ATTACHMENT D

ENVIRONMENTAL IMPACT REPORT

APPENDIX K

HYDROLOGY STUDY

PRIORITY PROJECT

HYDROLOGY STUDY

FOR:
CAPALINA APARTMENTS
APN No. 219-115-33
Capalina Road, San Marcos, CA 92069

PREPARED FOR:
Capalina SMA, LLC
179 Calle Magdalena #201
Encinitas, CA 92024
Attn: Jon Rilling
Tel No.: 760-445-5144

PREPARED BY:
EXCEL ENGINEERING
440 State Place
Escondido, CA 92029
Tel: (760) 745-8118
Project No: 22-060

DATE PREPARED:
6/12/2023

TABLE OF CONTENTS

Attachment 4 – Pre-Development Condition Exhibit

Attachment 5 – Post-Development Condition Exhibit

- 5a. Hydrology Map of Post-Development Condition Exhibit
- 5b. Hydrology Map of Post-Development Mitigation Condition Exhibit

Attachment 6 – Modified Rational Method Runoff Calculations

- 6a. CivilD Pre-Development Calculations
- 6b. CivilD Post-Development Calculations
- 6c. CivilD Mitigated Post-Development Calculations

Attachment 7 – Hydrograph

- 7a. HEC-HMS Simulation Results
- 7b. Runoff Coefficient C After Detention Structure

1.0 Project Description

1.1 Project Purpose

The objective of this study is to determine the flow rates from 100-year runoff analysis for the existing site conditions and compare that analysis to the 100-year runoff generated from the proposed project. We will also calculate the adequacy of the proposed storm drain facilities and mitigation measures to maintain existing peak flows.

1.2 Project Proposed Facilities

The 2.51-acre project site is located on Capalina Road in the City of San Marcos, California. The site is currently undeveloped. The project site fronts on West Mission Road to the north and Capalina Road to the south, existing commercial development is adjacent to the sites westerly and easterly boundaries.

The proposed project is a multifamily residential facility containing two buildings and associated surface parking and supporting utilities. The proposed drainage facilities include two biofiltration basins, an underground storge tank used to mitigate the projects peak flow and associated storm drain systems which outlet to Mission Road.

2.0 Vicinity Map

The project site is located on Capalina Road in the City of San Marcos, California. The project site fronts on West Mission Road to the north and Capalina Road to the south.

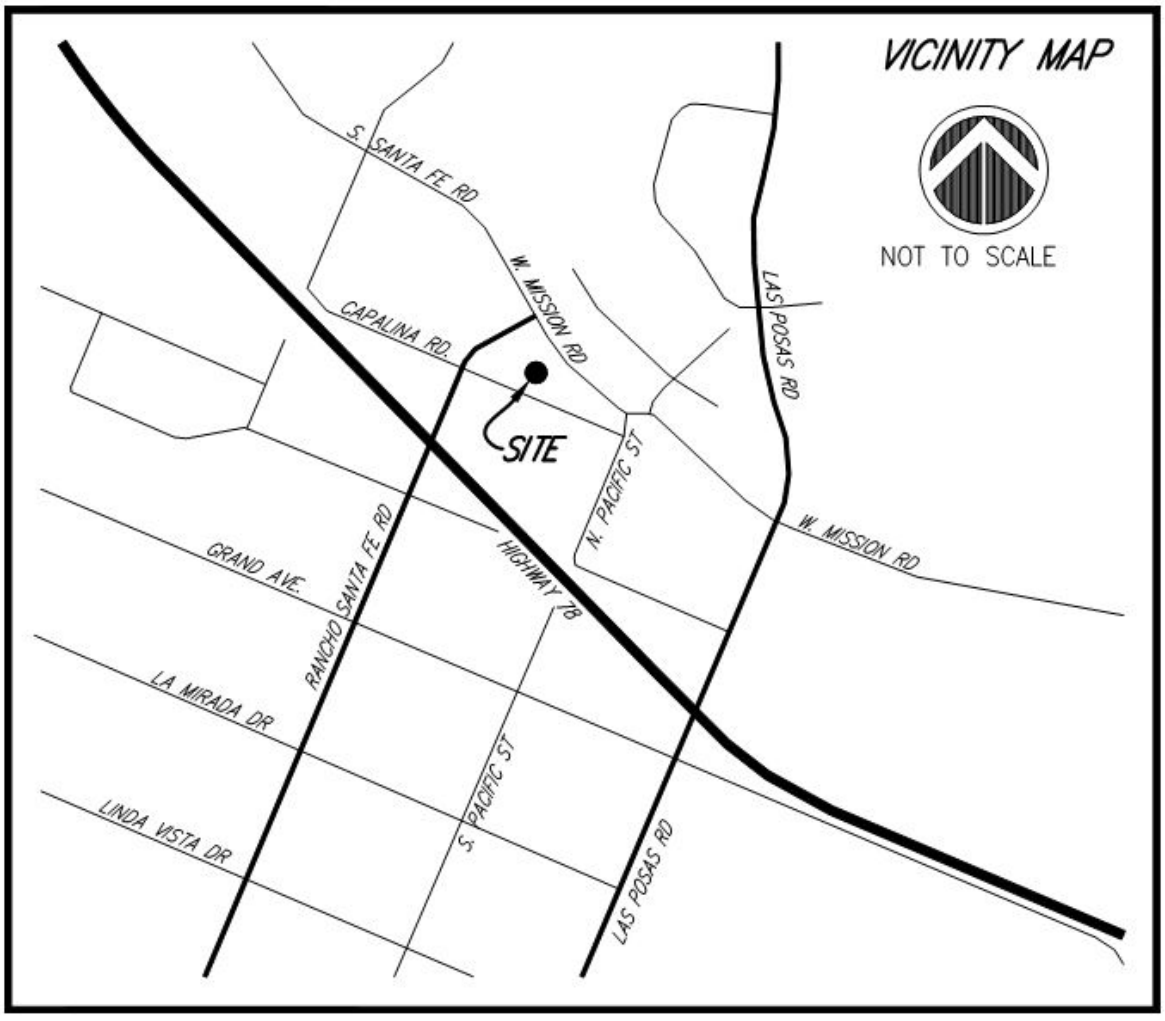


Fig. 1 Vicinity Map

3.0 Site Map

Please see Attachment 1 – Site Map

4.0 Description of Watershed

4.1 Existing Conditions Topography and Drainage Patterns

The existing site is currently undeveloped. The project fronts on West Mission Road to the north and Capalina Road to the south. The property drains primarily by overland flow to West Mission Road then easterly along West Mission Roads curb and getter to an existing storm drain system located at North Pacific Street.

According to the Web Soil Survey, the soil types for this site are Type C and Type D. Table 3-1 Runoff Coefficient for Urban Areas from the San Diego County Hydrology Manual will be utilized to determine the appropriate runoff coefficient based on the proposed use and the existing soils type.

The proposed development northerly of the right of way of Capalina Road drains to the north (West Mission Road) with the drainage leaving the site in two outlets to the existing curb and gutter along West Mission Road which flow to discharge point 1 at the projects northeasterly corner. The site improvements within the right of way of Capalina Road and consist of road widening, curb and gutter, driveway aprons and right of way improvements drains easterly to discharge point 2.

Downstream of the two discharge points, surface runoff continues easterly to the existing storm drain inlets located at North Pacific Street, the projects POC.

The **pre-development onsite** area is approximately 2.51 acre. The existing land use is undisturbed natural terrain. This determination was made based on a site inspection, aerial photography and a detailed aerial topography mapping. From table 3-1 “RUNOFF COEFFICIENTS FOR URBAN AREAs”, runoff coefficients for undisturbed natural terrain will be used in the pre-development runoff calculations.

A pre-developed drainage map can be found as Attachment 4 in this report.

4.2 Post Conditions Topography and Drainage Patterns

This proposed project is a multifamily residential facility containing two buildings and associated surface parking and supporting utilities. Two biofiltration basins are proposed to mitigate the storm water quality for the project (BMP-A and BMP-B). BMP-A is located near the northeast corner of the site and BMP-B is located near the northwest corner of the site. The biofiltration basins will collect the storm water runoff from the building and proposed parking lots and convey the storm water through storage tanks, storm drain systems and curb and gutters to POC.

At the center of the project site, the proposed impervious area runoff is routed northerly to BMP-A then through the proposed 18 inches storm drain to the proposed 48 inches storage pipe system. After detention in said storage pipe system the system outflow through a 12 inches storm drain to discharge point 1, which is located at the northeast corner of the project site. BMP-A also has an emergency overflow which exits with a 12 inches storm drain to the same discharge point 1.

At the northwest part of the project site, surface runoff follows the proposed grades through curb cuts to BMP-B. BMP-B then drains through a 12 inches storm drain to a curb outlet at West Mission Road. These flows confluence with the existing surface flow along West Mission Road and drains easterly along the curb and gutter to the discharge point 1.

The south portion of the project site, The Capalina Road proposed improvements, drain easterly along the proposed curb and gutter, to discharge point 2, located at the southeast corner of the project site. After runoff leaves discharge point 1 and the discharge point 2,

the drainage follows the existing curb and gutter to the east to the inlet in North Pacific Street, the project's POC.

The land use type for the project site proposed condition was estimated based on aerial photography and detailed aerial topographic mapping to be High Density Residential 43.0 DU/A or less. From table 3-1 "RUNOFF COEFFICIENTS FOR URBAN AREAs", runoff coefficients for High Density Residential 43.0 DU/A or less will be used in the post-development runoff calculations.

