)
Total runoff =      4.085(CFS)  Total area =      0.871(Ac.)
Depth of flow =   0.279(Ft.), Average velocity =   2.078(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      406.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------
Rainfall intensity (I) =      6.140(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(14.5 DU/A or Less      )
Impervious value, Ai = 0.500
Sub-Area C Value = 0.595
Time of concentration =     9.39 min.
Rainfall intensity =      6.140(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.695  CA =      1.022
Subarea runoff =      2.192(CFS) for      0.600(Ac.)
Total runoff =      6.277(CFS)  Total area =      1.471(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      406.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------
Rainfall intensity (I) =      6.140(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Time of concentration =     9.39 min.
Rainfall intensity =      6.140(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.715  CA =      1.374
Subarea runoff =      2.160(CFS) for      0.451(Ac.)
Total runoff =      8.437(CFS)  Total area =      1.922(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      406.000 to Point/Station      406.000
**** CONFLUENCE OF MINOR STREAMS ****

------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.922(Ac.)
Runoff from this stream =      8.437(CFS)
Time of concentration =    9.39 min.
Rainfall intensity =     6.140(In/Hr)
Summary of stream data:

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


1       26.305      9.08            6.276
2        8.437      9.39            6.140
Qmax(1) =
```

```
          1.000 *    1.000 *    26.305) +
          1.000 *    0.967 *     8.437) + =      34.460
     Qmax(2) =
          0.978 *    1.000 *    26.305) +
          1.000 *    1.000 *     8.437) + =      34.172

     Total of 2 streams to confluence:
     Flow rates before confluence point:
          26.305       8.437
     Maximum flow rates at confluence using above data:
          34.460       34.172
     Area of streams before confluence:
           9.270        1.922
     Results of confluence:
     Total flow rate =     34.460(CFS)
     Time of concentration =     9.080 min.
     Effective stream area after confluence =     11.192(Ac.)


     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
     Process from Point/Station      405.000 to Point/Station      406.000
     **** PIPEFLOW TRAVEL TIME (User specified size) ****

     ------------------------------------------------------------------------
     Upstream point/station elevation =   306.830(Ft.)
     Downstream point/station elevation =   285.720(Ft.)
     Pipe length  =   211.00(Ft.) Slope =   0.1000  Manning's N = 0.013
     No. of pipes = 1  Required pipe flow  =    34.460(CFS)
     Given pipe size =     18.00(In.)
     NOTE: Normal flow is pressure flow in user selected pipe size.
     The approximate hydraulic grade line above the pipe invert is
         10.448(Ft.)  at the headworks or inlet of the pipe(s)
      Pipe friction loss =     22.700(Ft.)
      Minor friction loss =      8.857(Ft.)  K-factor =   1.50
     Critical depth could not be calculated.
     Pipe flow velocity =     19.50(Ft/s)
     Travel time through pipe =    0.18 min.
     Time of concentration (TC) =     9.26 min.
     End of computations, total study area =          11.192 (Ac.)
```

3b. CivilD Pre-Development Offsite Calculations

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 01/20/21
------------------------------------------------------------------------
19025 Pre Dev
100 Year Study Offsite
19025Pre100Offsite.rd3

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------


Program License Serial Number 6332

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  379.000(Ft.)
Lowest elevation =  372.000(Ft.)
Elevation difference =    7.000(Ft.) Slope =  7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   7.00 %, in a development type of
 7.3 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration =   6.00 minutes
 (for slope value of   5.00 %)
Rainfall intensity (I) =      8.198(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff =      0.315(CFS)
Total initial stream area =        0.080(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      303.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      5.468(CFS)
Depth of flow =   0.404(Ft.), Average velocity =   5.574(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
```

```
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              2.71
          2             31.00              0.13
          3             32.50              0.00
          4             32.50              0.50
      Manning's 'N' friction factor =   0.015
      -----------------------------------------------------------------
      Sub-Channel flow  =      5.468(CFS)
        '     '    flow top width =      4.851(Ft.)
        '     '    velocity=    5.574(Ft/s)
        '     '    area =      0.981(Sq.Ft)
        '     '    Froude number =     2.184

      Upstream point elevation =   372.000(Ft.)
      Downstream point elevation =   347.000(Ft.)
      Flow length =   839.000(Ft.)
      Travel time  =    2.51 min.
      Time of concentration =    8.51 min.
      Depth of flow =   0.404(Ft.)
      Average velocity =   5.574(Ft/s)
      Total irregular channel flow =     5.468(CFS)
      Irregular channel normal depth above invert elev. =   0.404(Ft.)
      Average velocity of channel(s) =   5.574(Ft/s)
       Adding area flow to channel
      Rainfall intensity (I) =      6.545(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [MEDIUM DENSITY RESIDENTIAL                  ]
      (4.3 DU/A or Less       )
      Impervious value, Ai = 0.300
      Sub-Area C Value = 0.410
      Rainfall intensity =      6.545(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.411  CA =      1.609
      Subarea runoff =     10.213(CFS) for      3.830(Ac.)
      Total runoff =     10.528(CFS)  Total area =      3.910(Ac.)
      Depth of flow =   0.517(Ft.), Average velocity =   6.574(Ft/s)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      303.000 to Point/Station      304.000
      **** PIPEFLOW TRAVEL TIME (User specified size) ****
      ----------------------------------------------------------------------
      Upstream point/station elevation =   344.000(Ft.)
      Downstream point/station elevation =   325.600(Ft.)
      Pipe length  =   160.00(Ft.) Slope =   0.1150  Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    10.528(CFS)
      Given pipe size =     18.00(In.)
      Calculated individual pipe flow  =    10.528(CFS)
      Normal flow depth in pipe =    6.70(In.)
      Flow top width inside pipe =   17.40(In.)
      Critical Depth =   14.96(In.)
      Pipe flow velocity =     17.55(Ft/s)
      Travel time through pipe =    0.15 min.
      Time of concentration (TC) =     8.66 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      304.000 to Point/Station      304.000
      **** SUBAREA FLOW ADDITION ****
      ----------------------------------------------------------------------
      Rainfall intensity (I) =      6.470(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
```

```
      [MEDIUM DENSITY RESIDENTIAL                  ]
      (7.3 DU/A or Less       )
      Impervious value, Ai = 0.400
      Sub-Area C Value = 0.480
      Time of concentration =     8.66 min.
      Rainfall intensity =      6.470(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.426  CA =      2.132
      Subarea runoff =      3.266(CFS) for      1.090(Ac.)
      Total runoff =     13.794(CFS)  Total area =       5.000(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      304.000 to Point/Station      305.000
      **** PIPEFLOW TRAVEL TIME (User specified size) ****
      ------------------------------------------------------------------------
      Upstream point/station elevation =   325.500(Ft.)
      Downstream point/station elevation =   322.000(Ft.)
      Pipe length  =    71.00(Ft.) Slope =   0.0493  Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    13.794(CFS)
      Given pipe size =     18.00(In.)
      Calculated individual pipe flow  =    13.794(CFS)
      Normal flow depth in pipe =    9.96(In.)
      Flow top width inside pipe =   17.90(In.)
      Critical Depth =   16.50(In.)
      Pipe flow velocity =     13.75(Ft/s)
      Travel time through pipe =    0.09 min.
      Time of concentration (TC) =     8.75 min.
      End of computations, total study area =           5.000 (Ac.)
```

3c. CivilD Post Development Onsite Reach 1 Calculations

```
1
2               San Diego County Rational Hydrology Program
3
4       CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0
5
6       Rational method hydrology  program based on
7       San Diego County Flood Control Division 2003 hydrology manual
8           Rational Hydrology Study        Date: 12/15/21
9       ----------------------------------------------------------------------
10      19025 Post Dev
11      100 Year Study Reach 1
12      PostDev100R1.rd3
13      2021.12.15 Update
14      ----------------------------------------------------------------------
15       *********   Hydrology Study Control Information **********
16
17      ----------------------------------------------------------------------
18
19
20      Program License Serial Number 6332
21
22      ----------------------------------------------------------------------
23      Rational hydrology study storm event year is   100.0
24      English (in-lb) input data Units used
25
26      Map data precipitation entered:
27      6 hour,  precipitation(inches) =  3.500
28      24 hour precipitation(inches) =  6.000
29      P6/P24 =    58.3%
30      San Diego hydrology manual 'C' values used
31
32
33      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
34      Process from Point/Station      100.000 to Point/Station      101.000
35      **** INITIAL AREA EVALUATION ****
36      ________________________________________________________________________
37      Decimal fraction soil group A = 1.000
38      Decimal fraction soil group B = 0.000
39      Decimal fraction soil group C = 0.000
40      Decimal fraction soil group D = 0.000
41      [MEDIUM DENSITY RESIDENTIAL                  ]
42      (7.3 DU/A or Less       )
43      Impervious value, Ai = 0.400
44      Sub-Area C Value = 0.480
45      Initial subarea total flow distance  =   53.000(Ft.)
46      Highest elevation =  316.800(Ft.)
47      Lowest elevation =  316.700(Ft.)
48      Elevation difference =    0.100(Ft.) Slope =  0.189 %
49      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
50      The maximum overland flow distance is 50.00 (Ft)
51      for the top area slope value of   0.19 %, in a development type of
52       7.3 DU/A or Less
53      In Accordance With Figure 3-3
54      Initial Area Time of Concentration =  13.75 minutes
55      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
56      TC = [1.8*(1.1-0.4800)*(  50.000^.5)/(   0.189^(1/3)]=  13.75
57      The initial area total distance of   53.00 (Ft.) entered leaves a
58      remaining distance of    3.00 (Ft.)
59      Using Figure 3-4, the travel time for this distance is   0.20 minutes
60      for a distance of   3.00 (Ft.) and a slope of  0.19 %
61      with an elevation difference of   0.01(Ft.) from the end of the top area
62      Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
63       =    0.203 Minutes
64      Tt=[(11.9*0.0006^3)/(  0.01)]^.385=  0.20
65      Total initial area Ti =  13.75 minutes from Figure 3-3 formula plus
66        0.20 minutes from the Figure 3-4 formula =  13.95 minutes
67      Rainfall intensity (I) =     4.757(In/Hr) for a   100.0 year storm
68      Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
69      Subarea runoff =     0.068(CFS)
```

```
      Total initial stream area =       0.030(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      101.000 to Point/Station      102.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

      ______________________________________________________________________
      Estimated mean flow rate at midpoint of channel =      0.228(CFS)
      Depth of flow =   0.095(Ft.), Average velocity =   0.591(Ft/s)
          ******* Irregular Channel Data ***********
      ----------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              0.33
          2             23.00              0.00
          3             28.50              0.33
      Manning's 'N' friction factor =   0.015
      ----------------------------------------------------------------
      Sub-Channel flow  =      0.228(CFS)
        '     '    flow top width =      8.130(Ft.)
        '     '    velocity=    0.591(Ft/s)
        '     '    area =      0.386(Sq.Ft)
        '     '    Froude number =     0.478

      Upstream point elevation =   316.700(Ft.)
      Downstream point elevation =   316.300(Ft.)
      Flow length =   193.000(Ft.)
      Travel time  =    5.44 min.
      Time of concentration =   19.39 min.
      Depth of flow =   0.095(Ft.)
      Average velocity =   0.591(Ft/s)
      Total irregular channel flow =     0.228(CFS)
      Irregular channel normal depth above invert elev. =   0.095(Ft.)
      Average velocity of channel(s) =   0.591(Ft/s)
       Adding area flow to channel
      Rainfall intensity (I) =      3.847(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [MEDIUM DENSITY RESIDENTIAL                  ]
      (7.3 DU/A or Less       )
      Impervious value, Ai = 0.400
      Sub-Area C Value = 0.480
      Rainfall intensity =      3.847(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.480  CA =      0.082
      Subarea runoff =      0.245(CFS) for      0.140(Ac.)
      Total runoff =      0.314(CFS)  Total area =       0.170(Ac.)
      Depth of flow =   0.107(Ft.), Average velocity =   0.640(Ft/s)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      102.000 to Point/Station      102.000
      **** SUBAREA FLOW ADDITION ****

      ______________________________________________________________________
      Rainfall intensity (I) =      3.847(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [LOW DENSITY RESIDENTIAL                     ]
      (1.0 DU/A or Less       )
      Impervious value, Ai = 0.100
      Sub-Area C Value = 0.270
      Time of concentration =    19.39 min.
      Rainfall intensity =      3.847(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.393  CA =      0.114
```

```
Subarea runoff =      0.125(CFS) for      0.120(Ac.)
Total runoff =      0.439(CFS)  Total area =       0.290(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   310.200(Ft.)
Downstream point/station elevation =   309.000(Ft.)
Pipe length  =   250.00(Ft.) Slope =   0.0048  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.439(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.439(CFS)
Normal flow depth in pipe =    3.42(In.)
Flow top width inside pipe =   10.84(In.)
Critical Depth =    3.28(In.)
Pipe flow velocity =      2.37(Ft/s)
Travel time through pipe =    1.76 min.
Time of concentration (TC) =    21.15 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.290(Ac.)
Runoff from this stream =      0.439(CFS)
Time of concentration =   21.15 min.
Rainfall intensity =     3.637(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1100.000 to Point/Station     1101.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance  =   59.000(Ft.)
Highest elevation =  336.700(Ft.)
Lowest elevation =  321.600(Ft.)
Elevation difference =   15.100(Ft.) Slope = 25.593 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  25.59 %, in a development type of
 1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.07 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.2700)*( 100.000^.5)/(  25.593^(1/3)]=   5.07
Rainfall intensity (I) =      9.140(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff =      0.173(CFS)
Total initial stream area =       0.070(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1101.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.544(CFS)
Depth of flow =   0.128(Ft.), Average velocity =   3.658(Ft/s)
```

```
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.60
    2             16.00              0.00
    3             46.00              1.20
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.544(CFS)
  '     '    flow top width =      6.605(Ft.)
  '     '    velocity=    3.658(Ft/s)
  '     '    area =      0.422(Sq.Ft)
  '     '    Froude number =     2.549

Upstream point elevation =   321.600(Ft.)
Downstream point elevation =   309.000(Ft.)
Flow length =   236.000(Ft.)
Travel time  =    1.08 min.
Time of concentration =    6.15 min.
Depth of flow =   0.128(Ft.)
Average velocity =   3.658(Ft/s)
Total irregular channel flow =     1.544(CFS)
Irregular channel normal depth above invert elev. =   0.128(Ft.)
Average velocity of channel(s) =   3.658(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.073(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.534
Rainfall intensity =      8.073(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.509  CA =      0.371
Subarea runoff =      2.825(CFS) for      0.660(Ac.)
Total runoff =      2.998(CFS)  Total area =       0.730(Ac.)
Depth of flow =   0.164(Ft.), Average velocity =   4.317(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.730(Ac.)
Runoff from this stream =      2.998(CFS)
Time of concentration =    6.15 min.
Rainfall intensity =     8.073(In/Hr)
Summary of stream data:

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


1        0.439     21.15             3.637
2        2.998      6.15             8.073
Qmax(1) =
       1.000 *    1.000 *     0.439) +
       0.451 *    1.000 *     2.998) + =       1.789
Qmax(2) =
       1.000 *    0.291 *     0.439) +
       1.000 *    1.000 *     2.998) + =       3.125

Total of 2 streams to confluence:
Flow rates before confluence point:
```

```
       0.439       2.998
Maximum flow rates at confluence using above data:
        1.789        3.125
Area of streams before confluence:
        0.290        0.730
Results of confluence:
Total flow rate =      3.125(CFS)
Time of concentration =     6.145 min.
Effective stream area after confluence =      1.020(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   304.200(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =   189.00(Ft.) Slope =   0.0048  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.125(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     3.125(CFS)
Normal flow depth in pipe =    8.26(In.)
Flow top width inside pipe =   17.94(In.)
Critical Depth =    8.07(In.)
Pipe flow velocity =      3.95(Ft/s)
Travel time through pipe =    0.80 min.
Time of concentration (TC) =     6.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.020(Ac.)
Runoff from this stream =      3.125(CFS)
Time of concentration =    6.94 min.
Rainfall intensity =     7.462(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.050
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(Office Professional    )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.839
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  316.800(Ft.)
Lowest elevation =  316.200(Ft.)
Elevation difference =    0.600(Ft.) Slope =  1.200 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.20 %, in a development type of
 Office Professional
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.42 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8395)*(  60.000^.5)/(   1.200^(1/3)]=   3.42
Calculated TC of    3.418 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.839
Subarea runoff =      0.310(CFS)
```

```
 Total initial stream area =       0.040(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.245(CFS)
Depth of flow =   0.209(Ft.), Average velocity =   2.102(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.30
    2              1.50              0.00
    3             45.50              1.00
    4             61.50              1.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      2.245(CFS)
  '     '    flow top width =     10.230(Ft.)
  '     '    velocity=    2.102(Ft/s)
  '     '    area =      1.068(Sq.Ft)
  '     '    Froude number =     1.147

Upstream point elevation =   316.200(Ft.)
Downstream point elevation =   314.500(Ft.)
Flow length =   185.000(Ft.)
Travel time  =    1.47 min.
Time of concentration =    4.88 min.
Depth of flow =   0.209(Ft.)
Average velocity =   2.102(Ft/s)
Total irregular channel flow =     2.245(CFS)
Irregular channel normal depth above invert elev. =   0.209(Ft.)
Average velocity of channel(s) =   2.102(Ft/s)
 Adding area flow to channel
Calculated TC of    4.885 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                         ]
(Office Professional    )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.840
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.840  CA =      0.454
Subarea runoff =      3.873(CFS) for      0.500(Ac.)
Total runoff =      4.183(CFS)  Total area =       0.540(Ac.)
Depth of flow =   0.264(Ft.), Average velocity =   2.456(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   308.500(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =    48.00(Ft.) Slope =   0.1083  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.183(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     4.183(CFS)
Normal flow depth in pipe =    4.95(In.)
Flow top width inside pipe =   11.82(In.)
Critical Depth =   10.36(In.)
Pipe flow velocity =     13.68(Ft/s)
```