As calculated below and summarized further in section 6, the pre-development discharges a peak 100-year flow of 5.627 CFS to Discharge Point 1, 1.571 CFS to Discharge Point 2, **total 7.198 CFS to the project's POC.** The project proposed post-development discharge is a peak 100-year flow of 18.158 CFS to Discharge Point 1, 2.978 CFS to Discharge Point 2, for a **total 21.136 CFS to POC**, which needs storage and or detention upstream of the POC in post development design.

The mitigation system includes BMP-A and 224 ft of 48 inches RCP storage pipe to be installed as two 112 ft lengths. (Note: A third storage pipe is only used for hydromodification, not to peak flow). An 18 inches storm drain connects BMP-A to the storage pipe. The total storage volume of the storage pipe is 3067 cubic feet. The storage curve is shown in Figure 2 below.

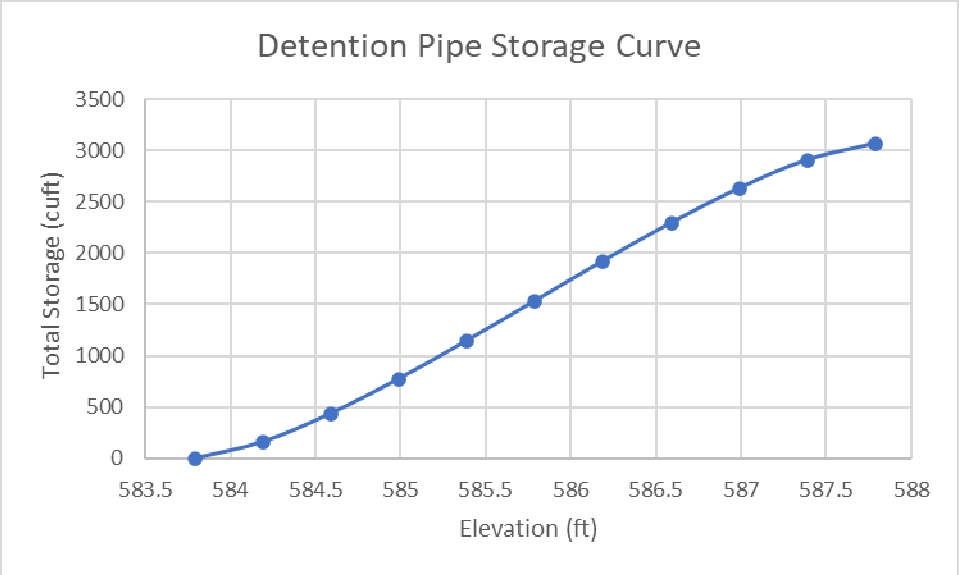


Fig. 2 – Detention Pipe Storage Cuve

At the west side of the 2 barrels of 48 inches storage pipe, weir plate 1 provides flow control with an orifice at the bottom and a spillway at the top of weir plate 1. Orifice 1 is 1.39 ft in length and 0.125' in height, and spillway 1 is 3.71 ft in length and 1.25 ft in height. The entire weir plate 1 is 48 inches in diameter. At the east end of the detention pipe, weir plate 2 which is 48 inches diameter is used to block water in the detention pipe. HEC-HMS was used for routing the project flows. The area of the orifice and spillways input into HEC-HMS. The result of the routing shows that the project is mitigated from

peak flow. The detailed routing results and hydrograph of HEC-HMS is in Attachment 7 of this study.

After mitigation, the peak 100-year flow of the post-development is reduced to 4.184 CFS at Discharge Point 1, for a **total 7.162 CFS at the project's POC.** The onsite 48 inches storage pipes systems perform peak flow detention to mitigate POC. A post-developed drainage map can be found as Attachment 5 in this report.

4.3 Hydrologic Unit Contribution

The project site is located in Richland Hydrologic Sub Area of the San Marcos Hydrologic Area of the Carlsbad Hydrologic Unit (904.52).

5.0 Methodology

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

5.1 Hydrology Software

We are using **the CivilCadd/**CivilDesign® software to analyze the runoff. The module we are using is the one for the *San Diego County Flood Control Division 2003 Hydrology Manual.* Please see the detailed hydrology calculations in Attachment 6.

5.2 Routing Software

Hydrologic Modeling System (HEC-HMS), Version 4.9 is 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 each detention pipe. The HEC-HMS simulation results can be found in Attachment 7 in this report.

5.3 Soil Type Determination

The soil type for the proposed project was determined by mapping the project limits on the EPA Web Soil Survey website. The Web soil Survey indicate that the site is composed of soil type C and type D. The soil report and soil index map can be found in Attachment 3 of this report.

5.4 Isopluvial Value Determination

The isopluvial values for the 100-year 6 hour and 24 hour storm events were determined by plotting the projects location on the respective exhibits from Appendix B of the Hydrology Manual. The rainfall isopluvial maps can be found in Attachment 3 of this report.

6.0 Calculations

The intent of the post-development calculation done as part of this report is to verify the 100-year flowrates expected from the post-developed conditions are lower than the pre-

developed conditions. These numbers will be used to size the proposed storm drainage pipes and to doublecheck if the existing storm drain outlet facilities are adequate.

6.1 Calculate Runoff Coefficient

The runoff coefficients for each of the drainage areas are taken from Table 3-1 of the Hydrology Manual. Based on the EPA Web Soil Survey, this project site is in type C and type D soil. The runoff coefficients C are based on the land use type for this project. Table 3-1 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, a detention structure is needed for this project. The method used on the resulting values of the outflow hydrograph is to recalculate the runoff coefficient C value based on the fixed 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 7 in this report.

6.2 Manning Roughness Coefficient

Manning Roughness Coefficients are taken from San Diego County Drainage Design Manual. Values are taken from Table A-1, Average Manning Roughness Coefficients for Pavement and Gutters, Table A-2, Average Manning Roughness Coefficients for Closed Conduits, and Table A-5, Average Manning roughness Coefficient for Natural Channels. Values of 0.015 for Concrete Gutter, 0.013 for PVC Pipe, and 0.03 for Fairly Regular Section Some Grass and Weeds, Little or No Brush are used in the hydrology calculations. Table of Manning's n value can be found in Attachment 2 in this report.

6.3 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 of Q100 Runoff

	PRE			POST			POST MITIGATION		
	Discharge Point 1	Discharge Point 2	**POC**	Discharge Point 1	Discharge Point 2	**POC**	Discharge Point 1	Discharge Point 2	**POC**
Q (CFS)	5.627	1.571	**7.198**	18.158	2.978	**21.136**	4.184	2.978	**7.162**
Tc (MIN)	11.112	5.23	11.112	4.77	4.61	4.77	5.677	4.61	5.677
A (ACRE)	2.7	0.398	3.098	2.675	0.423	3.098	2.673	0.423	3.096

Table 1. Q100 Analysis Results

Structures that used for detention consist of 48 inches storage pipes located at the northeast side of the project site within the project's parking lot.

CIVILD data and output files can be found in Attachment 6 of this report.

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

7.0 Summary

This project will not negatively impact the existing downstream storm drain facilities. Based on the results of this report, the project does not increase the 100-year peak flow rate of the Mitigated Post Development stormwater discharge from the site as flows are lower than those of the Pre Development condition.

8.0 References

County of San Diego, Department of Public Works, Flood Control Section, June 2003 San Diego County Hydrology Manual.

County of San Diego, Department of Public Works, Flood Control Section, September 2014 San Diego County Hydraulic Design Manual.

9.0 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
Excel Engineering
440 State Place
Escondido, CA 92029
Tel – (760)745-8118
Fax – (760)745-1890

Project Number: 22-060

_____ _____

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

ATTACHMENTS

Attachment 1 – Site Map

Attachment 2 – Figures & Tables from the San Diego County Hydrology Manual 2003

Attachment 3 – Watershed Information
- **Watershed Map**
- **Soils Index Map**
- **Soil Report**
- **Rainfall Isopluvial Maps**

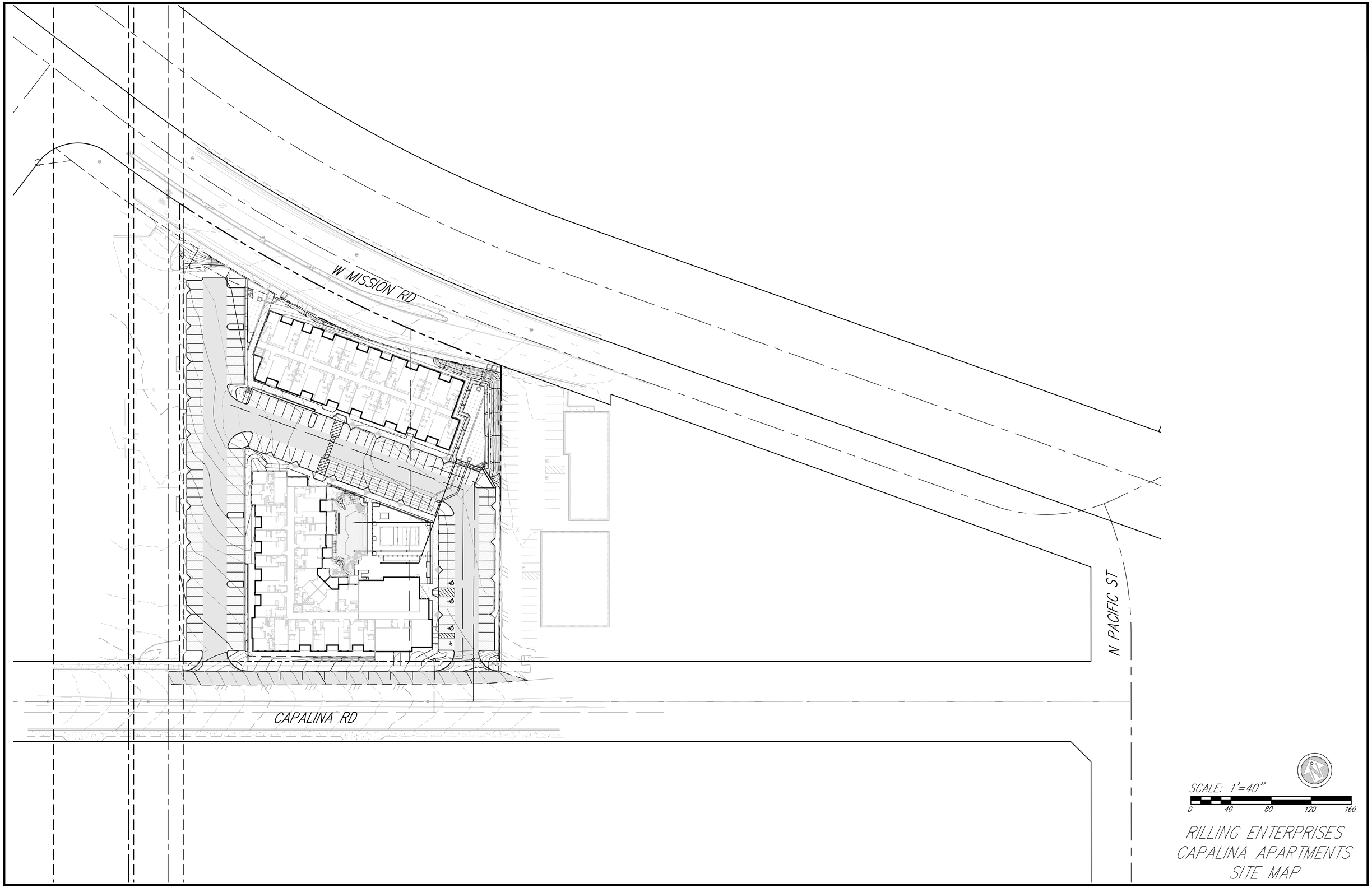
Attachment 4 – Pre-Development Condition Exhibit

Attachment 5 – Post-Development Condition Exhibit
- **5a. Hydrology Map of Post-Development Condition Exhibit**
- **5b. Hydrology Map of Post-Development Mitigation Condition Exhibit**

Attachment 6 – Modified Rational Method Runoff Calculations
- **6a. CivilD Pre-Development Calculations**
- **6b. CivilD Post-Development Calculations**
- **6c. CivilD Mitigated Post-Development Calculations**

Attachment 7 – Hydrograph
- **7a. HEC-HMS Simulation Results**
- **7b. Runoff Coefficient C After Detention Structure**

ATTACHMENT 1
SITE MAP



SCALE: 1"=40"

0 40 80 120 160

RILLING ENTERPRISES
CAPALINA APARTMENTS
SITE MAP

ATTACHMENT 2

FIGURES & TABLES FROM THE SAN DIEGO COUNTY HYDROLOGY MANUAL 2003

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

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

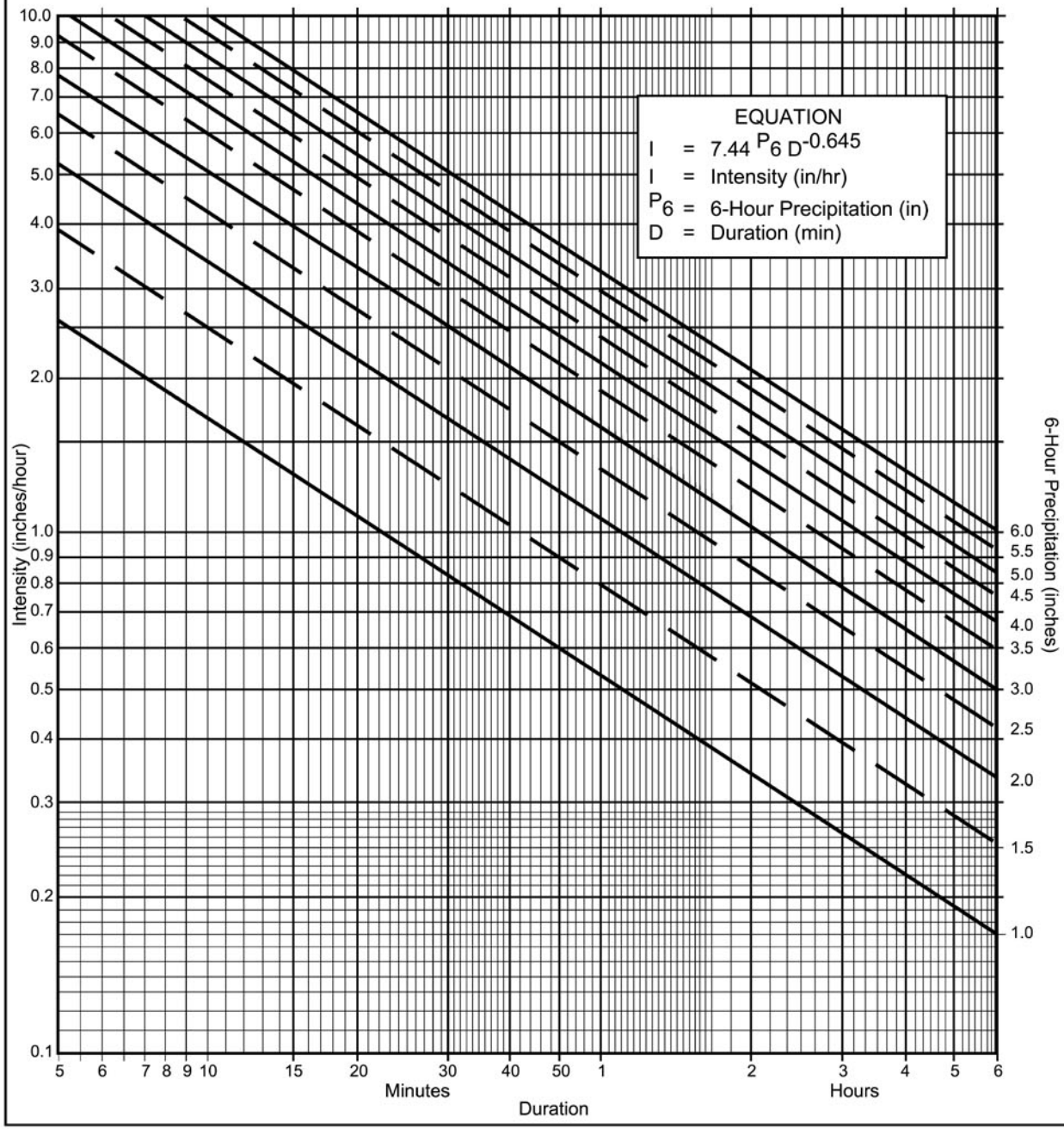
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

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



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.

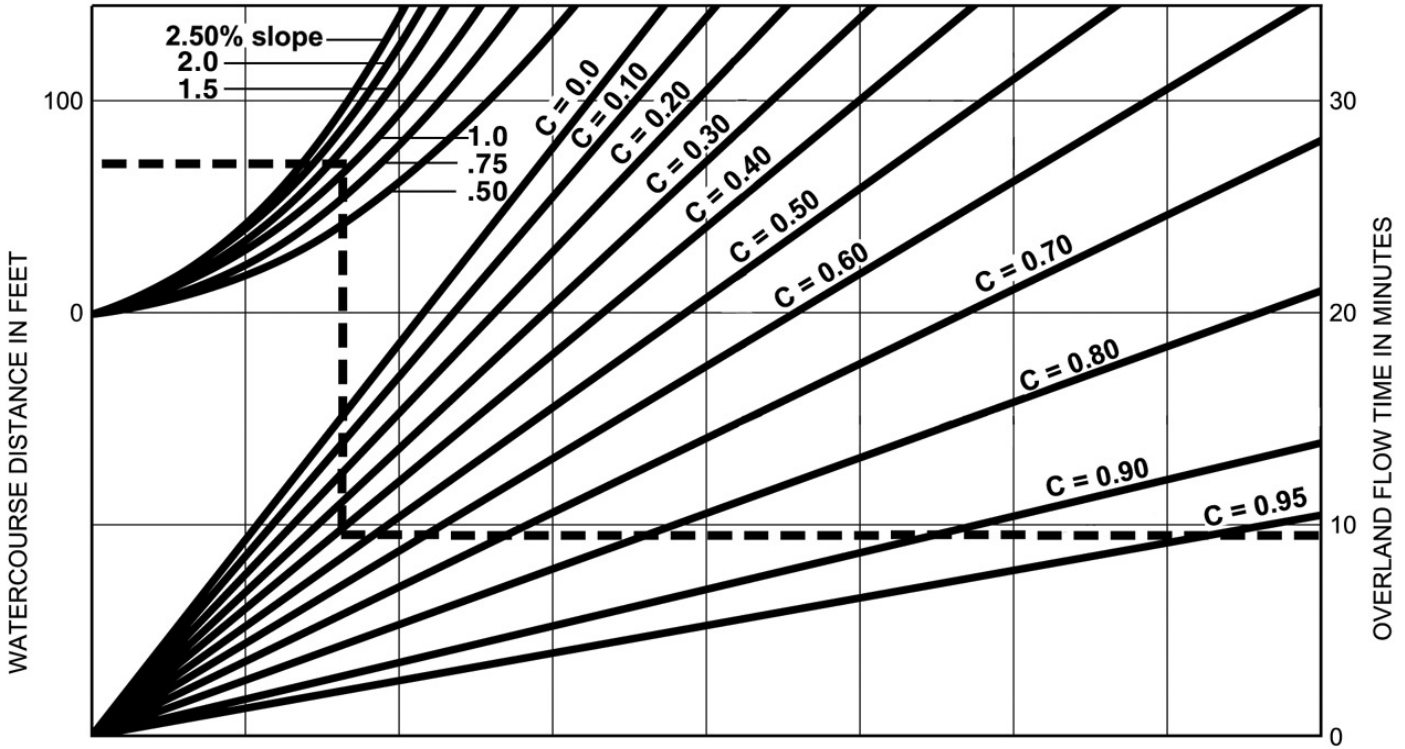
(e) I = _____ in./hr.