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      Travel time through pipe =    0.06 min.
      Time of concentration (TC) =     4.94 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      202.000 to Point/Station      104.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ________________________________________________________________________
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      0.540(Ac.)
      Runoff from this stream =      4.183(CFS)
      Time of concentration =    4.94 min.
      Rainfall intensity =     9.222(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      300.000 to Point/Station      301.000
      **** INITIAL AREA EVALUATION ****
      ________________________________________________________________________
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 1.000
      Decimal fraction soil group D = 0.000
      [COMMERCIAL area type                         ]
      (Neighborhod Commercial )
      Impervious value, Ai = 0.800
      Sub-Area C Value = 0.780
      Initial subarea total flow distance  =   42.000(Ft.)
      Highest elevation =  316.000(Ft.)
      Lowest elevation =  314.700(Ft.)
      Elevation difference =    1.300(Ft.) Slope =  3.095 %
      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
      The maximum overland flow distance is 85.00 (Ft)
      for the top area slope value of   3.10 %, in a development type of
       Neighborhod Commercial
      In Accordance With Figure 3-3
      Initial Area Time of Concentration =   3.64 minutes
      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
      TC = [1.8*(1.1-0.7800)*(  85.000^.5)/(   3.095^(1/3)]=   3.64
      Calculated TC of    3.644 minutes is less than 5 minutes,
       resetting TC to 5.0 minutes for rainfall intensity calculations
      Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
      Subarea runoff =      0.288(CFS)
      Total initial stream area =        0.040(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      301.000 to Point/Station      302.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
      ________________________________________________________________________
      Estimated mean flow rate at midpoint of channel =      1.259(CFS)
      Depth of flow =   0.087(Ft.), Average velocity =   2.583(Ft/s)
          ******* Irregular Channel Data ***********
      ------------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              0.50
          2              0.00              0.00
          3             64.00              0.50
      Manning's 'N' friction factor =   0.015
      ------------------------------------------------------------------
      Sub-Channel flow  =      1.259(CFS)
        '     '    flow top width =     11.169(Ft.)
        '     '    velocity=    2.583(Ft/s)
        '     '    area =      0.487(Sq.Ft)
        '     '    Froude number =     2.180

      Upstream point elevation =   314.700(Ft.)
```

```
Downstream point elevation =   313.000(Ft.)
Flow length =    38.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.89 min.
Depth of flow =   0.087(Ft.)
Average velocity =   2.583(Ft/s)
Total irregular channel flow =     1.259(CFS)
Irregular channel normal depth above invert elev. =   0.087(Ft.)
Average velocity of channel(s) =   2.583(Ft/s)
 Adding area flow to channel
Calculated TC of    3.889 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                         ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.242
Subarea runoff =      1.942(CFS) for      0.270(Ac.)
Total runoff =      2.230(CFS)  Total area =       0.310(Ac.)
Depth of flow =   0.108(Ft.), Average velocity =   2.980(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   306.000(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =    30.00(Ft.) Slope =   0.0900  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.230(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.230(CFS)
Normal flow depth in pipe =    3.72(In.)
Flow top width inside pipe =   11.10(In.)
Critical Depth =    7.66(In.)
Pipe flow velocity =     10.75(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     3.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.310(Ac.)
Runoff from this stream =      2.230(CFS)
Time of concentration =    3.94 min.
Rainfall intensity =     9.222(In/Hr)
Summary of stream data:

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


1        3.125      6.94             7.462
2        4.183      4.94             9.222
3        2.230      3.94             9.222
Qmax(1) =
       1.000 *    1.000 *     3.125) +
       0.809 *    1.000 *     4.183) +
       0.809 *    1.000 *     2.230) + =       8.314
```

```
Qmax(2) =
       1.000 *    0.712 *     3.125) +
       1.000 *    1.000 *     4.183) +
       1.000 *    1.000 *     2.230) + =       8.638
Qmax(3) =
       1.000 *    0.567 *     3.125) +
       1.000 *    0.796 *     4.183) +
       1.000 *    1.000 *     2.230) + =       7.332

Total of 3 streams to confluence:
Flow rates before confluence point:
       3.125       4.183       2.230
Maximum flow rates at confluence using above data:
        8.314       8.638       7.332
Area of streams before confluence:
        1.020       0.540       0.310
Results of confluence:
Total flow rate =      8.638(CFS)
Time of concentration =     4.943 min.
Effective stream area after confluence =      1.870(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   303.300(Ft.)
Downstream point/station elevation =   303.000(Ft.)
Pipe length  =    71.00(Ft.) Slope =   0.0042  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.638(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.736(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.480(Ft.)
 Minor friction loss =      0.556(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.89(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =     5.19 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.870(Ac.)
Runoff from this stream =      8.638(CFS)
Time of concentration =    5.19 min.
Rainfall intensity =     9.008(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      401.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  316.100(Ft.)
Lowest elevation =  312.600(Ft.)
Elevation difference =    3.500(Ft.) Slope =  3.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
```

```
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   3.50 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.50 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7800)*(  85.000^.5)/(   3.500^(1/3)]=   3.50
The initial area total distance of  100.00 (Ft.) entered leaves a
remaining distance of   15.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.23 minutes
for a distance of  15.00 (Ft.) and a slope of  3.50 %
with an elevation difference of   0.53(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.228 Minutes
Tt=[(11.9*0.0028^3)/(  0.53)]^.385=  0.23
Total initial area Ti =   3.50 minutes from Figure 3-3 formula plus
  0.23 minutes from the Figure 3-4 formula =   3.73 minutes
Calculated TC of    3.726 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff =      0.791(CFS)
Total initial stream area =        0.110(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.043(CFS)
Depth of flow =   0.351(Ft.), Average velocity =   4.504(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.10
    2             34.00              0.40
    3             35.50              0.00
    4             35.50              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.043(CFS)
  '     '    flow top width =      1.318(Ft.)
  '     '    velocity=    4.504(Ft/s)
  '     '    area =      0.232(Sq.Ft)
  '     '    Froude number =     1.894

Upstream point elevation =   312.600(Ft.)
Downstream point elevation =   310.600(Ft.)
Flow length =    67.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.97 min.
Depth of flow =   0.351(Ft.)
Average velocity =   4.504(Ft/s)
Total irregular channel flow =     1.043(CFS)
Irregular channel normal depth above invert elev. =   0.351(Ft.)
Average velocity of channel(s) =   4.504(Ft/s)
 Adding area flow to channel
Calculated TC of    3.974 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
```

```
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.140
Subarea runoff =      0.503(CFS) for      0.070(Ac.)
Total runoff =      1.295(CFS)  Total area =       0.180(Ac.)
Depth of flow =   0.381(Ft.), Average velocity =   4.754(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.180(Ac.)
Runoff from this stream =      1.295(CFS)
Time of concentration =    3.97 min.
Rainfall intensity =     9.222(In/Hr)
Summary of stream data:

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


1        8.638      5.19             9.008
2        1.295      3.97             9.222
Qmax(1) =
       1.000 *    1.000 *     8.638) +
       0.977 *    1.000 *     1.295) + =       9.902
Qmax(2) =
       1.000 *    0.766 *     8.638) +
       1.000 *    1.000 *     1.295) + =       7.915

Total of 2 streams to confluence:
Flow rates before confluence point:
       8.638       1.295
Maximum flow rates at confluence using above data:
        9.902        7.915
Area of streams before confluence:
        1.870        0.180
Results of confluence:
Total flow rate =      9.902(CFS)
Time of concentration =     5.185 min.
Effective stream area after confluence =      2.050(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   303.000(Ft.)
Downstream point/station elevation =   302.500(Ft.)
Pipe length  =    77.00(Ft.) Slope =   0.0065  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.902(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     9.149(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      5.946(Ft.)
 Minor friction loss =      3.703(Ft.)  K-factor =   1.50
Pipe flow velocity =     12.61(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     5.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      106.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
```

```
Stream flow area =      2.050(Ac.)
Runoff from this stream =      9.902(CFS)
Time of concentration =    5.29 min.
Rainfall intensity =     8.896(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      106.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity (I) =      5.833(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  10.17 min.  Rain intensity =       5.83(In/Hr)
Total area =       2.190(Ac.)  Total runoff =     6.705(CFS)


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Process from Point/Station      106.000 to Point/Station      106.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.190(Ac.)
Runoff from this stream =      6.705(CFS)
Time of concentration =   10.17 min.
Rainfall intensity =     5.833(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1004.000 to Point/Station     1005.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance  =   30.000(Ft.)
Highest elevation =  334.800(Ft.)
Lowest elevation =  327.500(Ft.)
Elevation difference =    7.300(Ft.) Slope = 24.333 %
Top of Initial Area Slope adjusted by User to  0.189 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.19 %, in a development type of
 1.0 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration =  12.20 minutes
 (for slope value of   0.50 %)
Rainfall intensity (I) =      5.187(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff =      0.014(CFS)
Total initial stream area =       0.010(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1005.000 to Point/Station     1003.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
```

```
      Estimated mean flow rate at midpoint of channel =      0.042(CFS)
      Depth of flow =   0.111(Ft.), Average velocity =   3.401(Ft/s)
          ******* Irregular Channel Data **********
      ------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              1.00
          2              1.00              0.00
          3              2.00              1.00
      Manning's 'N' friction factor =   0.015
      ------------------------------------------------------------
      Sub-Channel flow  =      0.042(CFS)
        '     '    flow top width =      0.222(Ft.)
        '     '    velocity=    3.401(Ft/s)
        '     '    area =      0.012(Sq.Ft)
        '     '    Froude number =     2.543

      Upstream point elevation =   327.500(Ft.)
      Downstream point elevation =   324.500(Ft.)
      Flow length =    34.000(Ft.)
      Travel time  =    0.17 min.
      Time of concentration =   12.37 min.
      Depth of flow =   0.111(Ft.)
      Average velocity =   3.401(Ft/s)
      Total irregular channel flow =     0.042(CFS)
      Irregular channel normal depth above invert elev. =   0.111(Ft.)
      Average velocity of channel(s) =   3.401(Ft/s)
       Adding area flow to channel
      Rainfall intensity (I) =      5.142(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [LOW DENSITY RESIDENTIAL                    ]
      (1.0 DU/A or Less       )
      Impervious value, Ai = 0.100
      Sub-Area C Value = 0.270
      Rainfall intensity =      5.142(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.270  CA =      0.014
      Subarea runoff =      0.055(CFS) for      0.040(Ac.)
      Total runoff =      0.069(CFS)  Total area =      0.050(Ac.)
      Depth of flow =   0.134(Ft.), Average velocity =   3.856(Ft/s)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station     1003.000 to Point/Station      106.000
      **** PIPEFLOW TRAVEL TIME (User specified size) ****
      ______________________________________________________________________
      Upstream point/station elevation =   311.100(Ft.)
      Downstream point/station elevation =   302.600(Ft.)
      Pipe length  =   209.00(Ft.) Slope =   0.0407  Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.069(CFS)
      Given pipe size =     18.00(In.)
      Calculated individual pipe flow  =     0.069(CFS)
      Normal flow depth in pipe =    0.75(In.)
      Flow top width inside pipe =    7.22(In.)
      Critical depth could not be calculated.
      Pipe flow velocity =      2.75(Ft/s)
      Travel time through pipe =    1.27 min.
      Time of concentration (TC) =    13.64 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      106.000 to Point/Station      106.000
      **** CONFLUENCE OF MINOR STREAMS ****

      ______________________________________________________________________
      Along Main Stream number: 1 in normal stream number 3
      Stream flow area =      0.050(Ac.)
```

```
Runoff from this stream =      0.069(CFS)
Time of concentration =   13.64 min.
Rainfall intensity =     4.828(In/Hr)
Summary of stream data:

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


1        9.902      5.29             8.896
2        6.705     10.17             5.833
3        0.069     13.64             4.828
Qmax(1) =
       1.000 *    1.000 *     9.902) +
       1.000 *    0.520 *     6.705) +
       1.000 *    0.388 *     0.069) + =      13.415
Qmax(2) =
       0.656 *    1.000 *     9.902) +
       1.000 *    1.000 *     6.705) +
       1.000 *    0.746 *     0.069) + =      13.250
Qmax(3) =
       0.543 *    1.000 *     9.902) +
       0.828 *    1.000 *     6.705) +
       1.000 *    1.000 *     0.069) + =      10.994

Total of 3 streams to confluence:
Flow rates before confluence point:
       9.902       6.705       0.069
Maximum flow rates at confluence using above data:
       13.415       13.250       10.994
Area of streams before confluence:
        2.050        2.190        0.050
Results of confluence:
Total flow rate =     13.415(CFS)
Time of concentration =     5.287 min.
Effective stream area after confluence =      4.290(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   302.500(Ft.)
Downstream point/station elevation =   302.100(Ft.)
Pipe length  =    31.00(Ft.) Slope =   0.0129  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.415(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.448(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.505(Ft.)
 Minor friction loss =      1.342(Ft.)  K-factor =   1.50
Critical depth could not be calculated.
Pipe flow velocity =      7.59(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     5.36 min.
End of computations, total study area =          4.290 (Ac.)
```

3d. CivilD Post Development Onsite Reach 6 Calculations

```
1
2               San Diego County Rational Hydrology Program
3
4       CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0
5
6       Rational method hydrology  program based on
7       San Diego County Flood Control Division 2003 hydrology manual
8           Rational Hydrology Study        Date: 09/16/21
9       ------------------------------------------------------------------------
10      19025 Post Dev
11      100 Year Study Reach 6
12      PostDev100R6.rd3
13      2021.09.16 update
14      ------------------------------------------------------------------------
15       *********   Hydrology Study Control Information **********
16
17      ------------------------------------------------------------------------
18
19
20      Program License Serial Number 6332
21
22      ------------------------------------------------------------------------
23      Rational hydrology study storm event year is   100.0
24      English (in-lb) input data Units used
25
26      Map data precipitation entered:
27      6 hour,  precipitation(inches) =  3.500
28      24 hour precipitation(inches) =  6.000
29      P6/P24 =    58.3%
30      San Diego hydrology manual 'C' values used
31
32
33      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
34      Process from Point/Station      600.000 to Point/Station      601.000
35      **** INITIAL AREA EVALUATION ****
36      ________________________________________________________________________
37      Decimal fraction soil group A = 0.000
38      Decimal fraction soil group B = 0.000
39      Decimal fraction soil group C = 1.000
40      Decimal fraction soil group D = 0.000
41      [HIGH DENSITY RESIDENTIAL                    ]
42      (43.0 DU/A or Less      )
43      Impervious value, Ai = 0.800
44      Sub-Area C Value = 0.780
45      Initial subarea total flow distance  =   45.000(Ft.)
46      Highest elevation =  315.400(Ft.)
47      Lowest elevation =  312.100(Ft.)
48      Elevation difference =    3.300(Ft.) Slope =  7.333 %
49      Top of Initial Area Slope adjusted by User to  7.300 %
50      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
51      The maximum overland flow distance is 95.00 (Ft)
52      for the top area slope value of   7.30 %, in a development type of
53       43.0 DU/A or Less
54      In Accordance With Figure 3-3
55      Initial Area Time of Concentration =   2.89 minutes
56      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
57      TC = [1.8*(1.1-0.7800)*(  95.000^.5)/(   7.300^(1/3)]=   2.89
58      Calculated TC of    2.894 minutes is less than 5 minutes,
59       resetting TC to 5.0 minutes for rainfall intensity calculations
60      Rainfall intensity (I) =     9.222(In/Hr) for a   100.0 year storm
61      Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
62      Subarea runoff =      0.288(CFS)
63      Total initial stream area =       0.040(Ac.)
64
65
66      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
67      Process from Point/Station      601.000 to Point/Station      602.000
68      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
69      ________________________________________________________________________
```

```
Estimated mean flow rate at midpoint of channel =      0.755(CFS)
Depth of flow =   0.022(Ft.), Average velocity =   0.371(Ft/s)
    ******* Irregular Channel Data **********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2              0.00              0.00
    3             91.00              0.00
    4             91.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.755(CFS)
  '     '    flow top width =     91.000(Ft.)
  '     '    velocity=    0.371(Ft/s)
  '     '    area =      2.037(Sq.Ft)
  '     '    Froude number =     0.437

Upstream point elevation =   312.100(Ft.)
Downstream point elevation =   312.000(Ft.)
Flow length =    45.000(Ft.)
Travel time  =    2.02 min.
Time of concentration =    4.92 min.
Depth of flow =   0.022(Ft.)
Average velocity =   0.371(Ft/s)
Total irregular channel flow =     0.755(CFS)
Irregular channel normal depth above invert elev. =   0.022(Ft.)
Average velocity of channel(s) =   0.371(Ft/s)
 Adding area flow to channel
Calculated TC of    4.917 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.133
Subarea runoff =      0.935(CFS) for      0.130(Ac.)
Total runoff =      1.223(CFS)  Total area =      0.170(Ac.)
Depth of flow =   0.030(Ft.), Average velocity =   0.450(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      602.000 to Point/Station      602.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.170(Ac.)
Runoff from this stream =      1.223(CFS)
Time of concentration =    4.92 min.
Rainfall intensity =     9.222(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      700.000 to Point/Station      701.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
```

```
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Initial subarea total flow distance  =   46.000(Ft.)
Highest elevation =  316.000(Ft.)
Lowest elevation =  315.400(Ft.)
Elevation difference =    0.600(Ft.) Slope =  1.304 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 65.00 (Ft)
for the top area slope value of   1.30 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.25 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7800)*(  65.000^.5)/(   1.304^(1/3)]=   4.25
Calculated TC of    4.251 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff =      0.288(CFS)
Total initial stream area =        0.040(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      701.000 to Point/Station      702.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.057(CFS)
Depth of flow =   0.011(Ft.), Average velocity =   0.730(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2              0.00              0.00
    3            130.00              0.00
    4            130.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.057(CFS)
  '     '    flow top width =    130.000(Ft.)
  '     '    velocity=    0.730(Ft/s)
  '     '    area =      1.448(Sq.Ft)
  '     '    Froude number =     1.219

Upstream point elevation =   315.400(Ft.)
Downstream point elevation =   312.100(Ft.)
Flow length =   151.000(Ft.)
Travel time  =    3.45 min.
Time of concentration =    7.70 min.
Depth of flow =   0.011(Ft.)
Average velocity =   0.730(Ft/s)
Total irregular channel flow =     1.057(CFS)
Irregular channel normal depth above invert elev. =   0.011(Ft.)
Average velocity of channel(s) =   0.730(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      6.981(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity =      6.981(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.250
Subarea runoff =      1.455(CFS) for      0.280(Ac.)
Total runoff =      1.743(CFS)  Total area =       0.320(Ac.)
```