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:

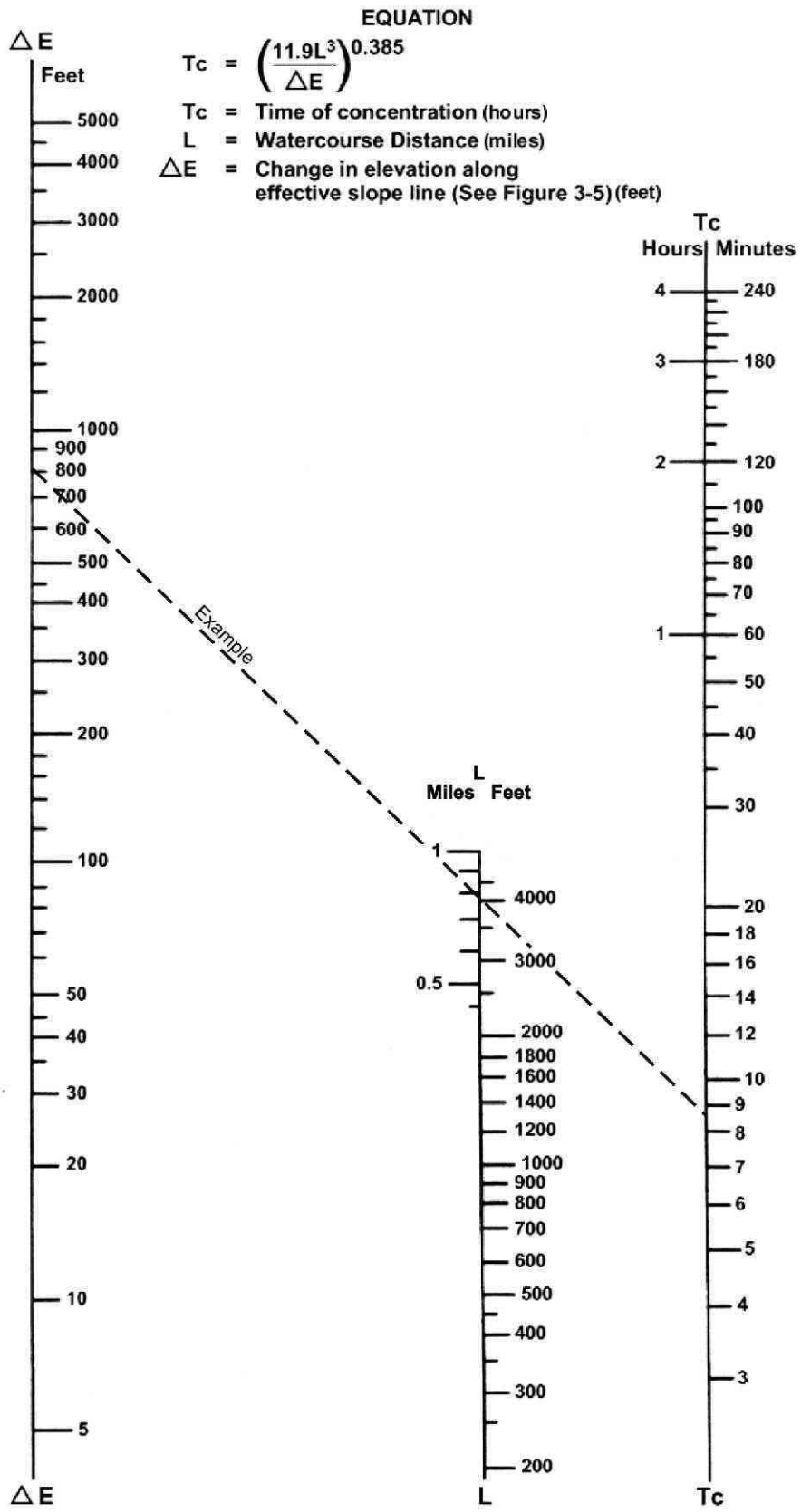
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

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

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE 3-3

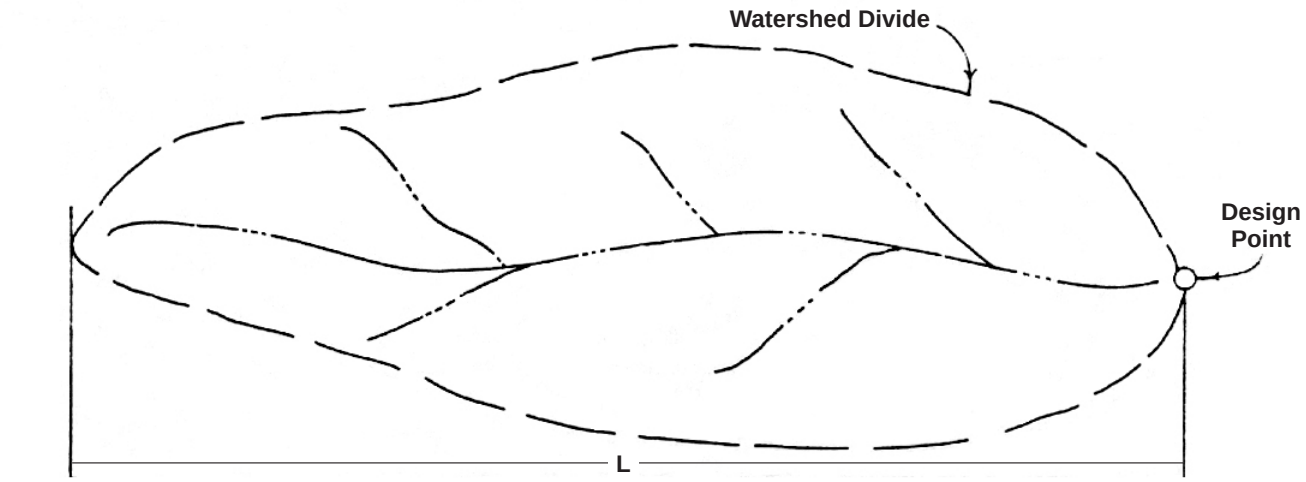
Rational Formula - Overland Time of Flow Nomograph