```
Depth of flow =   0.015(Ft.), Average velocity =   0.892(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      702.000 to Point/Station      602.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   312.100(Ft.)
Downstream point/station elevation =   312.000(Ft.)
Pipe length  =    40.00(Ft.) Slope =   0.0025  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.743(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.743(CFS)
Normal flow depth in pipe =    9.61(In.)
Flow top width inside pipe =    9.59(In.)
Critical Depth =    6.74(In.)
Pipe flow velocity =      2.59(Ft/s)
Travel time through pipe =    0.26 min.
Time of concentration (TC) =     7.96 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      602.000 to Point/Station      602.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.320(Ac.)
Runoff from this stream =      1.743(CFS)
Time of concentration =    7.96 min.
Rainfall intensity =     6.834(In/Hr)
Summary of stream data:

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


1        1.223      4.92             9.222
2        1.743      7.96             6.834
Qmax(1) =
       1.000 *    1.000 *     1.223) +
       1.000 *    0.618 *     1.743) + =       2.300
Qmax(2) =
       0.741 *    1.000 *     1.223) +
       1.000 *    1.000 *     1.743) + =       2.649

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.223       1.743
Maximum flow rates at confluence using above data:
        2.300        2.649
Area of streams before confluence:
        0.170        0.320
Results of confluence:
Total flow rate =      2.649(CFS)
Time of concentration =     7.956 min.
Effective stream area after confluence =      0.490(Ac.)
End of computations, total study area =          0.490 (Ac.)
```

3e. CivilD Post Development Onsite Reach 8 Calculations

```
            San Diego County Rational Hydrology Program

 CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

 Rational method hydrology  program based on
 San Diego County Flood Control Division 2003 hydrology manual
     Rational Hydrology Study        Date: 04/07/23
 ------------------------------------------------------------------------
 19025 Post Dev
 100 Year Study Reach 8
 PostDev100R8.rd3
 2021.09.16 update
 ------------------------------------------------------------------------
  *********   Hydrology Study Control Information **********

 ------------------------------------------------------------------------


 Program License Serial Number 6332

 ------------------------------------------------------------------------
 Rational hydrology study storm event year is   100.0
 English (in-lb) input data Units used

 Map data precipitation entered:
 6 hour,  precipitation(inches) =  3.500
 24 hour precipitation(inches) =  6.000
 P6/P24 =    58.3%
 San Diego hydrology manual 'C' values used


 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 Process from Point/Station      800.000 to Point/Station      801.000
 **** INITIAL AREA EVALUATION ****
 ------------------------------------------------------------------------
 Decimal fraction soil group A = 0.100
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.900
 Decimal fraction soil group D = 0.000
 [MEDIUM DENSITY RESIDENTIAL                  ]
 (14.5 DU/A or Less      )
 Impervious value, Ai = 0.500
 Sub-Area C Value = 0.595
 Initial subarea total flow distance  =   99.000(Ft.)
 Highest elevation =  315.200(Ft.)
 Lowest elevation =  314.100(Ft.)
 Elevation difference =    1.100(Ft.) Slope =  1.111 %
 Top of Initial Area Slope adjusted by User to  1.000 %
 Bottom of Initial Area Slope adjusted by User to  1.000 %
 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
 The maximum overland flow distance is 65.00 (Ft)
 for the top area slope value of   1.00 %, in a development type of
  14.5 DU/A or Less
 In Accordance With Figure 3-3
 Initial Area Time of Concentration =   7.33 minutes
 TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
 TC = [1.8*(1.1-0.5950)*(  65.000^.5)/(   1.000^(1/3)]=   7.33
 The initial area total distance of   99.00 (Ft.) entered leaves a
 remaining distance of   34.00 (Ft.)
 Using Figure 3-4, the travel time for this distance is   0.69 minutes
 for a distance of  34.00 (Ft.) and a slope of  1.00 %
 with an elevation difference of   0.34(Ft.) from the end of the top area
 Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
  =    0.695 Minutes
 Tt=[(11.9*0.0064^3)/(  0.34)]^.385=  0.69
 Total initial area Ti =   7.33 minutes from Figure 3-3 formula plus
   0.69 minutes from the Figure 3-4 formula =   8.02 minutes
 Rainfall intensity (I) =     6.797(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.595
Subarea runoff =      0.647(CFS)
Total initial stream area =        0.160(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      801.000 to Point/Station      802.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.706(CFS)
Depth of flow =   0.166(Ft.), Average velocity =   0.858(Ft/s)
    ******* Irregular Channel Data **********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2              0.00              0.00
    3             72.00              0.50
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      1.706(CFS)
  '     '    flow top width =     23.925(Ft.)
  '     '    velocity=    0.858(Ft/s)
  '     '    area =      1.988(Sq.Ft)
  '     '    Froude number =     0.525

Upstream point elevation =   314.100(Ft.)
Downstream point elevation =   311.500(Ft.)
Flow length =   311.000(Ft.)
Travel time  =    6.04 min.
Time of concentration =   14.06 min.
Depth of flow =   0.166(Ft.)
Average velocity =   0.858(Ft/s)
Total irregular channel flow =     1.706(CFS)
Irregular channel normal depth above invert elev. =   0.166(Ft.)
Average velocity of channel(s) =   0.858(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      4.733(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.400
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.600
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(14.5 DU/A or Less      )
Impervious value, Ai = 0.500
Sub-Area C Value = 0.580
Rainfall intensity =      4.733(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.582  CA =      0.565
Subarea runoff =      2.027(CFS) for      0.810(Ac.)
Total runoff =      2.674(CFS)  Total area =       0.970(Ac.)
Depth of flow =   0.197(Ft.), Average velocity =   0.960(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      802.000 to Point/Station      803.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   304.600(Ft.)
Downstream point/station elevation =   304.300(Ft.)
Pipe length  =   173.00(Ft.) Slope =   0.0017  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.674(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.944(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.974(Ft.)
 Minor friction loss =      0.270(Ft.)  K-factor =   1.50
Pipe flow velocity =      3.40(Ft/s)
```

```
      Travel time through pipe =    0.85 min.
      Time of concentration (TC) =    14.91 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      803.000 to Point/Station      803.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ----------------------------------------------------------------------
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      0.970(Ac.)
      Runoff from this stream =      2.674(CFS)
      Time of concentration =   14.91 min.
      Rainfall intensity =     4.558(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      900.000 to Point/Station      901.000
      **** INITIAL AREA EVALUATION ****
      ----------------------------------------------------------------------
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [LOW DENSITY RESIDENTIAL                    ]
      (1.0 DU/A or Less       )
      Impervious value, Ai = 0.100
      Sub-Area C Value = 0.270
      Initial subarea total flow distance  =  100.000(Ft.)
      Highest elevation =  333.100(Ft.)
      Lowest elevation =  323.900(Ft.)
      Elevation difference =    9.200(Ft.) Slope =  9.200 %
      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
      The maximum overland flow distance is 100.00 (Ft)
      for the top area slope value of   9.20 %, in a development type of
       1.0 DU/A or Less
      In Accordance With Figure 3-3
      Initial Area Time of Concentration =   7.13 minutes
      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
      TC = [1.8*(1.1-0.2700)*( 100.000^.5)/(   9.200^(1/3)]=   7.13
      Rainfall intensity (I) =      7.335(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
      Subarea runoff =      0.059(CFS)
      Total initial stream area =        0.030(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      901.000 to Point/Station      902.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
      ----------------------------------------------------------------------
      Estimated mean flow rate at midpoint of channel =      0.168(CFS)
      Depth of flow =   0.228(Ft.), Average velocity =   3.226(Ft/s)
          ******* Irregular Channel Data ***********
      ------------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              1.00
          2              1.00              0.00
          3              2.00              1.00
      Manning's 'N' friction factor =   0.016
      ------------------------------------------------------------------
      Sub-Channel flow  =      0.168(CFS)
        '     '    flow top width =      0.457(Ft.)
        '     '    velocity=    3.226(Ft/s)
        '     '    area =      0.052(Sq.Ft)
        '     '    Froude number =     1.682

      Upstream point elevation =   323.900(Ft.)
      Downstream point elevation =   315.400(Ft.)
      Flow length =   246.000(Ft.)
```

```
Travel time  =    1.27 min.
Time of concentration =    8.40 min.
Depth of flow =   0.228(Ft.)
Average velocity =   3.226(Ft/s)
Total irregular channel flow =     0.168(CFS)
Irregular channel normal depth above invert elev. =   0.228(Ft.)
Average velocity of channel(s) =   3.226(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      6.599(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Rainfall intensity =      6.599(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.270  CA =      0.038
Subarea runoff =      0.190(CFS) for      0.110(Ac.)
Total runoff =      0.249(CFS)  Total area =      0.140(Ac.)
Depth of flow =   0.265(Ft.), Average velocity =   3.559(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      902.000 to Point/Station      803.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   310.900(Ft.)
Downstream point/station elevation =   304.300(Ft.)
Pipe length  =   100.00(Ft.) Slope =   0.0660  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.249(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.249(CFS)
Normal flow depth in pipe =    1.36(In.)
Flow top width inside pipe =    7.62(In.)
Critical Depth =    2.46(In.)
Pipe flow velocity =      5.07(Ft/s)
Travel time through pipe =    0.33 min.
Time of concentration (TC) =     8.73 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      803.000 to Point/Station      803.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.140(Ac.)
Runoff from this stream =      0.249(CFS)
Time of concentration =    8.73 min.
Rainfall intensity =     6.437(In/Hr)
Summary of stream data:

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


1        2.674     14.91             4.558
2        0.249      8.73             6.437
Qmax(1) =
       1.000 *    1.000 *     2.674) +
       0.708 *    1.000 *     0.249) + =       2.851
Qmax(2) =
       1.000 *    0.586 *     2.674) +
       1.000 *    1.000 *     0.249) + =       1.815

Total of 2 streams to confluence:
Flow rates before confluence point:
```

```
        2.674       0.249
Maximum flow rates at confluence using above data:
        2.851       1.815
Area of streams before confluence:
        0.970       0.140
Results of confluence:
Total flow rate =      2.851(CFS)
Time of concentration =    14.909 min.
Effective stream area after confluence =      1.110(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      803.000 to Point/Station      804.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   304.300(Ft.)
Downstream point/station elevation =   302.800(Ft.)
Pipe length  =   301.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.851(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.733(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.926(Ft.)
 Minor friction loss =      0.307(Ft.)  K-factor =   1.50
Pipe flow velocity =      3.63(Ft/s)
Travel time through pipe =    1.38 min.
Time of concentration (TC) =    16.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      804.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.110(Ac.)
Runoff from this stream =      2.851(CFS)
Time of concentration =   16.29 min.
Rainfall intensity =     4.305(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      600.000 to Point/Station      804.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity (I) =      6.834(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   7.96 min.  Rain intensity =       6.83(In/Hr)
Total area =        0.490(Ac.)  Total runoff =     2.649(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      804.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.490(Ac.)
Runoff from this stream =      2.649(CFS)
Time of concentration =    7.96 min.
Rainfall intensity =     6.834(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      500.000 to Point/Station      501.000
**** INITIAL AREA EVALUATION ****

------------------------------------------------------------------------------
Decimal fraction soil group A = 0.900
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.663
Initial subarea total flow distance  =   68.000(Ft.)
Highest elevation =  315.800(Ft.)
Lowest elevation =  315.600(Ft.)
Elevation difference =    0.200(Ft.) Slope =  0.294 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.29 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   8.36 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6630)*(  50.000^.5)/(   0.294^(1/3)]=   8.36
The initial area total distance of   68.00 (Ft.) entered leaves a
remaining distance of   18.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.68 minutes
for a distance of  18.00 (Ft.) and a slope of  0.29 %
with an elevation difference of   0.05(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.682 Minutes
Tt=[(11.9*0.0034^3)/(  0.05)]^.385=  0.68
Total initial area Ti =   8.36 minutes from Figure 3-3 formula plus
  0.68 minutes from the Figure 3-4 formula =   9.05 minutes
Rainfall intensity (I) =     6.291(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.663
Subarea runoff =      0.167(CFS)
Total initial stream area =       0.040(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      501.000 to Point/Station      502.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------------
Rainfall intensity (I) =     6.291(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.900
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.762
Time of concentration =     9.05 min.
Rainfall intensity =     6.291(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.739  CA =      0.126
Subarea runoff =      0.623(CFS) for      0.130(Ac.)
Total runoff =      0.790(CFS)  Total area =       0.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      502.000 to Point/Station      503.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

------------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      1.710(CFS)
Depth of flow =   0.034(Ft.), Average velocity =   2.019(Ft/s)
    ******* Irregular Channel Data ***********
```

```
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2              0.00              0.00
    3             25.00              0.00
    4             25.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.710(CFS)
   '     '    flow top width =     25.000(Ft.)
   '     '    velocity=    2.019(Ft/s)
   '     '    area =      0.847(Sq.Ft)
   '     '    Froude number =     1.933

Upstream point elevation =   316.600(Ft.)
Downstream point elevation =   312.000(Ft.)
Flow length =   121.000(Ft.)
Travel time  =    1.00 min.
Time of concentration =   10.05 min.
Depth of flow =   0.034(Ft.)
Average velocity =   2.019(Ft/s)
Total irregular channel flow =     1.710(CFS)
Irregular channel normal depth above invert elev. =   0.034(Ft.)
Average velocity of channel(s) =   2.019(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.880(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.010
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.990
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity =      5.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.767  CA =      0.434
Subarea runoff =      1.764(CFS) for      0.396(Ac.)
Total runoff =      2.554(CFS)  Total area =       0.566(Ac.)
Depth of flow =   0.043(Ft.), Average velocity =   2.369(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      503.000 to Point/Station      804.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

------------------------------------------------------------------------
Upstream point/station elevation =   307.000(Ft.)
Downstream point/station elevation =   302.800(Ft.)
Pipe length  =    44.00(Ft.) Slope =   0.0955  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.554(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.554(CFS)
Normal flow depth in pipe =    3.93(In.)
Flow top width inside pipe =   11.26(In.)
Critical Depth =    8.22(In.)
Pipe flow velocity =     11.41(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    10.11 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      804.000
**** CONFLUENCE OF MINOR STREAMS ****

------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.566(Ac.)
Runoff from this stream =      2.554(CFS)
Time of concentration =   10.11 min.
```

```
Rainfall intensity =     5.856(In/Hr)
Summary of stream data:

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


1         2.851     16.29             4.305
2         2.649      7.96             6.834
3         2.554     10.11             5.856
Qmax(1) =
       1.000 *    1.000 *     2.851) +
       0.630 *    1.000 *     2.649) +
       0.735 *    1.000 *     2.554) + =       6.397
Qmax(2) =
       1.000 *    0.488 *     2.851) +
       1.000 *    1.000 *     2.649) +
       1.000 *    0.787 *     2.554) + =       6.051
Qmax(3) =
       1.000 *    0.621 *     2.851) +
       0.857 *    1.000 *     2.649) +
       1.000 *    1.000 *     2.554) + =       6.593

Total of 3 streams to confluence:
Flow rates before confluence point:
       2.851       2.649       2.554
Maximum flow rates at confluence using above data:
        6.397        6.051        6.593
Area of streams before confluence:
        1.110        0.490        0.566
Results of confluence:
Total flow rate =      6.593(CFS)
Time of concentration =    10.110 min.
Effective stream area after confluence =      2.166(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   302.800(Ft.)
Downstream point/station elevation =   302.600(Ft.)
Pipe length  =    38.00(Ft.) Slope =   0.0053  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.593(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     2.742(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.301(Ft.)
 Minor friction loss =      1.641(Ft.)  K-factor =   1.50
Pipe flow velocity =      8.39(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =    10.19 min.
End of computations, total study area =           2.166 (Ac.)
```

3f. CivilD Post Development Offsite Calculations

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 01/27/21
------------------------------------------------------------------------
19025 Post Dev
100 Year Study Offsite
19025Post100Offsite.rd3

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------


Program License Serial Number 6332

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1000.000 to Point/Station     1001.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  379.000(Ft.)
Lowest elevation =  372.000(Ft.)
Elevation difference =    7.000(Ft.) Slope =  7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   7.00 %, in a development type of
 7.3 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration =   6.00 minutes
 (for slope value of   5.00 %)
Rainfall intensity (I) =      8.198(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff =      0.315(CFS)
Total initial stream area =        0.080(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1001.000 to Point/Station     1002.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      5.468(CFS)
Depth of flow =   0.404(Ft.), Average velocity =   5.574(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
```

```
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              2.71
          2             31.00              0.13
          3             32.50              0.00
          4             32.50              0.50
      Manning's 'N' friction factor =   0.015
      -----------------------------------------------------------------
      Sub-Channel flow  =      5.468(CFS)
        '     '    flow top width =      4.851(Ft.)
        '     '    velocity=    5.574(Ft/s)
        '     '    area =      0.981(Sq.Ft)
        '     '    Froude number =     2.184

      Upstream point elevation =   372.000(Ft.)
      Downstream point elevation =   347.000(Ft.)
      Flow length =   839.000(Ft.)
      Travel time  =    2.51 min.
      Time of concentration =    8.51 min.
      Depth of flow =   0.404(Ft.)
      Average velocity =   5.574(Ft/s)
      Total irregular channel flow =     5.468(CFS)
      Irregular channel normal depth above invert elev. =   0.404(Ft.)
      Average velocity of channel(s) =   5.574(Ft/s)
       Adding area flow to channel
      Rainfall intensity (I) =      6.545(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [MEDIUM DENSITY RESIDENTIAL                  ]
      (4.3 DU/A or Less       )
      Impervious value, Ai = 0.300
      Sub-Area C Value = 0.410
      Rainfall intensity =      6.545(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.411  CA =      1.609
      Subarea runoff =     10.213(CFS) for      3.830(Ac.)
      Total runoff =     10.528(CFS)  Total area =       3.910(Ac.)
      Depth of flow =   0.517(Ft.), Average velocity =   6.574(Ft/s)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station     1002.000 to Point/Station     1002.500
      **** PIPEFLOW TRAVEL TIME (User specified size) ****
      ______________________________________________________________________
      Upstream point/station elevation =   344.000(Ft.)
      Downstream point/station elevation =   325.600(Ft.)
      Pipe length  =   160.00(Ft.) Slope =   0.1150  Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    10.528(CFS)
      Given pipe size =     18.00(In.)
      Calculated individual pipe flow  =    10.528(CFS)
      Normal flow depth in pipe =    6.70(In.)
      Flow top width inside pipe =   17.40(In.)
      Critical Depth =   14.96(In.)
      Pipe flow velocity =     17.55(Ft/s)
      Travel time through pipe =    0.15 min.
      Time of concentration (TC) =     8.66 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station     1002.500 to Point/Station     1002.500
      **** SUBAREA FLOW ADDITION ****
      ______________________________________________________________________
      Rainfall intensity (I) =      6.470(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
```

```
      [MEDIUM DENSITY RESIDENTIAL                  ]
      (7.3 DU/A or Less       )
      Impervious value, Ai = 0.400
      Sub-Area C Value = 0.480
      Time of concentration =     8.66 min.
      Rainfall intensity =      6.470(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.426  CA =      2.132
      Subarea runoff =      3.266(CFS) for      1.090(Ac.)
      Total runoff =     13.794(CFS)  Total area =       5.000(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station     1002.500 to Point/Station     1003.000
      **** PIPEFLOW TRAVEL TIME (User specified size) ****
      ________________________________________________________________________
      Upstream point/station elevation =   325.500(Ft.)
      Downstream point/station elevation =   322.000(Ft.)
      Pipe length  =    71.00(Ft.) Slope =   0.0493  Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =    13.794(CFS)
      Given pipe size =     18.00(In.)
      Calculated individual pipe flow  =    13.794(CFS)
      Normal flow depth in pipe =    9.96(In.)
      Flow top width inside pipe =   17.90(In.)
      Critical Depth =   16.50(In.)
      Pipe flow velocity =     13.75(Ft/s)
      Travel time through pipe =    0.09 min.
      Time of concentration (TC) =     8.75 min.
      End of computations, total study area =           5.000 (Ac.)
```

3f. CivilD Post Development Calculations

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 05/25/23
--------------------------------------------------------------------------
19025 Post Dev
100 Year Study Reach 1
PostDev100R1.rd3
offiste ud to onsite w/main confulence
--------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

--------------------------------------------------------------------------


Program License Serial Number 6332

--------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
__________________________________________________________________________
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Initial subarea total flow distance  =   53.000(Ft.)
Highest elevation =  316.800(Ft.)
Lowest elevation =  316.700(Ft.)
Elevation difference =    0.100(Ft.) Slope =  0.189 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.19 %, in a development type of
 7.3 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =  13.75 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4800)*(  50.000^.5)/(   0.189^(1/3)]=  13.75
The initial area total distance of   53.00 (Ft.) entered leaves a
remaining distance of    3.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.20 minutes
for a distance of   3.00 (Ft.) and a slope of  0.19 %
with an elevation difference of   0.01(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.203 Minutes
Tt=[(11.9*0.0006^3)/(  0.01)]^.385=  0.20
Total initial area Ti =  13.75 minutes from Figure 3-3 formula plus
  0.20 minutes from the Figure 3-4 formula =  13.95 minutes
Rainfall intensity (I) =      4.757(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
Subarea runoff =      0.068(CFS)
```

```
Total initial stream area =        0.030(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

------------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      0.228(CFS)
Depth of flow =   0.095(Ft.), Average velocity =   0.591(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.33
    2             23.00              0.00
    3             28.50              0.33
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.228(CFS)
  '     '    flow top width =      8.130(Ft.)
  '     '    velocity=    0.591(Ft/s)
  '     '    area =      0.386(Sq.Ft)
  '     '    Froude number =     0.478

Upstream point elevation =   316.700(Ft.)
Downstream point elevation =   316.300(Ft.)
Flow length =   193.000(Ft.)
Travel time  =    5.44 min.
Time of concentration =   19.39 min.
Depth of flow =   0.095(Ft.)
Average velocity =   0.591(Ft/s)
Total irregular channel flow =     0.228(CFS)
Irregular channel normal depth above invert elev. =   0.095(Ft.)
Average velocity of channel(s) =   0.591(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      3.847(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                 ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Rainfall intensity =      3.847(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.480  CA =      0.082
Subarea runoff =      0.245(CFS) for      0.140(Ac.)
Total runoff =      0.314(CFS)  Total area =      0.170(Ac.)
Depth of flow =   0.107(Ft.), Average velocity =   0.640(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------------
Rainfall intensity (I) =      3.847(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Time of concentration =    19.39 min.
Rainfall intensity =      3.847(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.393  CA =      0.114
```

```
Subarea runoff =      0.125(CFS) for      0.120(Ac.)
Total runoff =      0.439(CFS)  Total area =       0.290(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   310.200(Ft.)
Downstream point/station elevation =   309.000(Ft.)
Pipe length  =   250.00(Ft.) Slope =   0.0048  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.439(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.439(CFS)
Normal flow depth in pipe =    3.42(In.)
Flow top width inside pipe =   10.84(In.)
Critical Depth =    3.28(In.)
Pipe flow velocity =      2.37(Ft/s)
Travel time through pipe =    1.76 min.
Time of concentration (TC) =    21.15 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.290(Ac.)
Runoff from this stream =      0.439(CFS)
Time of concentration =   21.15 min.
Rainfall intensity =     3.637(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1100.000 to Point/Station     1101.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance  =   59.000(Ft.)
Highest elevation =  336.700(Ft.)
Lowest elevation =  321.600(Ft.)
Elevation difference =   15.100(Ft.) Slope = 25.593 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  25.59 %, in a development type of
 1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.07 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.2700)*( 100.000^.5)/(  25.593^(1/3)]=   5.07
Rainfall intensity (I) =      9.140(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff =      0.173(CFS)
Total initial stream area =       0.070(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1101.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      1.544(CFS)
Depth of flow =   0.128(Ft.), Average velocity =   3.658(Ft/s)
```

```
      ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.60
    2             16.00              0.00
    3             46.00              1.20
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.544(CFS)
   '     '    flow top width =      6.605(Ft.)
   '     '    velocity=    3.658(Ft/s)
   '     '    area =      0.422(Sq.Ft)
   '     '    Froude number =     2.549

Upstream point elevation =   321.600(Ft.)
Downstream point elevation =   309.000(Ft.)
Flow length =   236.000(Ft.)
Travel time  =    1.08 min.
Time of concentration =    6.15 min.
Depth of flow =   0.128(Ft.)
Average velocity =   3.658(Ft/s)
Total irregular channel flow =     1.544(CFS)
Irregular channel normal depth above invert elev. =   0.128(Ft.)
Average velocity of channel(s) =   3.658(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.073(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.534
Rainfall intensity =      8.073(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.509  CA =      0.371
Subarea runoff =      2.825(CFS) for      0.660(Ac.)
Total runoff =      2.998(CFS)  Total area =       0.730(Ac.)
Depth of flow =   0.164(Ft.), Average velocity =   4.317(Ft/s)


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Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.730(Ac.)
Runoff from this stream =      2.998(CFS)
Time of concentration =    6.15 min.
Rainfall intensity =     8.073(In/Hr)
Summary of stream data:

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


1        0.439     21.15             3.637
2        2.998      6.15             8.073
Qmax(1) =
       1.000 *    1.000 *     0.439) +
       0.451 *    1.000 *     2.998) + =       1.789
Qmax(2) =
       1.000 *    0.291 *     0.439) +
       1.000 *    1.000 *     2.998) + =       3.125

Total of 2 streams to confluence:
Flow rates before confluence point:
```

```
       0.439       2.998
Maximum flow rates at confluence using above data:
       1.789       3.125
Area of streams before confluence:
       0.290       0.730
Results of confluence:
Total flow rate =      3.125(CFS)
Time of concentration =     6.145 min.
Effective stream area after confluence =      1.020(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   304.200(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =   189.00(Ft.) Slope =   0.0048  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.125(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     3.125(CFS)
Normal flow depth in pipe =    8.26(In.)
Flow top width inside pipe =   17.94(In.)
Critical Depth =    8.07(In.)
Pipe flow velocity =      3.95(Ft/s)
Travel time through pipe =    0.80 min.
Time of concentration (TC) =     6.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.020(Ac.)
Runoff from this stream =      3.125(CFS)
Time of concentration =    6.94 min.
Rainfall intensity =     7.462(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.050
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(Office Professional    )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.839
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  316.800(Ft.)
Lowest elevation =  316.200(Ft.)
Elevation difference =    0.600(Ft.) Slope =  1.200 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.20 %, in a development type of
 Office Professional
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.42 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8395)*(  60.000^.5)/(   1.200^(1/3)]=   3.42
Calculated TC of    3.418 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.839
Subarea runoff =      0.310(CFS)
```

```
 Total initial stream area =        0.040(Ac.)


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Process from Point/Station      201.000 to Point/Station      202.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      2.245(CFS)
Depth of flow =   0.209(Ft.), Average velocity =   2.102(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.30
    2              1.50              0.00
    3             45.50              1.00
    4             61.50              1.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------------
Sub-Channel flow  =      2.245(CFS)
  '     '    flow top width =     10.230(Ft.)
  '     '    velocity=    2.102(Ft/s)
  '     '    area =      1.068(Sq.Ft)
  '     '    Froude number =     1.147

Upstream point elevation =   316.200(Ft.)
Downstream point elevation =   314.500(Ft.)
Flow length =   185.000(Ft.)
Travel time  =    1.47 min.
Time of concentration =    4.88 min.
Depth of flow =   0.209(Ft.)
Average velocity =   2.102(Ft/s)
Total irregular channel flow =     2.245(CFS)
Irregular channel normal depth above invert elev. =   0.209(Ft.)
Average velocity of channel(s) =   2.102(Ft/s)
 Adding area flow to channel
Calculated TC of    4.885 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(Office Professional    )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.840
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.840  CA =      0.454
Subarea runoff =      3.873(CFS) for      0.500(Ac.)
Total runoff =      4.183(CFS)  Total area =       0.540(Ac.)
Depth of flow =   0.264(Ft.), Average velocity =   2.456(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

------------------------------------------------------------------------
Upstream point/station elevation =   308.500(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =    48.00(Ft.) Slope =   0.1083  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.183(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     4.183(CFS)
Normal flow depth in pipe =    4.95(In.)
Flow top width inside pipe =   11.82(In.)
Critical Depth =   10.36(In.)
Pipe flow velocity =     13.68(Ft/s)
```

```
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     4.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.540(Ac.)
Runoff from this stream =      4.183(CFS)
Time of concentration =    4.94 min.
Rainfall intensity =     9.222(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      301.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Initial subarea total flow distance  =   42.000(Ft.)
Highest elevation =  316.000(Ft.)
Lowest elevation =  314.700(Ft.)
Elevation difference =    1.300(Ft.) Slope =  3.095 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   3.10 %, in a development type of
 Neighborhod Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.64 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7800)*(  85.000^.5)/(   3.095^(1/3)]=   3.64
Calculated TC of    3.644 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff =      0.288(CFS)
Total initial stream area =        0.040(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      1.259(CFS)
Depth of flow =   0.087(Ft.), Average velocity =   2.583(Ft/s)
    ******* Irregular Channel Data ***********
-------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2              0.00              0.00
    3             64.00              0.50
Manning's 'N' friction factor =   0.015
-------------------------------------------------------------
Sub-Channel flow  =      1.259(CFS)
  '     '    flow top width =     11.169(Ft.)
  '     '    velocity=    2.583(Ft/s)
  '     '    area =      0.487(Sq.Ft)
  '     '    Froude number =     2.180

Upstream point elevation =   314.700(Ft.)
```

```
Downstream point elevation =   313.000(Ft.)
Flow length =    38.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.89 min.
Depth of flow =   0.087(Ft.)
Average velocity =   2.583(Ft/s)
Total irregular channel flow =     1.259(CFS)
Irregular channel normal depth above invert elev. =   0.087(Ft.)
Average velocity of channel(s) =   2.583(Ft/s)
 Adding area flow to channel
Calculated TC of    3.889 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                         ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.242
Subarea runoff =      1.942(CFS) for      0.270(Ac.)
Total runoff =      2.230(CFS)  Total area =       0.310(Ac.)
Depth of flow =   0.108(Ft.), Average velocity =   2.980(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

------------------------------------------------------------------------
Upstream point/station elevation =   306.000(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =    30.00(Ft.) Slope =   0.0900  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.230(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.230(CFS)
Normal flow depth in pipe =    3.72(In.)
Flow top width inside pipe =   11.10(In.)
Critical Depth =    7.66(In.)
Pipe flow velocity =     10.75(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     3.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****

------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.310(Ac.)
Runoff from this stream =      2.230(CFS)
Time of concentration =    3.94 min.
Rainfall intensity =     9.222(In/Hr)
Summary of stream data:

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


1        3.125      6.94             7.462
2        4.183      4.94             9.222
3        2.230      3.94             9.222
Qmax(1) =
       1.000 *    1.000 *     3.125) +
       0.809 *    1.000 *     4.183) +
       0.809 *    1.000 *     2.230) + =       8.314
```

```
Qmax(2) =
       1.000 *    0.712 *     3.125) +
       1.000 *    1.000 *     4.183) +
       1.000 *    1.000 *     2.230) + =       8.638
Qmax(3) =
       1.000 *    0.567 *     3.125) +
       1.000 *    0.796 *     4.183) +
       1.000 *    1.000 *     2.230) + =       7.332

Total of 3 streams to confluence:
Flow rates before confluence point:
       3.125       4.183       2.230
Maximum flow rates at confluence using above data:
        8.314       8.638       7.332
Area of streams before confluence:
        1.020       0.540       0.310
Results of confluence:
Total flow rate =      8.638(CFS)
Time of concentration =     4.943 min.
Effective stream area after confluence =      1.870(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   303.300(Ft.)
Downstream point/station elevation =   303.000(Ft.)
Pipe length  =    71.00(Ft.) Slope =   0.0042  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.638(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.736(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.480(Ft.)
 Minor friction loss =      0.556(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.89(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =     5.19 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.870(Ac.)
Runoff from this stream =      8.638(CFS)
Time of concentration =    5.19 min.
Rainfall intensity =     9.008(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      401.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  316.100(Ft.)
Lowest elevation =  312.600(Ft.)
Elevation difference =    3.500(Ft.) Slope =  3.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
```

```
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   3.50 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.50 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7800)*(  85.000^.5)/(   3.500^(1/3)]=   3.50
The initial area total distance of  100.00 (Ft.) entered leaves a
remaining distance of   15.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.23 minutes
for a distance of  15.00 (Ft.) and a slope of  3.50 %
with an elevation difference of   0.53(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.228 Minutes
Tt=[(11.9*0.0028^3)/(  0.53)]^.385=  0.23
Total initial area Ti =   3.50 minutes from Figure 3-3 formula plus
  0.23 minutes from the Figure 3-4 formula =   3.73 minutes
Calculated TC of    3.726 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff =      0.791(CFS)
Total initial stream area =        0.110(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.043(CFS)
Depth of flow =   0.351(Ft.), Average velocity =   4.504(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.10
    2             34.00              0.40
    3             35.50              0.00
    4             35.50              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.043(CFS)
  '     '    flow top width =      1.318(Ft.)
  '     '    velocity=    4.504(Ft/s)
  '     '    area =      0.232(Sq.Ft)
  '     '    Froude number =     1.894

Upstream point elevation =   312.600(Ft.)
Downstream point elevation =   310.600(Ft.)
Flow length =    67.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.97 min.
Depth of flow =   0.351(Ft.)
Average velocity =   4.504(Ft/s)
Total irregular channel flow =     1.043(CFS)
Irregular channel normal depth above invert elev. =   0.351(Ft.)
Average velocity of channel(s) =   4.504(Ft/s)
 Adding area flow to channel
Calculated TC of    3.974 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
```

```
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.140
Subarea runoff =      0.503(CFS) for      0.070(Ac.)
Total runoff =      1.295(CFS)  Total area =       0.180(Ac.)
Depth of flow =   0.381(Ft.), Average velocity =   4.754(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.180(Ac.)
Runoff from this stream =      1.295(CFS)
Time of concentration =    3.97 min.
Rainfall intensity =     9.222(In/Hr)
Summary of stream data:

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


1        8.638      5.19             9.008
2        1.295      3.97             9.222
Qmax(1) =
       1.000 *    1.000 *     8.638) +
       0.977 *    1.000 *     1.295) + =       9.902
Qmax(2) =
       1.000 *    0.766 *     8.638) +
       1.000 *    1.000 *     1.295) + =       7.915

Total of 2 streams to confluence:
Flow rates before confluence point:
       8.638       1.295
Maximum flow rates at confluence using above data:
        9.902        7.915
Area of streams before confluence:
        1.870        0.180
Results of confluence:
Total flow rate =      9.902(CFS)
Time of concentration =     5.185 min.
Effective stream area after confluence =      2.050(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   303.000(Ft.)
Downstream point/station elevation =   302.500(Ft.)
Pipe length  =    77.00(Ft.) Slope =   0.0065  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.902(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     9.149(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      5.946(Ft.)
 Minor friction loss =      3.703(Ft.)  K-factor =   1.50
Pipe flow velocity =     12.61(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     5.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 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 =      2.050(Ac.)
Runoff from this stream =      9.902(CFS)
Time of concentration =    5.29 min.
Rainfall intensity =     8.896(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      106.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity (I) =      5.826(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  10.19 min.  Rain intensity =       5.83(In/Hr)
Total area =        2.170(Ac.)  Total runoff =     6.593(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 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 =      2.170(Ac.)
Runoff from this stream =      6.593(CFS)
Time of concentration =   10.19 min.
Rainfall intensity =     5.826(In/Hr)
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1004.000 to Point/Station     1005.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance  =   30.000(Ft.)
Highest elevation =  334.800(Ft.)
Lowest elevation =  327.500(Ft.)
Elevation difference =    7.300(Ft.) Slope = 24.333 %
Top of Initial Area Slope adjusted by User to  0.189 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.19 %, in a development type of
 1.0 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration =  12.20 minutes
 (for slope value of   0.50 %)
Rainfall intensity (I) =      5.187(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff =      0.014(CFS)
Total initial stream area =        0.010(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1005.000 to Point/Station     1003.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      0.042(CFS)
Depth of flow =   0.111(Ft.), Average velocity =   3.401(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.00
    2              1.00              0.00
    3              2.00              1.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.042(CFS)
  '     '    flow top width =      0.222(Ft.)
  '     '    velocity=    3.401(Ft/s)
  '     '    area =      0.012(Sq.Ft)
  '     '    Froude number =     2.543