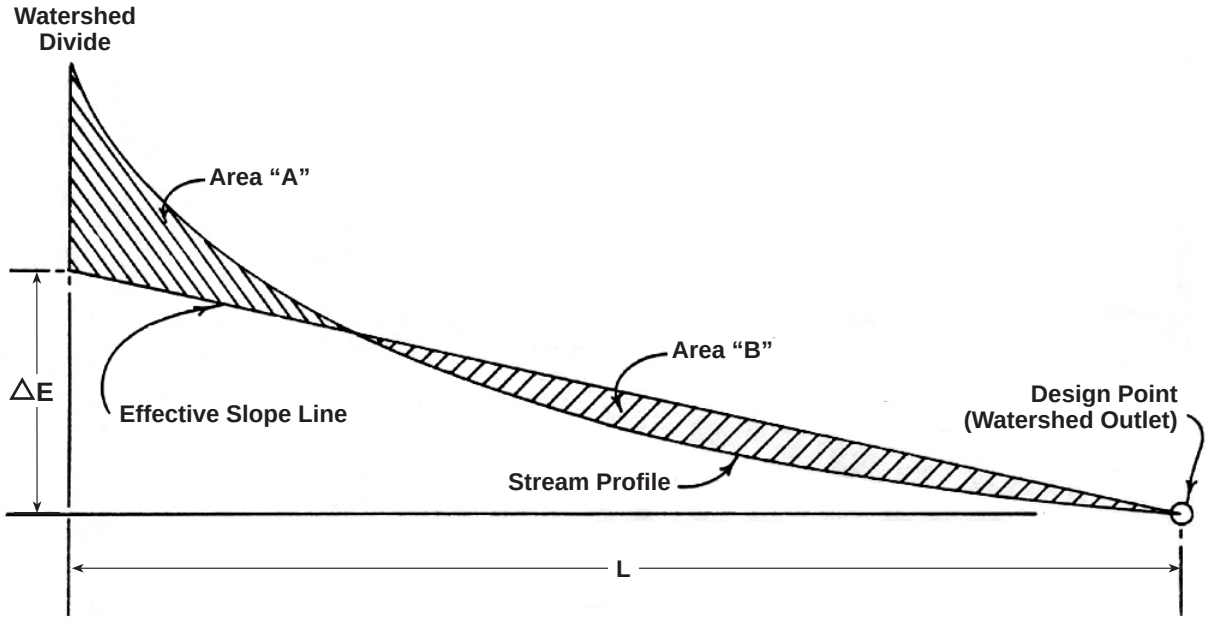


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds



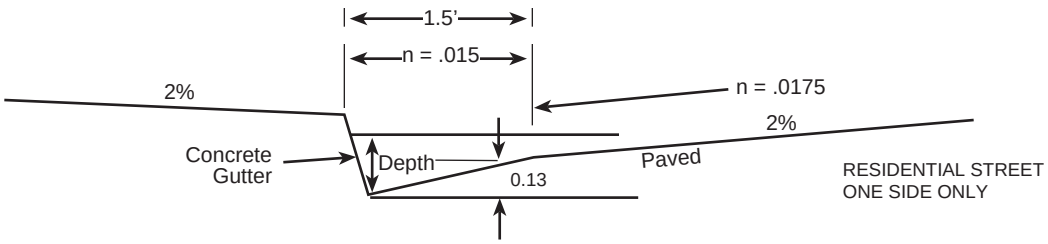


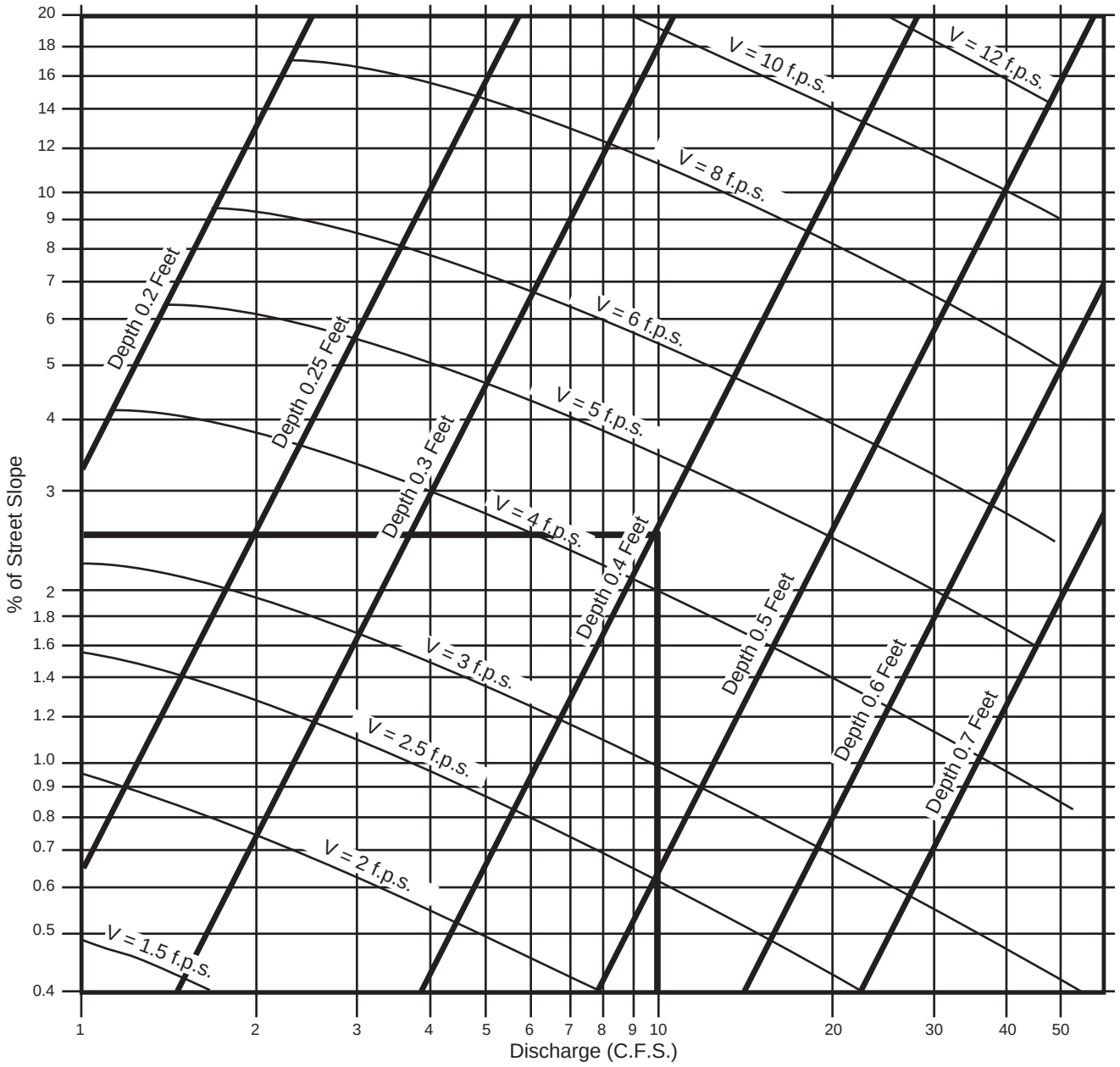
Area "A" = Area "B"

SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-5

Computation of Effective Slope for Natural Watersheds





EXAMPLE:

Given: Q = 10 S = 2.5%

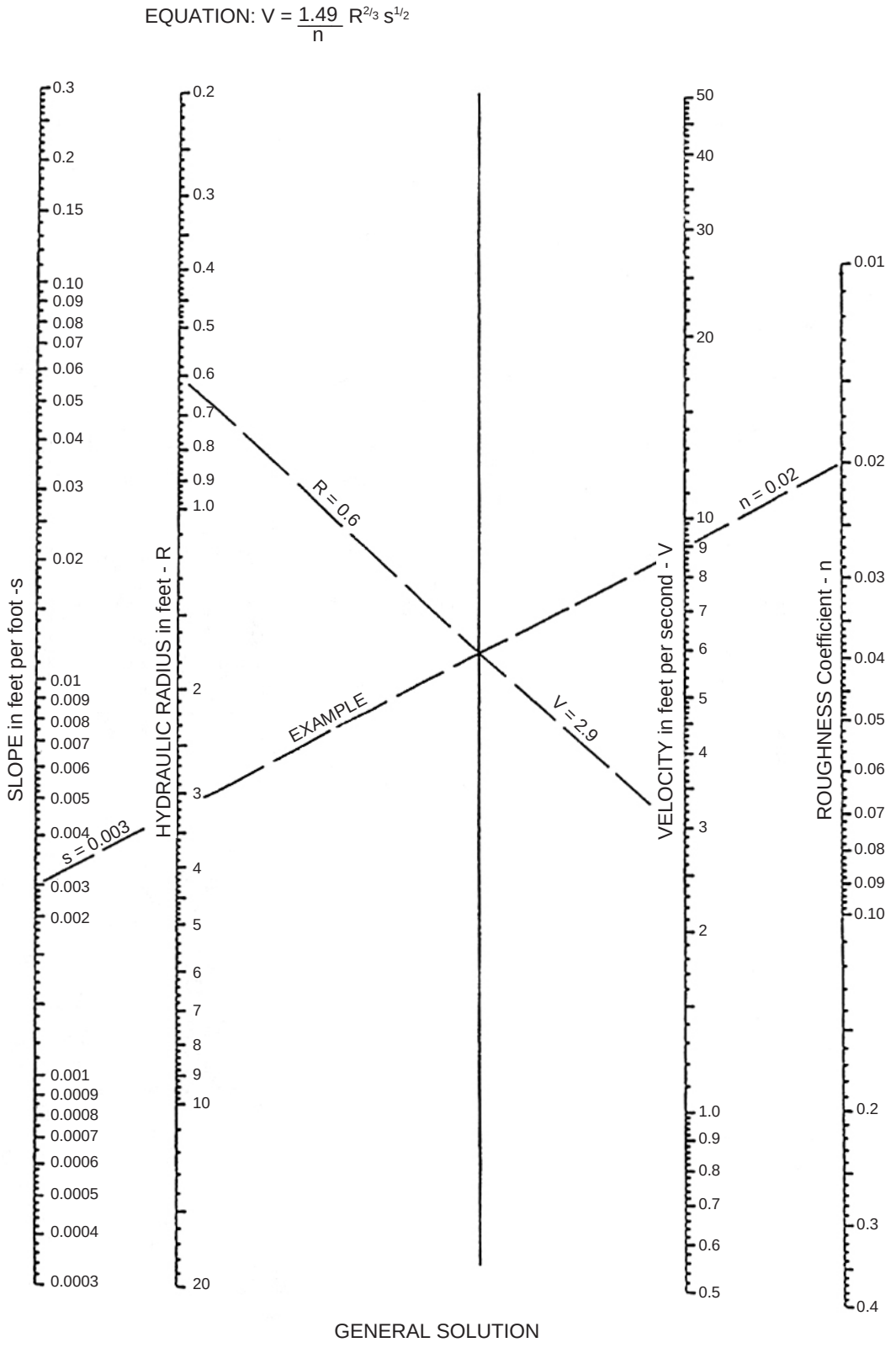
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

F I G U R E

Gutter and Roadway Discharge - Velocity Chart

3-6



SOURCE: USDOT, FHWA, HDS-3 (1961)

FIGURE 3-7

Manning's Equation Nomograph

Table A-1 Average Manning Roughness Coefficients for Pavement and Gutters[1]

Concrete Gutter[2]	0.015
Concrete Pavement	
Float Finish	0.014
Broom Finish	0.016
Concrete Gutter with Asphalt Pavement	
Smooth Finish	0.013
Rough Texture	0.015
Asphalt Pavement	
Smooth Finish	0.013
Rough Texture	0.016

Based on FHWA HEC-22.

[1] Based on materials and workmanship required by standard specifications.
[2] Increase roughness coefficient in gutters with mild slopes where sediment might accumulate by 0.020.

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.

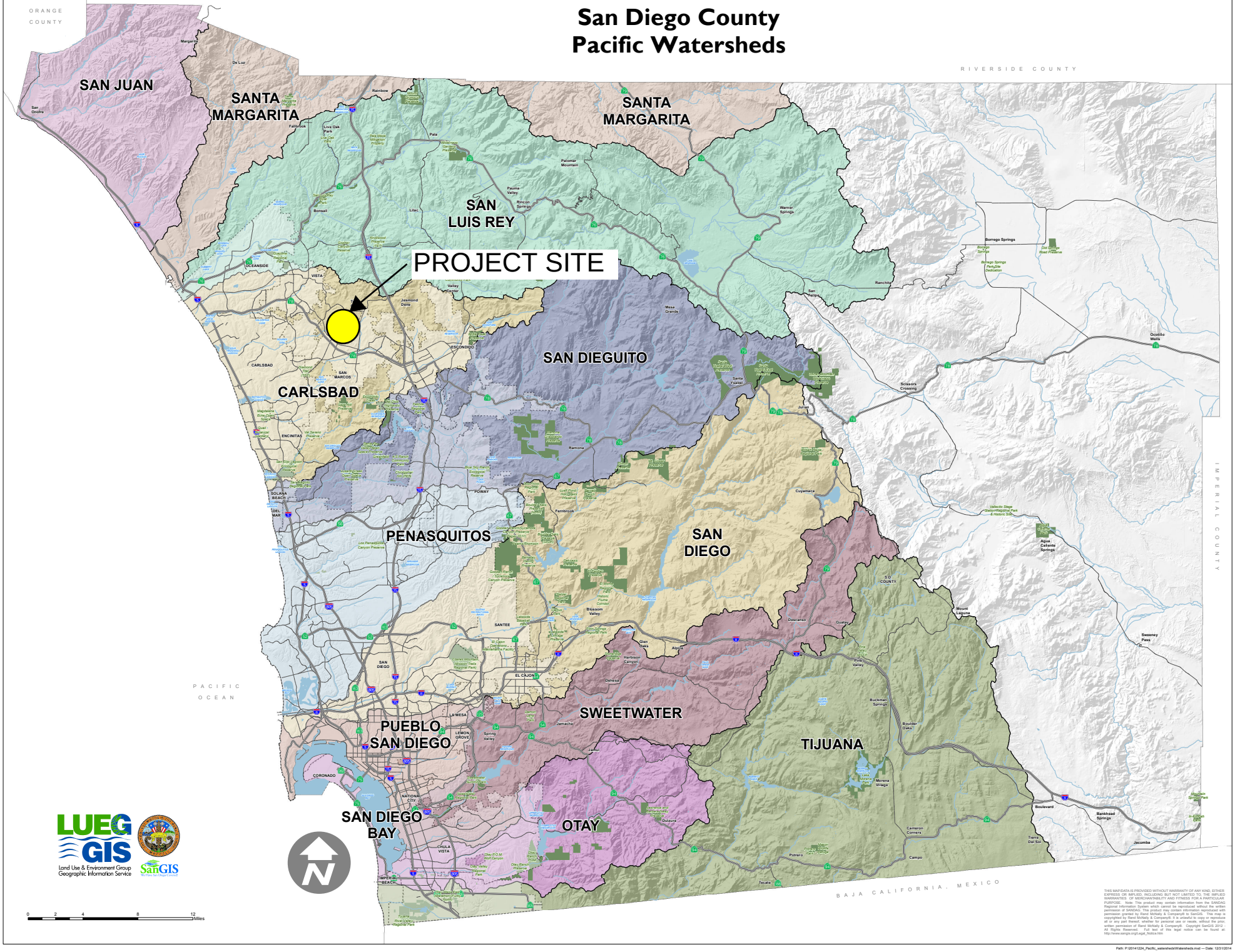
Table A-5 Average Manning Roughness Coefficients for Natural Channels

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 3
WATERSHED INFORMATION

WATERSHED MAP

San Diego County
Pacific Watersheds

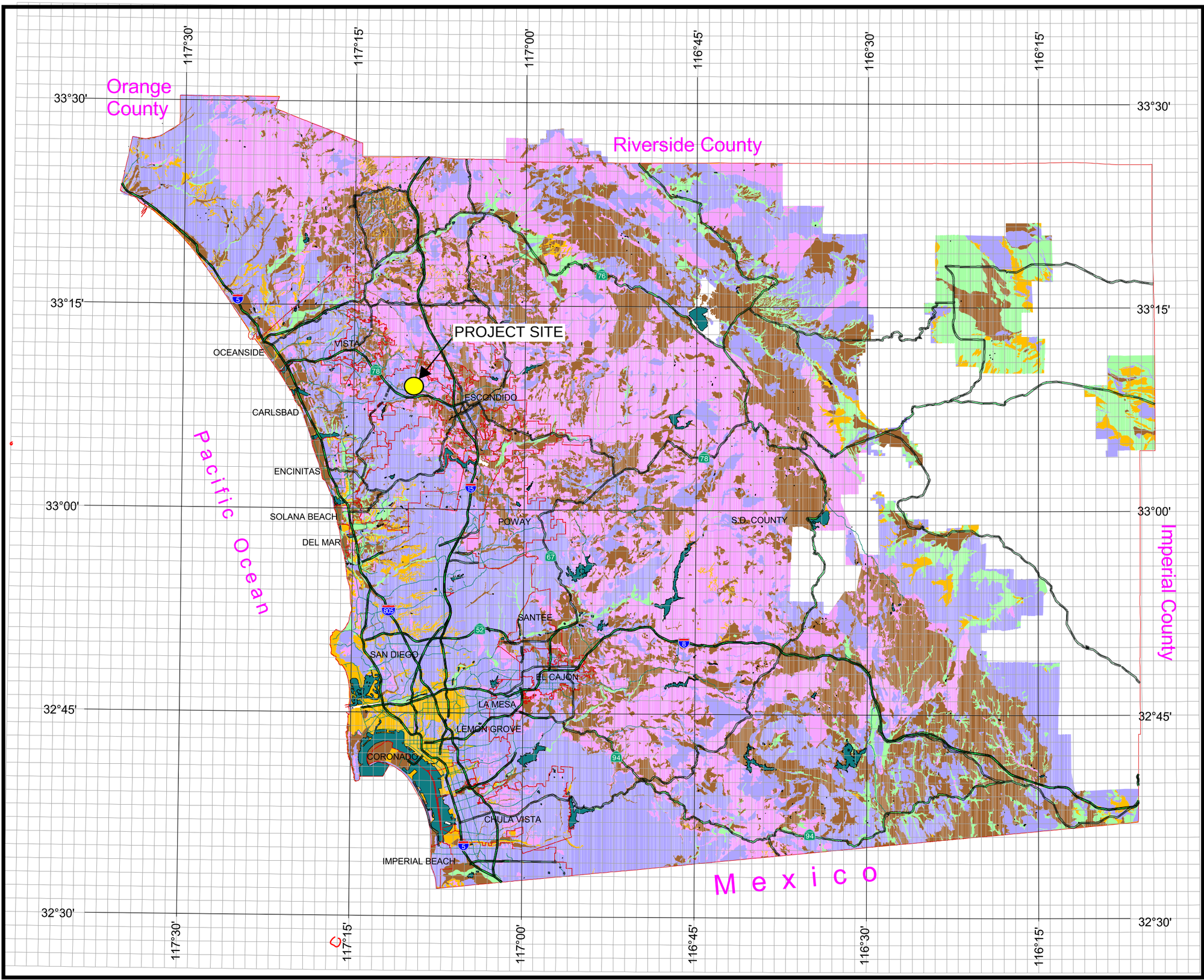


Path: P:\20141224_Pacific_watershedsWatersheds.mxd — Date: 12/31/2014

SOIL INDEX MAP

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

SOIL REPORT

Hydrologic Soil Group—San Diego County Area, California

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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 16, Sep 13, 2021

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

Date(s) aerial images were photographed: Mar 14, 2022—Mar 17, 2022

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
DaC	Diablo clay, 2 to 9 percent slopes	D	1.7	56.7%
DaD	Diablo clay, 9 to 15 percent slopes, warm MAAT	C	0.2	7.3%
LeC	Las Flores loamy fine sand, 2 to 9 percent slopes	D	1.1	36.0%
Totals for Area of Interest			**3.0**	**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