Upstream point elevation =   327.500(Ft.)
Downstream point elevation =   324.500(Ft.)
Flow length =    34.000(Ft.)
Travel time  =    0.17 min.
Time of concentration =   12.37 min.
Depth of flow =   0.111(Ft.)
Average velocity =   3.401(Ft/s)
Total irregular channel flow =     0.042(CFS)
Irregular channel normal depth above invert elev. =   0.111(Ft.)
Average velocity of channel(s) =   3.401(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.142(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Rainfall intensity =      5.142(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.270  CA =      0.014
Subarea runoff =      0.055(CFS) for      0.040(Ac.)
Total runoff =      0.069(CFS)  Total area =       0.050(Ac.)
Depth of flow =   0.134(Ft.), Average velocity =   3.856(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1003.000
**** CONFLUENCE OF MINOR STREAMS ****

------------------------------------------------------------------------
Along Main Stream number: 3 in normal stream number 1
Stream flow area =      0.050(Ac.)
Runoff from this stream =      0.069(CFS)
Time of concentration =   12.37 min.
Rainfall intensity =     5.142(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1003.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

------------------------------------------------------------------------
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                 ]
```

```
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Rainfall intensity (I) =      6.428(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   8.75 min.  Rain intensity =       6.43(In/Hr)
Total area =        5.000(Ac.)  Total runoff =    13.794(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1003.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 3 in normal stream number 2
Stream flow area =      5.000(Ac.)
Runoff from this stream =     13.794(CFS)
Time of concentration =    8.75 min.
Rainfall intensity =     6.428(In/Hr)
Summary of stream data:

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


1         0.069     12.37             5.142
2        13.794      8.75             6.428
Qmax(1) =
       1.000 *    1.000 *     0.069) +
       0.800 *    1.000 *    13.794) + =      11.105
Qmax(2) =
       1.000 *    0.708 *     0.069) +
       1.000 *    1.000 *    13.794) + =      13.843

Total of 2 streams to confluence:
Flow rates before confluence point:
       0.069      13.794
Maximum flow rates at confluence using above data:
       11.105       13.843
Area of streams before confluence:
        0.050        5.000
Results of confluence:
Total flow rate =     13.843(CFS)
Time of concentration =     8.750 min.
Effective stream area after confluence =      5.050(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   311.100(Ft.)
Downstream point/station elevation =   302.600(Ft.)
Pipe length  =   209.00(Ft.) Slope =   0.0407  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.843(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    13.843(CFS)
Normal flow depth in pipe =   10.61(In.)
Flow top width inside pipe =   17.71(In.)
Critical Depth =   16.52(In.)
Pipe flow velocity =     12.78(Ft/s)
Travel time through pipe =    0.27 min.
Time of concentration (TC) =     9.02 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      106.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
```

```
In Main Stream number: 3
Stream flow area =      5.050(Ac.)
Runoff from this stream =     13.843(CFS)
Time of concentration =    9.02 min.
Rainfall intensity =     6.302(In/Hr)
Summary of stream data:

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


1         9.902      5.29             8.896
2         6.593     10.19             5.826
3        13.843      9.02             6.302
Qmax(1) =
       1.000 *    1.000 *     9.902) +
       1.000 *    0.519 *     6.593) +
       1.000 *    0.586 *    13.843) + =      21.435
Qmax(2) =
       0.655 *    1.000 *     9.902) +
       1.000 *    1.000 *     6.593) +
       0.925 *    1.000 *    13.843) + =      25.877
Qmax(3) =
       0.708 *    1.000 *     9.902) +
       1.000 *    0.885 *     6.593) +
       1.000 *    1.000 *    13.843) + =      26.696

Total of 3 main streams to confluence:
Flow rates before confluence point:
       9.902       6.593      13.843
Maximum flow rates at confluence using above data:
       21.435       25.877       26.696
Area of streams before confluence:
        2.050        2.170        5.050


Results of confluence:
Total flow rate =     26.696(CFS)
Time of concentration =     9.023 min.
Effective stream area after confluence  =      9.270(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   302.500(Ft.)
Downstream point/station elevation =   302.100(Ft.)
Pipe length  =    31.00(Ft.) Slope =   0.0129  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.696(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     6.917(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      2.002(Ft.)
 Minor friction loss =      5.316(Ft.)  K-factor =   1.50
Pipe flow velocity =     15.11(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     9.06 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      109.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   302.100(Ft.)
Downstream point/station elevation =   285.720(Ft.)
Pipe length  =   137.00(Ft.) Slope =   0.1196  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.696(CFS)
```

```
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    26.696(CFS)
Normal flow depth in pipe =   11.47(In.)
Flow top width inside pipe =   17.31(In.)
Critical depth could not be calculated.
Pipe flow velocity =     22.47(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     9.16 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      9.270(Ac.)
Runoff from this stream =     26.696(CFS)
Time of concentration =    9.16 min.
Rainfall intensity =     6.241(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2002.000 to Point/Station     2003.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.810
Initial subarea total flow distance  =   93.000(Ft.)
Highest elevation =  318.000(Ft.)
Lowest elevation =  316.300(Ft.)
Elevation difference =    1.700(Ft.) Slope =  1.828 %
Top of Initial Area Slope adjusted by User to  1.400 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.40 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.61 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8100)*(  60.000^.5)/(   1.400^(1/3)]=   3.61
Calculated TC of    3.614 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =     9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.810
Subarea runoff =     0.254(CFS)
Total initial stream area =       0.034(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2003.000 to Point/Station     2004.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =     2.206(CFS)
Depth of flow =   0.250(Ft.), Average velocity =   1.603(Ft/s)
    ******* Irregular Channel Data ***********
-------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.31
    2             26.00              0.13
    3             27.50              0.00
    4             27.50              0.50
Manning's 'N' friction factor =   0.015
```

```
------------------------------------------------------------------
Sub-Channel flow  =      2.206(CFS)
  '      '    flow top width =     18.940(Ft.)
  '      '    velocity=    1.603(Ft/s)
  '      '    area =      1.376(Sq.Ft)
  '      '    Froude number =     1.048

Upstream point elevation =   316.300(Ft.)
Downstream point elevation =   310.800(Ft.)
Flow length =   625.000(Ft.)
Travel time  =    6.50 min.
Time of concentration =   10.11 min.
Depth of flow =   0.250(Ft.)
Average velocity =   1.603(Ft/s)
Total irregular channel flow =     2.206(CFS)
Irregular channel normal depth above invert elev. =   0.250(Ft.)
Average velocity of channel(s) =   1.603(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.855(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.804 given for subarea
Rainfall intensity =      5.855(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.804  CA =      0.700
Subarea runoff =      3.848(CFS) for      0.837(Ac.)
Total runoff =      4.102(CFS)  Total area =       0.871(Ac.)
Depth of flow =   0.289(Ft.), Average velocity =   1.862(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2000.000 to Point/Station      109.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------
Rainfall intensity (I) =      5.855(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                 ]
(14.5 DU/A or Less      )
Impervious value, Ai = 0.500
Sub-Area C Value = 0.595
Time of concentration =    10.11 min.
Rainfall intensity =      5.855(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.719  CA =      1.057
Subarea runoff =      2.090(CFS) for      0.600(Ac.)
Total runoff =      6.192(CFS)  Total area =       1.471(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2001.000 to Point/Station      109.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------
Rainfall intensity (I) =      5.855(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                       ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Time of concentration =    10.11 min.
Rainfall intensity =      5.855(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.733  CA =      1.409
Subarea runoff =      2.060(CFS) for      0.451(Ac.)
Total runoff =      8.252(CFS)  Total area =       1.922(Ac.)

```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.922(Ac.)
Runoff from this stream =      8.252(CFS)
Time of concentration =   10.11 min.
Rainfall intensity =     5.855(In/Hr)
Summary of stream data:

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


1       26.696      9.16             6.241
2        8.252     10.11             5.855
Qmax(1) =
       1.000 *    1.000 *    26.696) +
       1.000 *    0.906 *     8.252) + =      34.170
Qmax(2) =
       0.938 *    1.000 *    26.696) +
       1.000 *    1.000 *     8.252) + =      33.297

Total of 2 streams to confluence:
Flow rates before confluence point:
      26.696       8.252
Maximum flow rates at confluence using above data:
       34.170       33.297
Area of streams before confluence:
        9.270        1.922
Results of confluence:
Total flow rate =     34.170(CFS)
Time of concentration =     9.158 min.
Effective stream area after confluence =     11.192(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2004.000 to Point/Station      109.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   306.830(Ft.)
Downstream point/station elevation =   285.720(Ft.)
Pipe length  =   211.00(Ft.) Slope =   0.1000  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    34.170(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     9.918(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =     22.320(Ft.)
 Minor friction loss =      8.709(Ft.)  K-factor =   1.50
Critical depth could not be calculated.
Pipe flow velocity =     19.34(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     9.34 min.
End of computations, total study area =          11.192 (Ac.)
```

3g. CivilD Post Development Mitigation Calculations

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 06/08/23
--------------------------------------------------------------------------
19025 Post Dev
100 Year Study Reach 8
MIT
2021.09.16 update
--------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

--------------------------------------------------------------------------


Program License Serial Number 6332

--------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      800.000 to Point/Station      802.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____________________________________________________________________________
User specified 'C' value of 0.195 given for subarea
Rainfall intensity (I) =      3.045(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  27.86 min.  Rain intensity =       3.05(In/Hr)
Total area =        0.970(Ac.)  Total runoff =     0.577(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      802.000 to Point/Station      803.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____________________________________________________________________________
Upstream point/station elevation =   304.600(Ft.)
Downstream point/station elevation =   304.300(Ft.)
Pipe length  =   173.00(Ft.) Slope =   0.0017  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.577(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.577(CFS)
Normal flow depth in pipe =    5.19(In.)
Flow top width inside pipe =   11.89(In.)
Critical Depth =    3.79(In.)
Pipe flow velocity =      1.77(Ft/s)
Travel time through pipe =    1.63 min.
Time of concentration (TC) =    29.49 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      803.000 to Point/Station      803.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.970(Ac.)
Runoff from this stream =      0.577(CFS)
Time of concentration =   29.49 min.
```

```
      Rainfall intensity =     2.936(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      900.000 to Point/Station      901.000
      **** INITIAL AREA EVALUATION ****

      ------------------------------------------------------------------------
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [LOW DENSITY RESIDENTIAL                        ]
      (1.0 DU/A or Less       )
      Impervious value, Ai = 0.100
      Sub-Area C Value = 0.270
      Initial subarea total flow distance  =  100.000(Ft.)
      Highest elevation =  333.100(Ft.)
      Lowest elevation =  323.900(Ft.)
      Elevation difference =    9.200(Ft.) Slope =  9.200 %
      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
      The maximum overland flow distance is 100.00 (Ft)
      for the top area slope value of   9.20 %, in a development type of
       1.0 DU/A or Less
      In Accordance With Figure 3-3
      Initial Area Time of Concentration =   7.13 minutes
      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
      TC = [1.8*(1.1-0.2700)*( 100.000^.5)/(   9.200^(1/3)]=   7.13
      Rainfall intensity (I) =      7.335(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
      Subarea runoff =      0.059(CFS)
      Total initial stream area =        0.030(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      901.000 to Point/Station      902.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

      ------------------------------------------------------------------------
      Estimated mean flow rate at midpoint of channel =      0.168(CFS)
      Depth of flow =   0.228(Ft.), Average velocity =   3.226(Ft/s)
          ******* Irregular Channel Data ***********
      ------------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              1.00
          2              1.00              0.00
          3              2.00              1.00
      Manning's 'N' friction factor =   0.016
      ------------------------------------------------------------------
      Sub-Channel flow  =      0.168(CFS)
        '     '    flow top width =      0.457(Ft.)
        '     '    velocity=    3.226(Ft/s)
        '     '    area =      0.052(Sq.Ft)
        '     '    Froude number =     1.682

      Upstream point elevation =   323.900(Ft.)
      Downstream point elevation =   315.400(Ft.)
      Flow length =   246.000(Ft.)
      Travel time  =    1.27 min.
      Time of concentration =    8.40 min.
      Depth of flow =   0.228(Ft.)
      Average velocity =   3.226(Ft/s)
      Total irregular channel flow =     0.168(CFS)
      Irregular channel normal depth above invert elev. =   0.228(Ft.)
      Average velocity of channel(s) =   3.226(Ft/s)
       Adding area flow to channel
      Rainfall intensity (I) =      6.599(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
```

```
      Decimal fraction soil group D = 0.000
      [LOW DENSITY RESIDENTIAL                    ]
      (1.0 DU/A or Less       )
      Impervious value, Ai = 0.100
      Sub-Area C Value = 0.270
      Rainfall intensity =      6.599(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.270  CA =      0.038
      Subarea runoff =      0.190(CFS) for      0.110(Ac.)
      Total runoff =      0.249(CFS)  Total area =       0.140(Ac.)
      Depth of flow =   0.265(Ft.), Average velocity =   3.559(Ft/s)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      902.000 to Point/Station      803.000
      **** PIPEFLOW TRAVEL TIME (User specified size) ****
      ----------------------------------------------------------------------
      Upstream point/station elevation =   310.900(Ft.)
      Downstream point/station elevation =   304.300(Ft.)
      Pipe length  =   100.00(Ft.) Slope =   0.0660  Manning's N = 0.013
      No. of pipes = 1  Required pipe flow  =     0.249(CFS)
      Given pipe size =     12.00(In.)
      Calculated individual pipe flow  =     0.249(CFS)
      Normal flow depth in pipe =    1.36(In.)
      Flow top width inside pipe =    7.62(In.)
      Critical Depth =    2.46(In.)
      Pipe flow velocity =      5.07(Ft/s)
      Travel time through pipe =    0.33 min.
      Time of concentration (TC) =     8.73 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      803.000 to Point/Station      803.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ----------------------------------------------------------------------
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      0.140(Ac.)
      Runoff from this stream =      0.249(CFS)
      Time of concentration =    8.73 min.
      Rainfall intensity =     6.437(In/Hr)
      Summary of stream data:

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


      1        0.577     29.49             2.936
      2        0.249      8.73             6.437
      Qmax(1) =
             1.000 *    1.000 *     0.577) +
             0.456 *    1.000 *     0.249) + =       0.691
      Qmax(2) =
             1.000 *    0.296 *     0.577) +
             1.000 *    1.000 *     0.249) + =       0.420

      Total of 2 streams to confluence:
      Flow rates before confluence point:
             0.577       0.249
      Maximum flow rates at confluence using above data:
              0.691       0.420
      Area of streams before confluence:
              0.970       0.140
      Results of confluence:
      Total flow rate =      0.691(CFS)
      Time of concentration =    29.489 min.
      Effective stream area after confluence =      1.110(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
Process from Point/Station      803.000 to Point/Station      804.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   304.300(Ft.)
Downstream point/station elevation =   302.800(Ft.)
Pipe length  =   301.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.691(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.691(CFS)
Normal flow depth in pipe =    4.30(In.)
Flow top width inside pipe =   11.51(In.)
Critical Depth =    4.15(In.)
Pipe flow velocity =      2.73(Ft/s)
Travel time through pipe =    1.84 min.
Time of concentration (TC) =    31.32 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      804.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.110(Ac.)
Runoff from this stream =      0.691(CFS)
Time of concentration =   31.32 min.
Rainfall intensity =     2.824(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      600.000 to Point/Station      804.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity (I) =      6.834(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   7.96 min.  Rain intensity =       6.83(In/Hr)
Total area =       0.490(Ac.)  Total runoff =     2.649(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      804.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.490(Ac.)
Runoff from this stream =      2.649(CFS)
Time of concentration =    7.96 min.
Rainfall intensity =     6.834(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      500.000 to Point/Station      501.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.900
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.663
```

```
Initial subarea total flow distance  =   68.000(Ft.)
Highest elevation =  315.800(Ft.)
Lowest elevation =  315.600(Ft.)
Elevation difference =    0.200(Ft.) Slope =  0.294 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.29 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   8.36 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6630)*(  50.000^.5)/(   0.294^(1/3)]=   8.36
The initial area total distance of   68.00 (Ft.) entered leaves a
remaining distance of   18.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.68 minutes
for a distance of  18.00 (Ft.) and a slope of  0.29 %
with an elevation difference of   0.05(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.682 Minutes
Tt=[(11.9*0.0034^3)/(  0.05)]^.385=  0.68
Total initial area Ti =   8.36 minutes from Figure 3-3 formula plus
  0.68 minutes from the Figure 3-4 formula =   9.05 minutes
Rainfall intensity (I) =      6.291(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.663
Subarea runoff =      0.167(CFS)
Total initial stream area =        0.040(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      501.000 to Point/Station      502.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Rainfall intensity (I) =      6.291(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.900
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.762
Time of concentration =     9.05 min.
Rainfall intensity =      6.291(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.739  CA =      0.126
Subarea runoff =      0.623(CFS) for      0.130(Ac.)
Total runoff =      0.790(CFS)  Total area =       0.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      502.000 to Point/Station      503.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      1.710(CFS)
Depth of flow =   0.034(Ft.), Average velocity =   2.019(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2              0.00              0.00
    3             25.00              0.00
    4             25.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.710(CFS)
  '     '    flow top width =     25.000(Ft.)
  '     '    velocity=    2.019(Ft/s)
  '     '    area =      0.847(Sq.Ft)
```