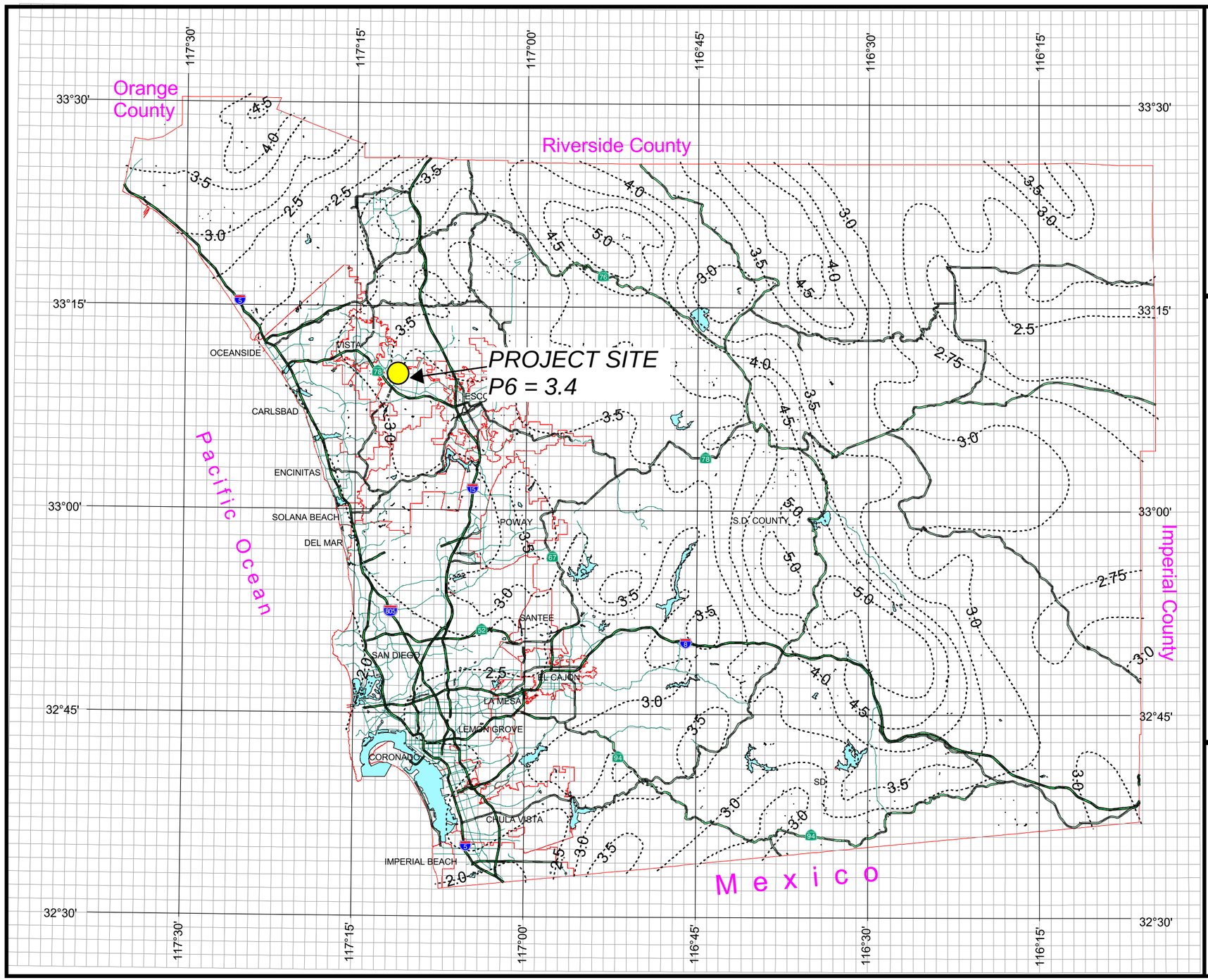
RAINFALL ISOPLUVIAL MAPS

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



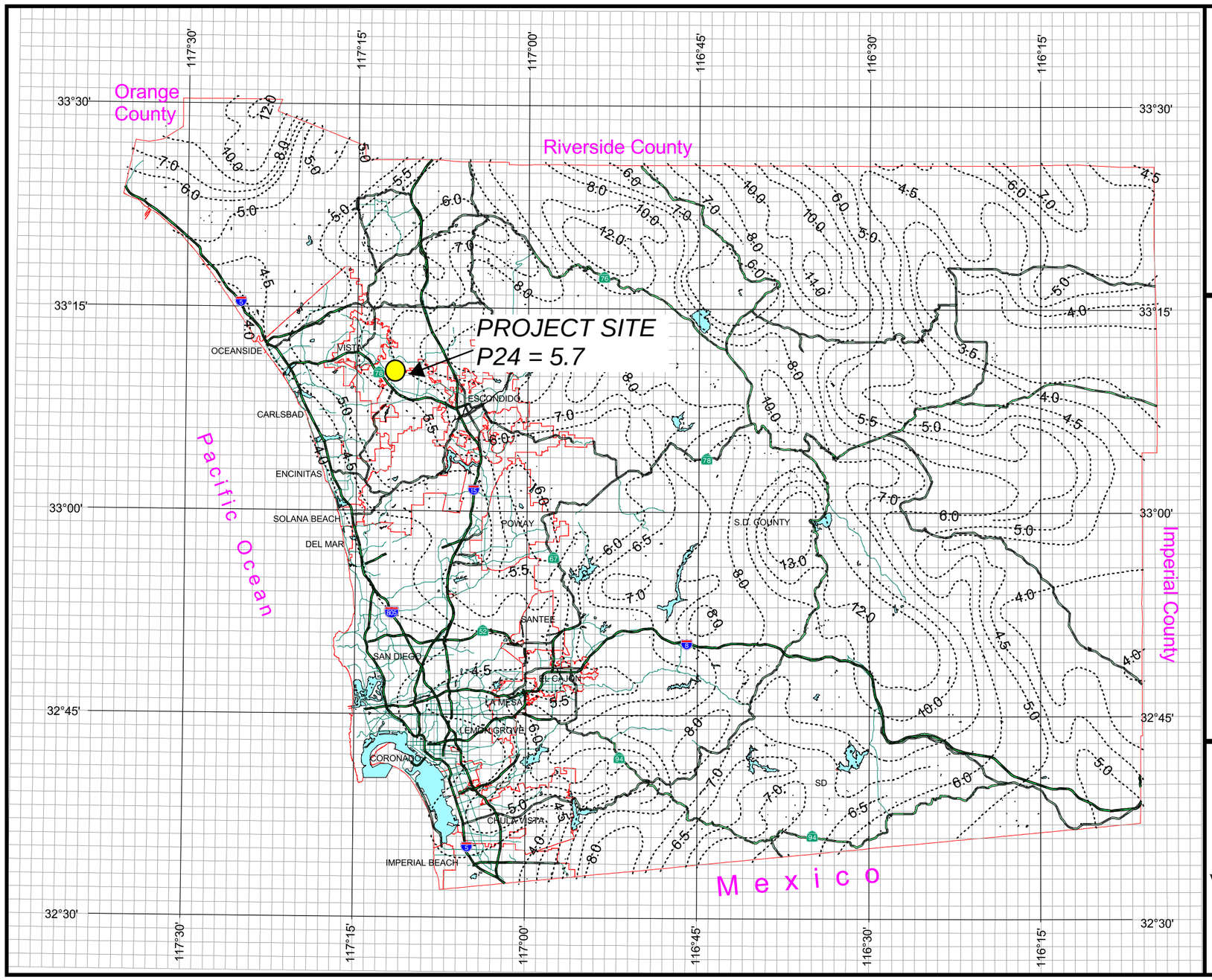
DPW GIS — Department of Public Works, Geographic Information Services

SanGIS — We Have San Diego Covered!

N W E S

3 0 3 Miles

PROJECT ISOPULIVIAL MAP



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

PROJECT ISOPULIVIAL MAP

ATTACHMENT 4
PRE-DEVELOPMENT CONDITION EXHIBIT

LEGEND

- 101 — NODE NUMBER
- —> —> — SURFACE FLOW
- HYD BASIN BOUNDARY
- (XXX) ES — EXISTING SURFACE ELEVATION

SCALE: 1"=40"

0 40 80 120 160

RILLING ENTERPRISES CAPALINA APARTMENTS PRE DEVELOPMENT HYDROLOGY EXHIBIT

ATTACHMENT 5
POST-DEVELOPMENT CONDITION EXHIBIT

5a. Hydrology Map of Post-Development Condition Exhibit

LEGEND

- 101 — NODE NUMBER
- —> ——> — SURFACE FLOW
- —> ——> — PIPE FLOW
- HYD BASIN BOUNDARY
- (XXX) ES — EXISTING SURFACE ELEVATION
- XXX FS — FINISH SURFACE ELEVATION

SCALE: 1"=40'

0 40 80 120 160

RILLING ENTERPRISES CAPALINA APARTMENTS POST DEVELOPMENT HYDROLOGY EXHIBIT

V:\22\22060\Engineering\Storm-TM\Working Files\Hyd\working files after 3rd pcc\22060 post hyd.dwg 5/19/2023 3:45 PM ORIGINAL PLOT SIZE: ----

5b. Hydrology Map of Post-Development Mitigation Condition Exhibit

LEGEND

- (101) — NODE NUMBER
- —> —> — SURFACE FLOW
- —> —> — PIPE FLOW
- HYD BASIN BOUNDARY
- (XXX) ES — EXISTING SURFACE ELEVATION
- XXX FS — FINISH SURFACE ELEVATION
- MITIGATED AREA

SCALE: 1"=40'

0 40 80 120 160

RILLING ENTERPRISES CAPALINA APARTMENTS POST DEVELOPMENT MITIGATION HYDROLOGY EXHIBIT

ATTACHMENT 6
MODIFIED RATIONAL METHOD RUNOFF CALCULATIONS

Steps Taken To Analyze This Condition

The Rational Method Runoff Calculations are followed here. The software that we are using is the "Rational Hydrology Method, San Diego County (2003 Manual)" module of the CIVILCADD/CIVILDESIGN Engineering Software, Version 9.1.

Please see the subsequent pages for the calculations. These calculations are for the $\mathbf{Q_{100}}$. The results are outlined/summarized in Section 6.