```
  '     '    Froude number =     1.933

Upstream point elevation =   316.600(Ft.)
Downstream point elevation =   312.000(Ft.)
Flow length =   121.000(Ft.)
Travel time  =    1.00 min.
Time of concentration =   10.05 min.
Depth of flow =   0.034(Ft.)
Average velocity =   2.019(Ft/s)
Total irregular channel flow =     1.710(CFS)
Irregular channel normal depth above invert elev. =   0.034(Ft.)
Average velocity of channel(s) =   2.019(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.880(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.010
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.990
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity =      5.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.767  CA =      0.434
Subarea runoff =      1.764(CFS) for      0.396(Ac.)
Total runoff =      2.554(CFS)  Total area =       0.566(Ac.)
Depth of flow =   0.043(Ft.), Average velocity =   2.369(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      503.000 to Point/Station      804.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   307.000(Ft.)
Downstream point/station elevation =   302.800(Ft.)
Pipe length  =    44.00(Ft.) Slope =   0.0955  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.554(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.554(CFS)
Normal flow depth in pipe =    3.93(In.)
Flow top width inside pipe =   11.26(In.)
Critical Depth =    8.22(In.)
Pipe flow velocity =     11.41(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    10.11 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      804.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.566(Ac.)
Runoff from this stream =      2.554(CFS)
Time of concentration =   10.11 min.
Rainfall intensity =     5.856(In/Hr)
Summary of stream data:

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


1        0.691     31.32            2.824
2        2.649      7.96            6.834
3        2.554     10.11            5.856
Qmax(1) =
       1.000 *    1.000 *     0.691) +
       0.413 *    1.000 *     2.649) +
```

```
       0.482 *    1.000 *     2.554) + =       3.017
Qmax(2) =
       1.000 *    0.254 *     0.691) +
       1.000 *    1.000 *     2.649) +
       1.000 *    0.787 *     2.554) + =       4.834
Qmax(3) =
       1.000 *    0.323 *     0.691) +
       0.857 *    1.000 *     2.649) +
       1.000 *    1.000 *     2.554) + =       5.047

Total of 3 streams to confluence:
Flow rates before confluence point:
       0.691       2.649       2.554
Maximum flow rates at confluence using above data:
        3.017       4.834       5.047
Area of streams before confluence:
        1.110       0.490       0.566
Results of confluence:
Total flow rate =      5.047(CFS)
Time of concentration =    10.110 min.
Effective stream area after confluence =      2.166(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   302.800(Ft.)
Downstream point/station elevation =   302.600(Ft.)
Pipe length  =    38.00(Ft.) Slope =   0.0053  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.047(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.524(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.762(Ft.)
 Minor friction loss =      0.962(Ft.)  K-factor =   1.50
Pipe flow velocity =      6.43(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =    10.21 min.
End of computations, total study area =           2.166 (Ac.)
```

```
            San Diego County Rational Hydrology Program

     CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2014 Version 9.0

     Rational method hydrology  program based on
     San Diego County Flood Control Division 2003 hydrology manual
         Rational Hydrology Study        Date: 06/08/23
     ------------------------------------------------------------------------
     19025 Post Dev
     100 Year Study Reach 1
     PostDev100R1.rd3
     mit
     ------------------------------------------------------------------------
      *********   Hydrology Study Control Information **********

     ------------------------------------------------------------------------


     Program License Serial Number 6332

     ------------------------------------------------------------------------
     Rational hydrology study storm event year is   100.0
     English (in-lb) input data Units used

     Map data precipitation entered:
     6 hour,  precipitation(inches) =  3.500
     24 hour precipitation(inches) =  6.000
     P6/P24 =    58.3%
     San Diego hydrology manual 'C' values used


     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
     Process from Point/Station      100.000 to Point/Station      101.000
     **** INITIAL AREA EVALUATION ****
     ________________________________________________________________________
     Decimal fraction soil group A = 1.000
     Decimal fraction soil group B = 0.000
     Decimal fraction soil group C = 0.000
     Decimal fraction soil group D = 0.000
     [MEDIUM DENSITY RESIDENTIAL                  ]
     (7.3 DU/A or Less       )
     Impervious value, Ai = 0.400
     Sub-Area C Value = 0.480
     Initial subarea total flow distance  =   53.000(Ft.)
     Highest elevation =  316.800(Ft.)
     Lowest elevation =  316.700(Ft.)
     Elevation difference =    0.100(Ft.) Slope =  0.189 %
     INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
     The maximum overland flow distance is 50.00 (Ft)
     for the top area slope value of   0.19 %, in a development type of
      7.3 DU/A or Less
     In Accordance With Figure 3-3
     Initial Area Time of Concentration =  13.75 minutes
     TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
     TC = [1.8*(1.1-0.4800)*(  50.000^.5)/(   0.189^(1/3)]=  13.75
     The initial area total distance of   53.00 (Ft.) entered leaves a
     remaining distance of    3.00 (Ft.)
     Using Figure 3-4, the travel time for this distance is   0.20 minutes
     for a distance of   3.00 (Ft.) and a slope of  0.19 %
     with an elevation difference of   0.01(Ft.) from the end of the top area
     Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
      =    0.203 Minutes
     Tt=[(11.9*0.0006^3)/(  0.01)]^.385=  0.20
     Total initial area Ti =  13.75 minutes from Figure 3-3 formula plus
       0.20 minutes from the Figure 3-4 formula =  13.95 minutes
     Rainfall intensity (I) =     4.757(In/Hr) for a   100.0 year storm
     Effective runoff coefficient used for area (Q=KCIA) is C = 0.480
     Subarea runoff =     0.068(CFS)
```

```
      Total initial stream area =       0.030(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      101.000 to Point/Station      102.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

      ______________________________________________________________________
      Estimated mean flow rate at midpoint of channel =      0.228(CFS)
      Depth of flow =   0.095(Ft.), Average velocity =   0.591(Ft/s)
          ******* Irregular Channel Data ***********
      ----------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              0.33
          2             23.00              0.00
          3             28.50              0.33
      Manning's 'N' friction factor =   0.015
      ----------------------------------------------------------------
      Sub-Channel flow  =      0.228(CFS)
        '     '    flow top width =      8.130(Ft.)
        '     '    velocity=    0.591(Ft/s)
        '     '    area =      0.386(Sq.Ft)
        '     '    Froude number =     0.478

      Upstream point elevation =   316.700(Ft.)
      Downstream point elevation =   316.300(Ft.)
      Flow length =   193.000(Ft.)
      Travel time  =    5.44 min.
      Time of concentration =   19.39 min.
      Depth of flow =   0.095(Ft.)
      Average velocity =   0.591(Ft/s)
      Total irregular channel flow =     0.228(CFS)
      Irregular channel normal depth above invert elev. =   0.095(Ft.)
      Average velocity of channel(s) =   0.591(Ft/s)
       Adding area flow to channel
      Rainfall intensity (I) =      3.847(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [MEDIUM DENSITY RESIDENTIAL                  ]
      (7.3 DU/A or Less       )
      Impervious value, Ai = 0.400
      Sub-Area C Value = 0.480
      Rainfall intensity =      3.847(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.480  CA =      0.082
      Subarea runoff =      0.245(CFS) for      0.140(Ac.)
      Total runoff =      0.314(CFS)  Total area =       0.170(Ac.)
      Depth of flow =   0.107(Ft.), Average velocity =   0.640(Ft/s)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      102.000 to Point/Station      102.000
      **** SUBAREA FLOW ADDITION ****

      ______________________________________________________________________
      Rainfall intensity (I) =      3.847(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 1.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 0.000
      [LOW DENSITY RESIDENTIAL                     ]
      (1.0 DU/A or Less       )
      Impervious value, Ai = 0.100
      Sub-Area C Value = 0.270
      Time of concentration =    19.39 min.
      Rainfall intensity =      3.847(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.393  CA =      0.114
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```
Subarea runoff =      0.125(CFS) for      0.120(Ac.)
Total runoff =      0.439(CFS)  Total area =       0.290(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   310.200(Ft.)
Downstream point/station elevation =   309.000(Ft.)
Pipe length  =   250.00(Ft.) Slope =   0.0048  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.439(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.439(CFS)
Normal flow depth in pipe =    3.42(In.)
Flow top width inside pipe =   10.84(In.)
Critical Depth =    3.28(In.)
Pipe flow velocity =      2.37(Ft/s)
Travel time through pipe =    1.76 min.
Time of concentration (TC) =    21.15 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.290(Ac.)
Runoff from this stream =      0.439(CFS)
Time of concentration =   21.15 min.
Rainfall intensity =     3.637(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1100.000 to Point/Station     1101.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance  =   59.000(Ft.)
Highest elevation =  336.700(Ft.)
Lowest elevation =  321.600(Ft.)
Elevation difference =   15.100(Ft.) Slope = 25.593 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  25.59 %, in a development type of
 1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.07 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.2700)*( 100.000^.5)/(  25.593^(1/3)]=   5.07
Rainfall intensity (I) =      9.140(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff =      0.173(CFS)
Total initial stream area =       0.070(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1101.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.544(CFS)
Depth of flow =   0.128(Ft.), Average velocity =   3.658(Ft/s)
```

```
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.60
    2             16.00              0.00
    3             46.00              1.20
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.544(CFS)
  '     '    flow top width =      6.605(Ft.)
  '     '    velocity=    3.658(Ft/s)
  '     '    area =      0.422(Sq.Ft)
  '     '    Froude number =     2.549

Upstream point elevation =   321.600(Ft.)
Downstream point elevation =   309.000(Ft.)
Flow length =   236.000(Ft.)
Travel time  =    1.08 min.
Time of concentration =    6.15 min.
Depth of flow =   0.128(Ft.)
Average velocity =   3.658(Ft/s)
Total irregular channel flow =     1.544(CFS)
Irregular channel normal depth above invert elev. =   0.128(Ft.)
Average velocity of channel(s) =   3.658(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.073(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.534
Rainfall intensity =      8.073(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.509  CA =      0.371
Subarea runoff =      2.825(CFS) for      0.660(Ac.)
Total runoff =      2.998(CFS)  Total area =       0.730(Ac.)
Depth of flow =   0.164(Ft.), Average velocity =   4.317(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.730(Ac.)
Runoff from this stream =      2.998(CFS)
Time of concentration =    6.15 min.
Rainfall intensity =     8.073(In/Hr)
Summary of stream data:

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


1        0.439     21.15             3.637
2        2.998      6.15             8.073
Qmax(1) =
       1.000 *    1.000 *     0.439) +
       0.451 *    1.000 *     2.998) + =       1.789
Qmax(2) =
       1.000 *    0.291 *     0.439) +
       1.000 *    1.000 *     2.998) + =       3.125

Total of 2 streams to confluence:
Flow rates before confluence point:
```

```
       0.439       2.998
Maximum flow rates at confluence using above data:
        1.789        3.125
Area of streams before confluence:
        0.290        0.730
Results of confluence:
Total flow rate =      3.125(CFS)
Time of concentration =     6.145 min.
Effective stream area after confluence =      1.020(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   304.200(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =   189.00(Ft.) Slope =   0.0048  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.125(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     3.125(CFS)
Normal flow depth in pipe =    8.26(In.)
Flow top width inside pipe =   17.94(In.)
Critical Depth =    8.07(In.)
Pipe flow velocity =      3.95(Ft/s)
Travel time through pipe =    0.80 min.
Time of concentration (TC) =     6.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.020(Ac.)
Runoff from this stream =      3.125(CFS)
Time of concentration =    6.94 min.
Rainfall intensity =     7.462(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.050
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(Office Professional    )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.839
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  316.800(Ft.)
Lowest elevation =  316.200(Ft.)
Elevation difference =    0.600(Ft.) Slope =  1.200 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.20 %, in a development type of
 Office Professional
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.42 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8395)*(  60.000^.5)/(   1.200^(1/3)]=   3.42
Calculated TC of    3.418 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.839
Subarea runoff =      0.310(CFS)
```

```
 Total initial stream area =       0.040(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.245(CFS)
Depth of flow =   0.209(Ft.), Average velocity =   2.102(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.30
    2              1.50              0.00
    3             45.50              1.00
    4             61.50              1.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      2.245(CFS)
  '     '    flow top width =     10.230(Ft.)
  '     '    velocity=    2.102(Ft/s)
  '     '    area =      1.068(Sq.Ft)
  '     '    Froude number =     1.147

Upstream point elevation =   316.200(Ft.)
Downstream point elevation =   314.500(Ft.)
Flow length =   185.000(Ft.)
Travel time  =    1.47 min.
Time of concentration =    4.88 min.
Depth of flow =   0.209(Ft.)
Average velocity =   2.102(Ft/s)
Total irregular channel flow =     2.245(CFS)
Irregular channel normal depth above invert elev. =   0.209(Ft.)
Average velocity of channel(s) =   2.102(Ft/s)
 Adding area flow to channel
Calculated TC of    4.885 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                         ]
(Office Professional    )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.840
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.840  CA =      0.454
Subarea runoff =      3.873(CFS) for      0.500(Ac.)
Total runoff =      4.183(CFS)  Total area =       0.540(Ac.)
Depth of flow =   0.264(Ft.), Average velocity =   2.456(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   308.500(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =    48.00(Ft.) Slope =   0.1083  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.183(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     4.183(CFS)
Normal flow depth in pipe =    4.95(In.)
Flow top width inside pipe =   11.82(In.)
Critical Depth =   10.36(In.)
Pipe flow velocity =     13.68(Ft/s)
```

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      Travel time through pipe =    0.06 min.
      Time of concentration (TC) =     4.94 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      202.000 to Point/Station      104.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ________________________________________________________________________
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      0.540(Ac.)
      Runoff from this stream =      4.183(CFS)
      Time of concentration =    4.94 min.
      Rainfall intensity =     9.222(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      300.000 to Point/Station      301.000
      **** INITIAL AREA EVALUATION ****
      ________________________________________________________________________
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 1.000
      Decimal fraction soil group D = 0.000
      [COMMERCIAL area type                         ]
      (Neighborhod Commercial )
      Impervious value, Ai = 0.800
      Sub-Area C Value = 0.780
      Initial subarea total flow distance  =   42.000(Ft.)
      Highest elevation =  316.000(Ft.)
      Lowest elevation =  314.700(Ft.)
      Elevation difference =    1.300(Ft.) Slope =  3.095 %
      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
      The maximum overland flow distance is 85.00 (Ft)
      for the top area slope value of   3.10 %, in a development type of
       Neighborhod Commercial
      In Accordance With Figure 3-3
      Initial Area Time of Concentration =   3.64 minutes
      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
      TC = [1.8*(1.1-0.7800)*(  85.000^.5)/(   3.095^(1/3)]=   3.64
      Calculated TC of    3.644 minutes is less than 5 minutes,
       resetting TC to 5.0 minutes for rainfall intensity calculations
      Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
      Subarea runoff =      0.288(CFS)
      Total initial stream area =        0.040(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      301.000 to Point/Station      302.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
      ________________________________________________________________________
      Estimated mean flow rate at midpoint of channel =      1.259(CFS)
      Depth of flow =   0.087(Ft.), Average velocity =   2.583(Ft/s)
          ******* Irregular Channel Data ***********
      ------------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              0.50
          2              0.00              0.00
          3             64.00              0.50
      Manning's 'N' friction factor =   0.015
      ------------------------------------------------------------------
      Sub-Channel flow  =      1.259(CFS)
        '     '    flow top width =     11.169(Ft.)
        '     '    velocity=    2.583(Ft/s)
        '     '    area =      0.487(Sq.Ft)
        '     '    Froude number =     2.180

      Upstream point elevation =   314.700(Ft.)
```

```
Downstream point elevation =   313.000(Ft.)
Flow length =    38.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.89 min.
Depth of flow =   0.087(Ft.)
Average velocity =   2.583(Ft/s)
Total irregular channel flow =     1.259(CFS)
Irregular channel normal depth above invert elev. =   0.087(Ft.)
Average velocity of channel(s) =   2.583(Ft/s)
 Adding area flow to channel
Calculated TC of    3.889 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                         ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.242
Subarea runoff =      1.942(CFS) for      0.270(Ac.)
Total runoff =      2.230(CFS)  Total area =       0.310(Ac.)
Depth of flow =   0.108(Ft.), Average velocity =   2.980(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   306.000(Ft.)
Downstream point/station elevation =   303.300(Ft.)
Pipe length  =    30.00(Ft.) Slope =   0.0900  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.230(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.230(CFS)
Normal flow depth in pipe =    3.72(In.)
Flow top width inside pipe =   11.10(In.)
Critical Depth =    7.66(In.)
Pipe flow velocity =     10.75(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     3.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.310(Ac.)
Runoff from this stream =      2.230(CFS)
Time of concentration =    3.94 min.
Rainfall intensity =     9.222(In/Hr)
Summary of stream data:

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


1        3.125      6.94             7.462
2        4.183      4.94             9.222
3        2.230      3.94             9.222
Qmax(1) =
       1.000 *    1.000 *     3.125) +
       0.809 *    1.000 *     4.183) +
       0.809 *    1.000 *     2.230) + =       8.314
```

```
Qmax(2) =
       1.000 *    0.712 *     3.125) +
       1.000 *    1.000 *     4.183) +
       1.000 *    1.000 *     2.230) + =       8.638
Qmax(3) =
       1.000 *    0.567 *     3.125) +
       1.000 *    0.796 *     4.183) +
       1.000 *    1.000 *     2.230) + =       7.332

Total of 3 streams to confluence:
Flow rates before confluence point:
       3.125       4.183       2.230
Maximum flow rates at confluence using above data:
        8.314       8.638       7.332
Area of streams before confluence:
        1.020       0.540       0.310
Results of confluence:
Total flow rate =      8.638(CFS)
Time of concentration =     4.943 min.
Effective stream area after confluence =      1.870(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   303.300(Ft.)
Downstream point/station elevation =   303.000(Ft.)
Pipe length  =    71.00(Ft.) Slope =   0.0042  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.638(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.736(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.480(Ft.)
 Minor friction loss =      0.556(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.89(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =     5.19 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.870(Ac.)
Runoff from this stream =      8.638(CFS)
Time of concentration =    5.19 min.
Rainfall intensity =     9.008(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      401.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  316.100(Ft.)
Lowest elevation =  312.600(Ft.)
Elevation difference =    3.500(Ft.) Slope =  3.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
```

```
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   3.50 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.50 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7800)*(  85.000^.5)/(   3.500^(1/3)]=   3.50
The initial area total distance of  100.00 (Ft.) entered leaves a
remaining distance of   15.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.23 minutes
for a distance of  15.00 (Ft.) and a slope of  3.50 %
with an elevation difference of   0.53(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.228 Minutes
Tt=[(11.9*0.0028^3)/(  0.53)]^.385=  0.23
Total initial area Ti =   3.50 minutes from Figure 3-3 formula plus
  0.23 minutes from the Figure 3-4 formula =   3.73 minutes
Calculated TC of    3.726 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff =      0.791(CFS)
Total initial stream area =        0.110(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.043(CFS)
Depth of flow =   0.351(Ft.), Average velocity =   4.504(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.10
    2             34.00              0.40
    3             35.50              0.00
    4             35.50              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.043(CFS)
  '     '    flow top width =      1.318(Ft.)
  '     '    velocity=    4.504(Ft/s)
  '     '    area =      0.232(Sq.Ft)
  '     '    Froude number =     1.894

Upstream point elevation =   312.600(Ft.)
Downstream point elevation =   310.600(Ft.)
Flow length =    67.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.97 min.
Depth of flow =   0.351(Ft.)
Average velocity =   4.504(Ft/s)
Total irregular channel flow =     1.043(CFS)
Irregular channel normal depth above invert elev. =   0.351(Ft.)
Average velocity of channel(s) =   4.504(Ft/s)
 Adding area flow to channel
Calculated TC of    3.974 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
```

```
Rainfall intensity =      9.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.780  CA =      0.140
Subarea runoff =      0.503(CFS) for      0.070(Ac.)
Total runoff =      1.295(CFS)  Total area =       0.180(Ac.)
Depth of flow =   0.381(Ft.), Average velocity =   4.754(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.180(Ac.)
Runoff from this stream =      1.295(CFS)
Time of concentration =    3.97 min.
Rainfall intensity =     9.222(In/Hr)
Summary of stream data:

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


1        8.638      5.19             9.008
2        1.295      3.97             9.222
Qmax(1) =
       1.000 *    1.000 *     8.638) +
       0.977 *    1.000 *     1.295) + =       9.902
Qmax(2) =
       1.000 *    0.766 *     8.638) +
       1.000 *    1.000 *     1.295) + =       7.915

Total of 2 streams to confluence:
Flow rates before confluence point:
       8.638       1.295
Maximum flow rates at confluence using above data:
        9.902        7.915
Area of streams before confluence:
        1.870        0.180
Results of confluence:
Total flow rate =      9.902(CFS)
Time of concentration =     5.185 min.
Effective stream area after confluence =      2.050(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   303.000(Ft.)
Downstream point/station elevation =   302.500(Ft.)
Pipe length  =    77.00(Ft.) Slope =   0.0065  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.902(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     9.149(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      5.946(Ft.)
 Minor friction loss =      3.703(Ft.)  K-factor =   1.50
Pipe flow velocity =     12.61(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     5.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 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 =      2.050(Ac.)
Runoff from this stream =      9.902(CFS)
Time of concentration =    5.29 min.
Rainfall intensity =     8.896(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      804.000 to Point/Station      106.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Rainfall intensity (I) =      5.819(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  10.21 min.  Rain intensity =       5.82(In/Hr)
Total area =       2.170(Ac.)  Total runoff =     5.047(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 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 =      2.170(Ac.)
Runoff from this stream =      5.047(CFS)
Time of concentration =   10.21 min.
Rainfall intensity =     5.819(In/Hr)
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1004.000 to Point/Station     1005.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Initial subarea total flow distance  =   30.000(Ft.)
Highest elevation =  334.800(Ft.)
Lowest elevation =  327.500(Ft.)
Elevation difference =    7.300(Ft.) Slope = 24.333 %
Top of Initial Area Slope adjusted by User to  0.189 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.19 %, in a development type of
 1.0 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration =  12.20 minutes
 (for slope value of   0.50 %)
Rainfall intensity (I) =      5.187(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.270
Subarea runoff =      0.014(CFS)
Total initial stream area =       0.010(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1005.000 to Point/Station     1003.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =      0.042(CFS)
Depth of flow =   0.111(Ft.), Average velocity =   3.401(Ft/s)
    ******* Irregular Channel Data **********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.00
    2              1.00              0.00
    3              2.00              1.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.042(CFS)
  '     '    flow top width =      0.222(Ft.)
  '     '    velocity=    3.401(Ft/s)
  '     '    area =      0.012(Sq.Ft)
  '     '    Froude number =     2.543

Upstream point elevation =   327.500(Ft.)
Downstream point elevation =   324.500(Ft.)
Flow length =    34.000(Ft.)
Travel time  =    0.17 min.
Time of concentration =   12.37 min.
Depth of flow =   0.111(Ft.)
Average velocity =   3.401(Ft/s)
Total irregular channel flow =     0.042(CFS)
Irregular channel normal depth above invert elev. =   0.111(Ft.)
Average velocity of channel(s) =   3.401(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.142(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.270
Rainfall intensity =      5.142(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.270  CA =      0.014
Subarea runoff =      0.055(CFS) for      0.040(Ac.)
Total runoff =      0.069(CFS)  Total area =       0.050(Ac.)
Depth of flow =   0.134(Ft.), Average velocity =   3.856(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1003.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 3 in normal stream number 1
Stream flow area =      0.050(Ac.)
Runoff from this stream =      0.069(CFS)
Time of concentration =   12.37 min.
Rainfall intensity =     5.142(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1003.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                 ]
```

```
(7.3 DU/A or Less       )
Impervious value, Ai = 0.400
Sub-Area C Value = 0.480
Rainfall intensity (I) =      6.428(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   8.75 min.  Rain intensity =       6.43(In/Hr)
Total area =        5.000(Ac.)  Total runoff =    13.794(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1003.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 3 in normal stream number 2
Stream flow area =      5.000(Ac.)
Runoff from this stream =     13.794(CFS)
Time of concentration =    8.75 min.
Rainfall intensity =     6.428(In/Hr)
Summary of stream data:

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


1        0.069     12.37             5.142
2       13.794      8.75             6.428
Qmax(1) =
       1.000 *    1.000 *     0.069) +
       0.800 *    1.000 *    13.794) + =      11.105
Qmax(2) =
       1.000 *    0.708 *     0.069) +
       1.000 *    1.000 *    13.794) + =      13.843

Total of 2 streams to confluence:
Flow rates before confluence point:
       0.069      13.794
Maximum flow rates at confluence using above data:
       11.105       13.843
Area of streams before confluence:
        0.050        5.000
Results of confluence:
Total flow rate =     13.843(CFS)
Time of concentration =     8.750 min.
Effective stream area after confluence =      5.050(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   311.100(Ft.)
Downstream point/station elevation =   302.600(Ft.)
Pipe length  =   209.00(Ft.) Slope =   0.0407  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.843(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    13.843(CFS)
Normal flow depth in pipe =   10.61(In.)
Flow top width inside pipe =   17.71(In.)
Critical Depth =   16.52(In.)
Pipe flow velocity =     12.78(Ft/s)
Travel time through pipe =    0.27 min.
Time of concentration (TC) =     9.02 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      106.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
```

```
In Main Stream number: 3
Stream flow area =      5.050(Ac.)
Runoff from this stream =     13.843(CFS)
Time of concentration =    9.02 min.
Rainfall intensity =     6.302(In/Hr)
Summary of stream data:

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


1        9.902      5.29             8.896
2        5.047     10.21             5.819
3       13.843      9.02             6.302
Qmax(1) =
       1.000 *    1.000 *     9.902) +
       1.000 *    0.518 *     5.047) +
       1.000 *    0.586 *    13.843) + =      20.628
Qmax(2) =
       0.654 *    1.000 *     9.902) +
       1.000 *    1.000 *     5.047) +
       0.923 *    1.000 *    13.843) + =      24.306
Qmax(3) =
       0.708 *    1.000 *     9.902) +
       1.000 *    0.884 *     5.047) +
       1.000 *    1.000 *    13.843) + =      25.318

Total of 3 main streams to confluence:
Flow rates before confluence point:
       9.902       5.047      13.843
Maximum flow rates at confluence using above data:
       20.628       24.306       25.318
Area of streams before confluence:
        2.050        2.170        5.050


Results of confluence:
Total flow rate =     25.318(CFS)
Time of concentration =     9.023 min.
Effective stream area after confluence  =      9.270(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   302.500(Ft.)
Downstream point/station elevation =   302.100(Ft.)
Pipe length  =    31.00(Ft.) Slope =   0.0129  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.318(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     6.181(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.800(Ft.)
 Minor friction loss =      4.781(Ft.)  K-factor =   1.50
Pipe flow velocity =     14.33(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     9.06 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      109.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   302.100(Ft.)
Downstream point/station elevation =   285.720(Ft.)
Pipe length  =   137.00(Ft.) Slope =   0.1196  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.318(CFS)
```

```
      Given pipe size =     18.00(In.)
      Calculated individual pipe flow  =    25.318(CFS)
      Normal flow depth in pipe =   11.06(In.)
      Flow top width inside pipe =   17.52(In.)
      Critical depth could not be calculated.
      Pipe flow velocity =     22.22(Ft/s)
      Travel time through pipe =    0.10 min.
      Time of concentration (TC) =     9.16 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      109.000 to Point/Station      109.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ----------------------------------------------------------------------
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      9.270(Ac.)
      Runoff from this stream =     25.318(CFS)
      Time of concentration =    9.16 min.
      Rainfall intensity =     6.240(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station     2002.000 to Point/Station     2003.000
      **** INITIAL AREA EVALUATION ****
      ----------------------------------------------------------------------
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 1.000
      Decimal fraction soil group D = 0.000
      [COMMERCIAL area type                        ]
      (General Commercial    )
      Impervious value, Ai = 0.850
      Sub-Area C Value = 0.810
      Initial subarea total flow distance  =   93.000(Ft.)
      Highest elevation =  318.000(Ft.)
      Lowest elevation =  316.300(Ft.)
      Elevation difference =    1.700(Ft.) Slope =  1.828 %
      Top of Initial Area Slope adjusted by User to  1.400 %
      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
      The maximum overland flow distance is 60.00 (Ft)
      for the top area slope value of   1.40 %, in a development type of
       General Commercial
      In Accordance With Figure 3-3
      Initial Area Time of Concentration =   3.61 minutes
      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
      TC = [1.8*(1.1-0.8100)*(  60.000^.5)/(   1.400^(1/3)]=   3.61
      Calculated TC of    3.614 minutes is less than 5 minutes,
       resetting TC to 5.0 minutes for rainfall intensity calculations
      Rainfall intensity (I) =     9.222(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.810
      Subarea runoff =     0.254(CFS)
      Total initial stream area =       0.034(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station     2003.000 to Point/Station     2004.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
      ----------------------------------------------------------------------
      Estimated mean flow rate at midpoint of channel =     2.206(CFS)
      Depth of flow =   0.250(Ft.), Average velocity =   1.603(Ft/s)
          ******* Irregular Channel Data ***********
      ----------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              0.31
          2             26.00              0.13
          3             27.50              0.00
          4             27.50              0.50
      Manning's 'N' friction factor =   0.015
```

```
------------------------------------------------------------------
Sub-Channel flow  =      2.206(CFS)
  '     '    flow top width =     18.940(Ft.)
  '     '    velocity=    1.603(Ft/s)
  '     '    area =      1.376(Sq.Ft)
  '     '    Froude number =     1.048

Upstream point elevation =   316.300(Ft.)
Downstream point elevation =   310.800(Ft.)
Flow length =   625.000(Ft.)
Travel time  =    6.50 min.
Time of concentration =   10.11 min.
Depth of flow =   0.250(Ft.)
Average velocity =   1.603(Ft/s)
Total irregular channel flow =     2.206(CFS)
Irregular channel normal depth above invert elev. =   0.250(Ft.)
Average velocity of channel(s) =   1.603(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.855(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.804 given for subarea
Rainfall intensity =      5.855(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.804  CA =      0.700
Subarea runoff =      3.848(CFS) for      0.837(Ac.)
Total runoff =      4.102(CFS)  Total area =       0.871(Ac.)
Depth of flow =   0.289(Ft.), Average velocity =   1.862(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2000.000 to Point/Station      109.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      5.855(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.100
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(14.5 DU/A or Less      )
Impervious value, Ai = 0.500
Sub-Area C Value = 0.595
Time of concentration =    10.11 min.
Rainfall intensity =      5.855(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.719  CA =      1.057
Subarea runoff =      2.090(CFS) for      0.600(Ac.)
Total runoff =      6.192(CFS)  Total area =       1.471(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2001.000 to Point/Station      109.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      5.855(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                        ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.780
Time of concentration =    10.11 min.
Rainfall intensity =      5.855(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.733  CA =      1.409
Subarea runoff =      2.060(CFS) for      0.451(Ac.)
Total runoff =      8.252(CFS)  Total area =       1.922(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.922(Ac.)
Runoff from this stream =      8.252(CFS)
Time of concentration =   10.11 min.
Rainfall intensity =     5.855(In/Hr)
Summary of stream data:

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


1       25.318      9.16             6.240
2        8.252     10.11             5.855
Qmax(1) =
       1.000 *    1.000 *    25.318) +
       1.000 *    0.906 *     8.252) + =      32.795
Qmax(2) =
       0.938 *    1.000 *    25.318) +
       1.000 *    1.000 *     8.252) + =      32.009

Total of 2 streams to confluence:
Flow rates before confluence point:
      25.318       8.252
Maximum flow rates at confluence using above data:
       32.795       32.009
Area of streams before confluence:
        9.270        1.922
Results of confluence:
Total flow rate =     32.795(CFS)
Time of concentration =     9.161 min.
Effective stream area after confluence =     11.192(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2004.000 to Point/Station      109.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   306.830(Ft.)
Downstream point/station elevation =   285.720(Ft.)
Pipe length  =   211.00(Ft.) Slope =   0.1000  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    32.795(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    32.795(CFS)
Normal flow depth in pipe =   14.53(In.)
Flow top width inside pipe =   14.20(In.)
Critical depth could not be calculated.
Pipe flow velocity =     21.43(Ft/s)
Travel time through pipe =    0.16 min.
Time of concentration (TC) =     9.33 min.
End of computations, total study area =          11.192 (Ac.)
```

ATTACHMENT 4

4. FEMA Floodplains/Floodways

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations (BFEs) shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). this information was photogrammetrically compiled at a scale of 1:24,000 from aerial photography dated 2009.

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

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

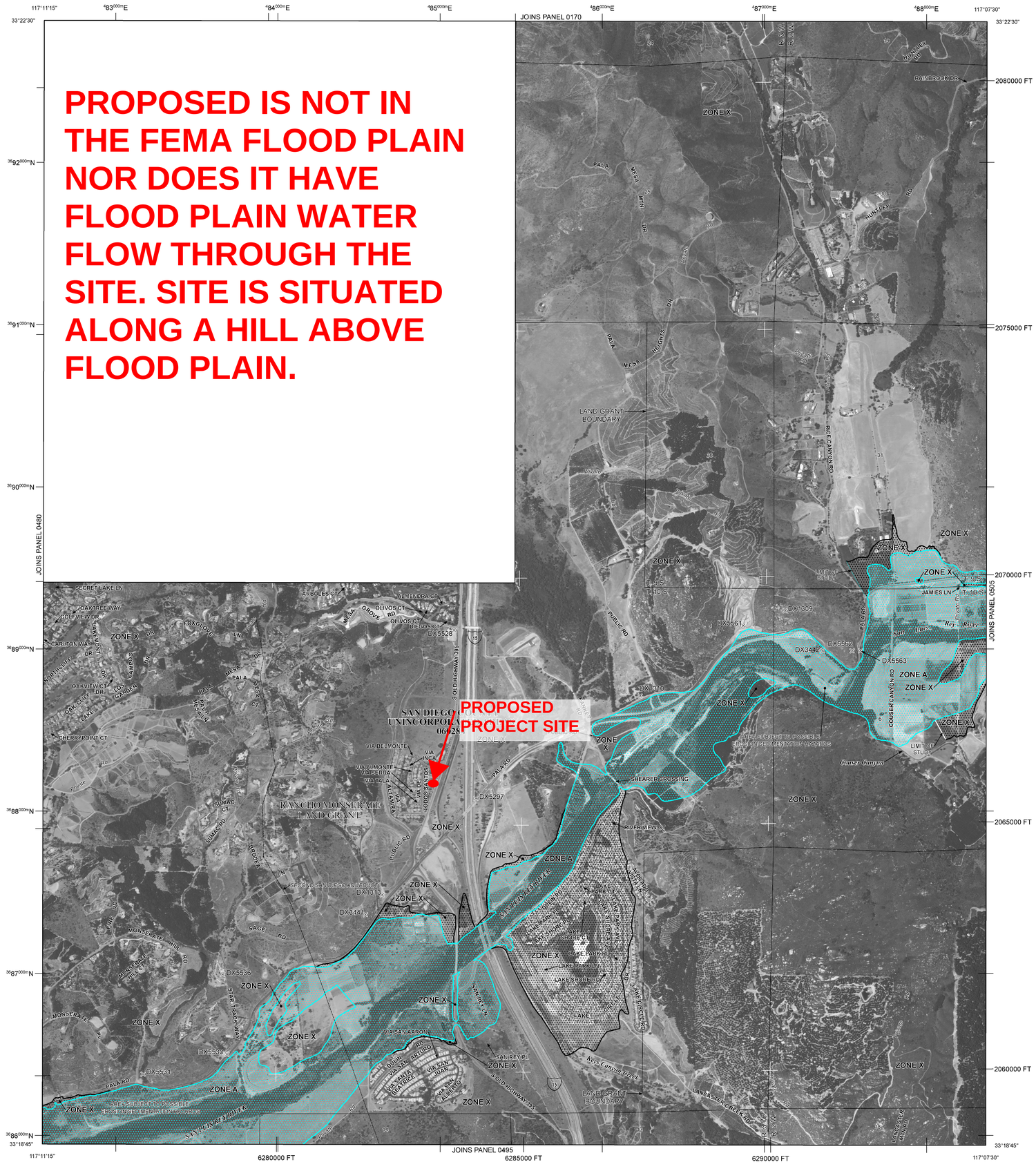
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-877-FEMA MAP (1-877-336-2627) for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov/.

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

The **"profile base lines"** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line", in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

PROPOSED IS NOT IN THE FEMA FLOOD PLAIN NOR DOES IT HAVE FLOOD PLAIN WATER FLOW THROUGH THE SITE. SITE IS SITUATED ALONG A HILL ABOVE FLOOD PLAIN.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A — Cross section line
23 — 23 — Transect line
97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000mE — 1000-meter Universal Transverse Mercator grid ticks, zone 11
6000000 FT — 5000-foot grid values: California State Plane coordinate system, Zone VI (FIPSZONE = 406), Lambert projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
June 19, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
May 16, 2012 – to update corporate limits, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to update map elevations to North American Vertical Datum of 1988.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 500 1,000 1,500 2,000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0485G

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 485 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO COUNTY	060284	0485	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06073C0485G

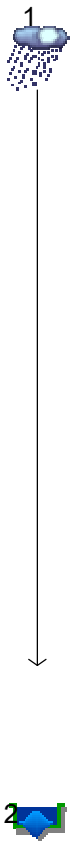
MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency

ATTACHMENT 5

5a. Hydrograph Report

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Manual	<no description>
2	Reservoir	<no description>

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Manual	------	-------	-------	-------	-------	-------	-------	-------	2.670	<no description>
2	Reservoir	1	-------	-------	-------	-------	-------	-------	-------	0.577	<no description>

Hydrograph Summary Report

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

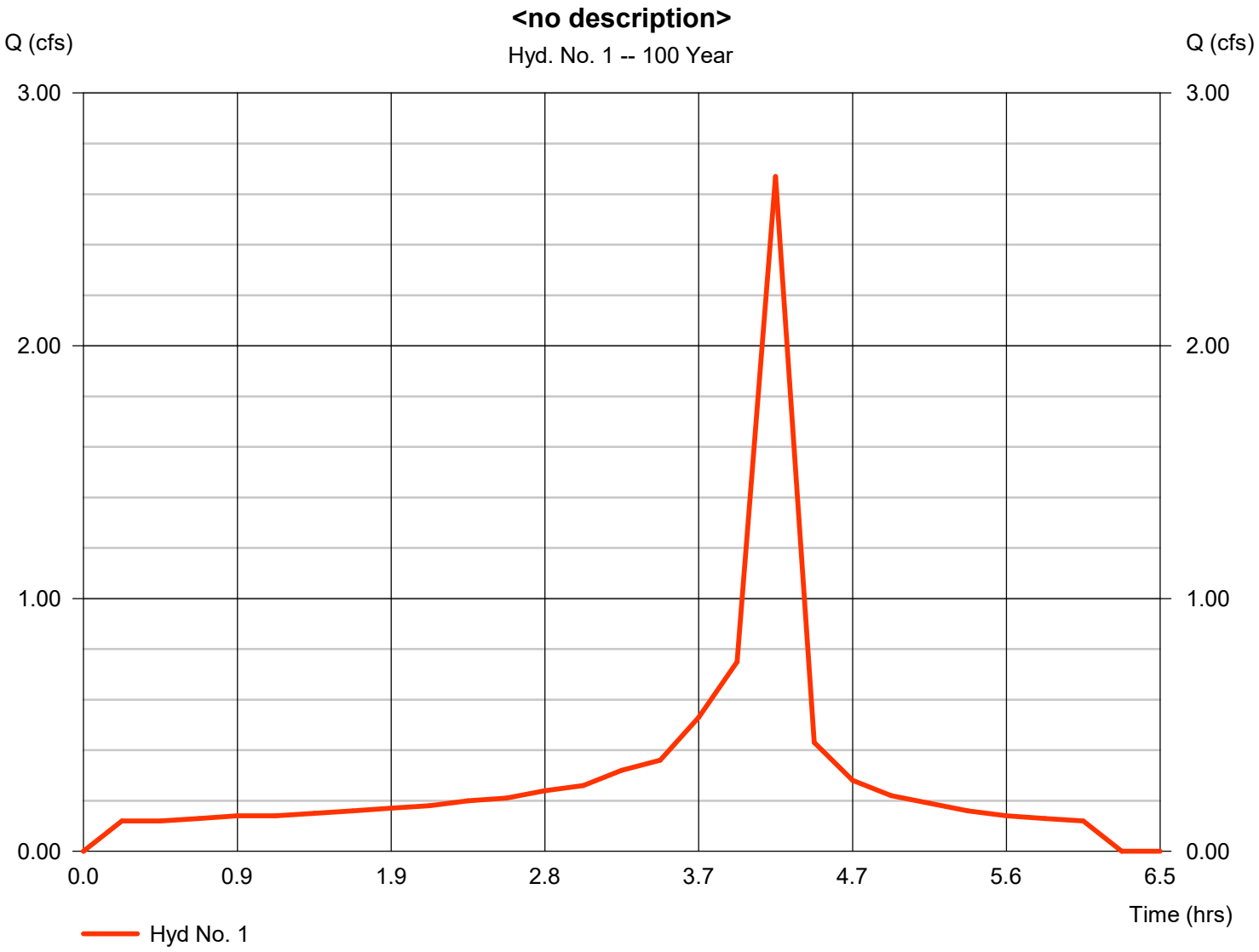
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	2.670	14	252	7,157	------	------	------	<no description>
2	Reservoir	0.577	14	266	7,154	1	311.75	3,118	<no description>

Hydrograph Report

Hyd. No. 1

<no description>

Hydrograph type	= Manual	Peak discharge	= 2.670 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.20 hrs
Time interval	= 14 min	Hyd. volume	= 7,157 cuft



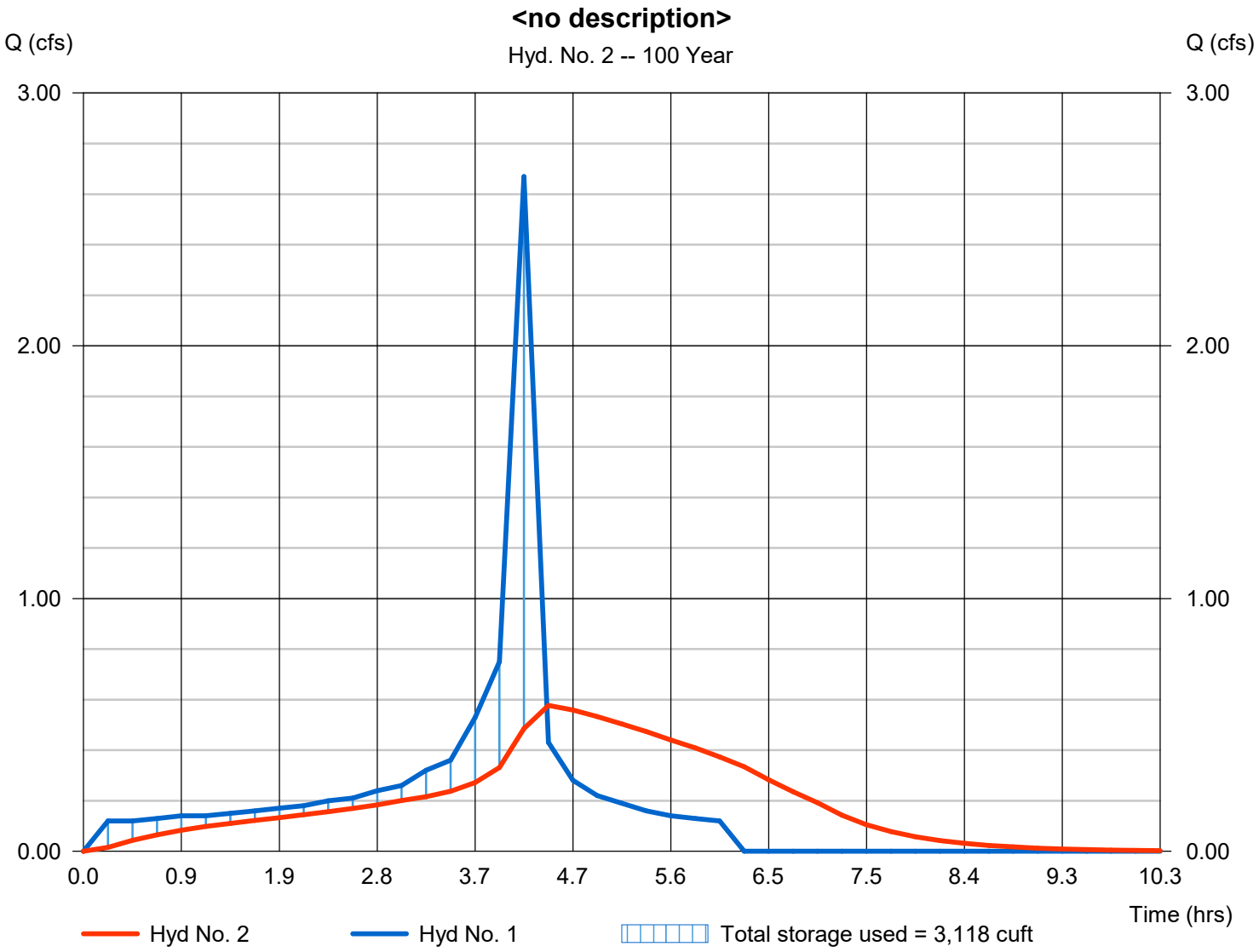
Hydrograph Report

Hyd. No. 2

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.577 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.43 hrs
Time interval	= 14 min	Hyd. volume	= 7,154 cuft
Inflow hyd. No.	= 1 - <no description>	Max. Elevation	= 311.75 ft
Reservoir name	= bmp802	Max. Storage	= 3,118 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - bmp802

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 310.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	310.50	1,880	0	0
2.25	312.75	3,167	5,615	5,615

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	2.00	0.00	0.00
Span (in)	= 12.00	8.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 304.60	310.50	0.00	0.00
Length (ft)	= 173.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.49	0.00	0.00	0.00
Crest El. (ft)	= 312.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	310.50	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.22	561	310.73	5.33 oc	0.20 ic	---	---	0.00	---	---	---	---	---	0.201
0.45	1,123	310.95	5.33 oc	0.32 ic	---	---	0.00	---	---	---	---	---	0.324
0.68	1,684	311.17	5.33 oc	0.41 ic	---	---	0.00	---	---	---	---	---	0.412
0.90	2,246	311.40	5.33 oc	0.48 ic	---	---	0.00	---	---	---	---	---	0.483
1.13	2,807	311.63	5.33 oc	0.55 ic	---	---	0.00	---	---	---	---	---	0.546
1.35	3,369	311.85	5.33 oc	0.60 ic	---	---	0.00	---	---	---	---	---	0.602
1.58	3,930	312.08	5.33 oc	0.65 ic	---	---	0.58	---	---	---	---	---	1.234
1.80	4,492	312.30	5.35 oc	0.70 ic	---	---	4.65	---	---	---	---	---	5.346
2.03	5,053	312.53	6.29 oc	0.16 ic	---	---	6.14 s	---	---	---	---	---	6.292
2.25	5,615	312.75	6.42 oc	0.10 ic	---	---	6.32 s	---	---	---	---	---	6.412

5b. Runoff Coefficient C After Detention Structure

CALCULATION AFTER THE DETENTION STRUCTURE

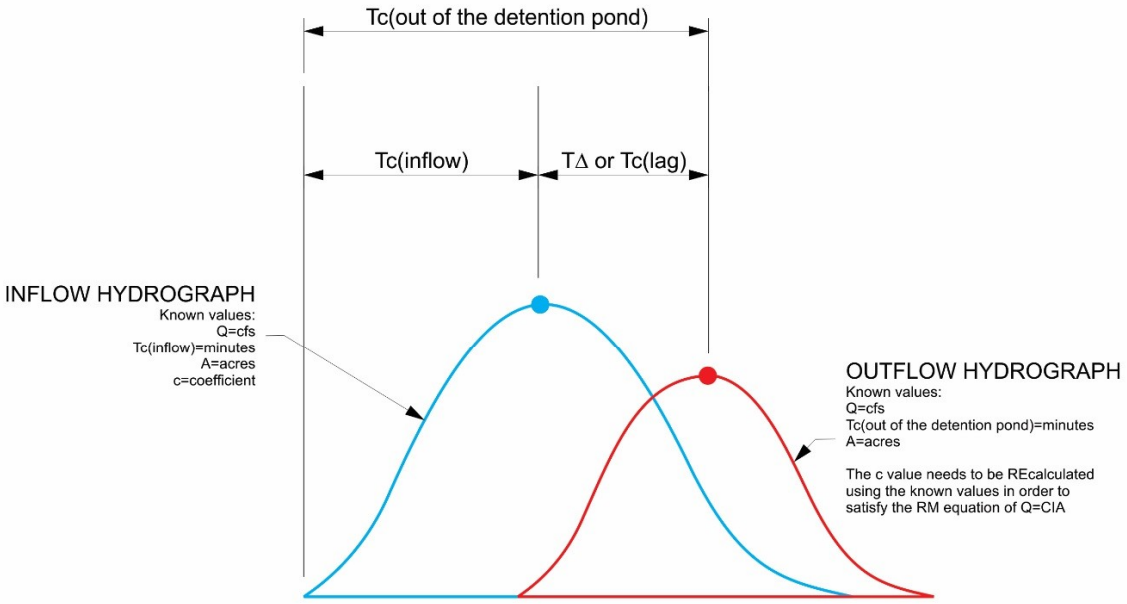
The purpose of the detention structure is to alter the peak flow and or time to peak of a given storm so it will not have a negative impact on the downstream facilities. There are different methods on how to use the resulting values of the outflow hydrograph.

For the purposes of this example there will be an association of the following values:

Q_{in} = Is equal to the inflow value that will enter the basin before storage
Q_{out} = Is equal to the outflow value that will exit the basin after storage
Tc_{in} = Is equal to the Time of Concentration flowing into the basin before detention
Tc_{out} = Is equal to the Time of Concentration exiting the basin after detention
A = Area of the tributary area being examined; (This value does not change)
c_{inflow} = The runoff coefficient going into the basin for detention
c_{out} = The runoff coefficient recalculated taking into account water stored in pond for detention

One method is to keep the value of c(inflow) and solve for the I=intensity & Tc(outflow). In this interpretation, we will get a Tc that will not match the value of the $Tc_{(\text{out of the detention structure})}$ of the outflow hydrograph that was calculated using the detention pond. The Tc Using this method shows a disruption on the oneness & continuity of the outflow hydrograph & the formula Q=cIA.

The second method; that is the method we are using is to recalculate the c=coefficient based on the fix values of the outflow hydrograph to achieve a c_{out} . This value uses the c_{inflow} from the flow into the detention basin and then is recalculated by the output of the hydrograph software using Q=cIA; translated as c=Q/IA. This method preserves the formula Q=cIA & does not alter the $Tc_{(\text{out of the detention structure})}$. This method shows that in order to maintain mathematical integrity of the rational equation (Q=CIA), the detention structure alters the runoff coefficient which is the only unknown in the equation. It is noted that the designer feels it is important to hold the value of Tc and the Q values that are calculated from the hydrograph.



GRAPHICAL DIAGRAM OF THE HYDROGRAPH COMING OUT OF THE DETENTION POND

The routing of the runoff through the detention structure gives us the $Q_{(\text{out of the detention structure})}$ and TΔ time lag between $Q_{(\text{inflow})}$ & $Q_{(\text{out of the detention structure})}$.

The known fix values coming out of the detention structure are:

- Q = cfs
- $Tc_{(\text{out of the detention structure})}$ = minutes
- A = acres
- *Please note that c=coefficient is not given directly from the resulting hydrograph coming out of the detention pond.*

In order to satisfy the rational equation of Q=CIA (see Section 3 of the 2003 San Diego County Hydrology Manual) coming out of the detention structure, we will calculate the only unknown value of the equation which is the outlet runoff coefficient, $C_{(\text{outlet})}$. By using the $Tc_{(\text{out of the detention structure})}$ we can solve for the intensity, I. With the intensity (I) value calculated, we can solve for the outlet runoff coefficient, $C_{(\text{outlet})}$.

The following equations are used in this stage: $Q = CIA$

$I = 7.44P_6D^{-0.645}$

Where:

$Q_{(\text{out of the detention structure})}$ = runoff (cfs), known value

$Tc_{(\text{inflow})}$ = detention structure inflow time of concentration (D) (minutes)

TΔ = time lag between $Q_{(\text{inflow})}$ & $Q_{(\text{out of the detention structure})}$

(minutes) $Tc_{(\text{out of the detention structure})} = Tc_{(\text{inflow})} + T\Delta$ (minutes)
P_6 = 6 hour precipitation (inches), known value.
I = intensity (inches/hour), calculated based on the value of $Tc_{(\text{out of the detention structure})}$
A = tributary area of the detention structure (acres),
known value $C_{(\text{outflow})}$ = runoff coefficient (unitless),
value to be solved

STORAGE PIPE			
LINE	**ITEM**	**STORAGE PIPE**	**REMARKS**
1	P6 inch	3.5	KNOWN VALUE
2	TC (inflow) mins	14.06	KNOWN VALUE
3	TC (lag) mins	13.8	FROM THE OUTFLOW HYDROGRAPH
4	TC (ouflow) mins	27.86	LINE 2+3
5	I inches/hour	3.045	FROM THE INTENSITY FORMULA
6	Q(outflow)	0.577	KNOWN VALUE
7	A (inflow=outflow)	0.97	KNOWN VALUE
8	c(inflow)	0.582	KNOWN VALUE FROM THE CONTRIBUTING BASIN(S)
9	c(outflow)	0.195	CALCULATED FROM C=Q/IA

The preceding highlighted data are then used to continue the calculations downstream of the detention structure.

In summary these are the steps of the calculations presented here:

1. Hydrologic methods of calculation as laid out in the 2003 San Diego Hydrology Manual was used upstream of the detention structure. These includes the methods of determining c, Tc and confluence of a junction. The c values used in the proposed conditions range from “undisturbed natural terrain” to “low & high density residential” whichever is appropriate for the contributing basin.
2. At the outflow of the detention structure, the c value was recalculated using the resulting values of the outflow hydrograph. This method preserves the values of $Tc_{(\text{out of the detention structure})}$, A & $Q_{(\text{outflow})}$. Methods and software satisfy the formula Q=cIA & the 2003 San Diego Hydrology Manual. This step shows that in order to maintain mathematical integrity of the rational equation (Q=CIA), the detention structure alters the runoff coefficient which is the only unknown in the equation.
3. The values determined in step 2 were used in the continuation of the calculations using the Hydrologic methods of calculation as laid out in the 2003 San Diego Hydrology Manual downstream of the detention structure. These includes the methods of determining c, Tc and confluence of a junction. The c values used in the proposed conditions range from “undisturbed natural terrain” to “low & high density residential” whichever is appropriate for the contributing basin.

End of Report