6a. CivilD Pre-Development Calculations

```
1
2               San Diego County Rational Hydrology Program
3
4       CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1
5
6       Rational method hydrology  program based on
7       San Diego County Flood Control Division 2003 hydrology manual
8           Rational Hydrology Study        Date: 09/29/22
9       ------------------------------------------------------------------------
10
11      22060 PRE DISCHARGE POINT 1
12
13
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) =  3.400
28      24 hour precipitation(inches) =  5.700
29      P6/P24 =    59.6%
30      San Diego hydrology manual 'C' values used
31
32
33      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
34      Process from Point/Station      101.000 to Point/Station      102.000
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      [UNDISTURBED NATURAL TERRAIN                ]
42      (Permanent Open Space   )
43      Impervious value, Ai = 0.000
44      Sub-Area C Value = 0.300
45      Initial subarea total flow distance  =  100.000(Ft.)
46      Highest elevation =  601.000(Ft.)
47      Lowest elevation =  597.300(Ft.)
48      Elevation difference =    3.700(Ft.) Slope =  3.700 %
49      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
50      The maximum overland flow distance is 100.00 (Ft)
51      for the top area slope value of   3.70 %, in a development type of
52       Permanent Open Space
53      In Accordance With Figure 3-3
54      Initial Area Time of Concentration =   9.31 minutes
55      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
56      TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(   3.700^(1/3)]=   9.31
57      Rainfall intensity (I) =      5.999(In/Hr) for a   100.0 year storm
58      Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
59      Subarea runoff =      0.050(CFS)
60      Total initial stream area =        0.028(Ac.)
61
62
63      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
64      Process from Point/Station      102.000 to Point/Station      103.000
65      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
66      ________________________________________________________________________
67      Estimated mean flow rate at midpoint of channel =      2.277(CFS)
68      Depth of flow =   0.767(Ft.), Average velocity =   3.867(Ft/s)
69          ******* 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 =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      2.277(CFS)
  '      '    flow top width =      1.535(Ft.)
  '      '    velocity=    3.867(Ft/s)
  '      '    area =      0.589(Sq.Ft)
  '      '    Froude number =     1.100

Upstream point elevation =   597.300(Ft.)
Downstream point elevation =   582.790(Ft.)
Flow length =   418.000(Ft.)
Travel time  =    1.80 min.
Time of concentration =   11.11 min.
Depth of flow =   0.767(Ft.)
Average velocity =   3.867(Ft/s)
Total irregular channel flow =     2.277(CFS)
Irregular channel normal depth above invert elev. =   0.767(Ft.)
Average velocity of channel(s) =   3.867(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.352(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 = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      5.352(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.349  CA =      0.858
Subarea runoff =      4.541(CFS) for      2.427(Ac.)
Total runoff =      4.591(CFS)  Total area =       2.455(Ac.)
Depth of flow =   0.998(Ft.), Average velocity =   4.609(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 =      2.455(Ac.)
Runoff from this stream =      4.591(CFS)
Time of concentration =   11.11 min.
Rainfall intensity =     5.352(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                   ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  589.000(Ft.)
Lowest elevation =  587.420(Ft.)
Elevation difference =    1.580(Ft.) Slope =  1.580 %
```

```
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   1.58 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.15 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7900)*(  75.000^.5)/(   1.580^(1/3)]=   4.15
Calculated TC of    4.149 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff =      0.729(CFS)
Total initial stream area =        0.103(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 =      1.188(CFS)
Depth of flow =   0.221(Ft.), Average velocity =   2.398(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              1.30              0.11
    4             19.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.188(CFS)
  '     '    flow top width =      6.338(Ft.)
  '     '    velocity=    2.398(Ft/s)
  '     '    area =      0.495(Sq.Ft)
  '     '    Froude number =     1.512

Upstream point elevation =   587.420(Ft.)
Downstream point elevation =   582.790(Ft.)
Flow length =   252.000(Ft.)
Travel time  =    1.75 min.
Time of concentration =    5.90 min.
Depth of flow =   0.221(Ft.)
Average velocity =   2.398(Ft/s)
Total irregular channel flow =     1.188(CFS)
Irregular channel normal depth above invert elev. =   0.221(Ft.)
Average velocity of channel(s) =   2.398(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.051(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Rainfall intensity =      8.051(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      0.194
Subarea runoff =      0.829(CFS) for      0.142(Ac.)
Total runoff =      1.558(CFS)  Total area =       0.245(Ac.)
Depth of flow =   0.238(Ft.), Average velocity =   2.554(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 =      0.245(Ac.)
 Runoff from this stream =      1.558(CFS)
 Time of concentration =    5.90 min.
 Rainfall intensity =     8.051(In/Hr)
 Summary of stream data:

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


 1        4.591     11.11             5.352
 2        1.558      5.90             8.051
 Qmax(1) =
        1.000 *    1.000 *     4.591) +
        0.665 *    1.000 *     1.558) + =       5.627
 Qmax(2) =
        1.000 *    0.531 *     4.591) +
        1.000 *    1.000 *     1.558) + =       3.996

 Total of 2 streams to confluence:
 Flow rates before confluence point:
        4.591       1.558
 Maximum flow rates at confluence using above data:
         5.627        3.996
 Area of streams before confluence:
         2.455        0.245
 Results of confluence:
 Total flow rate =      5.627(CFS)
 Time of concentration =    11.112 min.
 Effective stream area after confluence =      2.700(Ac.)
 End of computations, total study area =          2.700 (Ac.)
```

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 09/29/22
--------------------------------------------------------------------------
22060 PRE DISCHARGE POINT 2



--------------------------------------------------------------------------
 *********   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) =  3.400
24 hour precipitation(inches) =  5.700
P6/P24 =    59.6%
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 = 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 =  601.000(Ft.)
Lowest elevation =  597.520(Ft.)
Elevation difference =    3.480(Ft.) Slope =  3.480 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   3.48 %, 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)/(   3.480^(1/3)]=   3.50
Calculated TC of    3.504 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff =      0.671(CFS)
Total initial stream area =        0.096(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 =      1.162(CFS)
```

```
Depth of flow =   0.598(Ft.), Average velocity =   3.250(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 =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      1.162(CFS)
  '     '    flow top width =      1.196(Ft.)
  '     '    velocity=    3.250(Ft/s)
  '     '    area =      0.358(Sq.Ft)
  '     '    Froude number =     1.047

Upstream point elevation =   597.520(Ft.)
Downstream point elevation =   586.000(Ft.)
Flow length =   337.000(Ft.)
Travel time  =    1.73 min.
Time of concentration =    5.23 min.
Depth of flow =   0.598(Ft.)
Average velocity =   3.250(Ft/s)
Total irregular channel flow =     1.162(CFS)
Irregular channel normal depth above invert elev. =   0.598(Ft.)
Average velocity of channel(s) =   3.250(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.699(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 = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      8.699(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.454  CA =      0.181
Subarea runoff =      0.900(CFS) for      0.302(Ac.)
Total runoff =      1.571(CFS)  Total area =       0.398(Ac.)
Depth of flow =   0.670(Ft.), Average velocity =   3.504(Ft/s)
End of computations, total study area =          0.398 (Ac.)
```

6b. CivilD Post-Development Calculations

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 04/06/23
--------------------------------------------------------------------------
22060 POST DISCHARGE POINT 1



--------------------------------------------------------------------------
 *********   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) =  3.400
24 hour precipitation(inches) =  5.700
P6/P24 =    59.6%
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 = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  598.420(Ft.)
Lowest elevation =  596.140(Ft.)
Elevation difference =    2.280(Ft.) Slope =  2.280 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.28 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.67 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7900)*(  75.000^.5)/(   2.280^(1/3)]=   3.67
Calculated TC of    3.672 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff =      0.863(CFS)
Total initial stream area =        0.122(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 =      5.761(CFS)
```

```
Depth of flow =   1.164(Ft.), Average velocity =   7.312(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.42
    2             56.50              1.29
    3             58.00              0.00
    4             58.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      5.761(CFS)
  '     '    flow top width =      1.354(Ft.)
  '     '    velocity=    7.312(Ft/s)
  '     '    area =      0.788(Sq.Ft)
  '     '    Froude number =     1.689

Upstream point elevation =   596.140(Ft.)
Downstream point elevation =   587.530(Ft.)
Flow length =   382.000(Ft.)
Travel time  =    0.87 min.
Time of concentration =    4.54 min.
Depth of flow =   1.164(Ft.)
Average velocity =   7.312(Ft/s)
Total irregular channel flow =     5.761(CFS)
Irregular channel normal depth above invert elev. =   1.164(Ft.)
Average velocity of channel(s) =   7.312(Ft/s)
 Adding area flow to channel
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.190
Subarea runoff =      9.794(CFS) for      1.384(Ac.)
Total runoff =     10.658(CFS)  Total area =       1.506(Ac.)
Depth of flow =   1.403(Ft.), Average velocity =   2.648(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Time of concentration =     4.54 min.
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.502
Subarea runoff =      2.795(CFS) for      0.395(Ac.)
Total runoff =     13.453(CFS)  Total area =       1.901(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Time of concentration =     4.54 min.
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.589
Subarea runoff =      0.786(CFS) for      0.111(Ac.)
Total runoff =     14.239(CFS)  Total area =       2.012(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Time of concentration =     4.54 min.
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.732
Subarea runoff =      1.274(CFS) for      0.180(Ac.)
Total runoff =     15.513(CFS)  Total area =       2.192(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   585.100(Ft.)
Downstream point/station elevation =   584.810(Ft.)
Pipe length  =    58.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.513(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
     2.769(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.264(Ft.)
 Minor friction loss =      1.795(Ft.)  K-factor =   1.50
Pipe flow velocity =      8.78(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     4.65 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
```

```
208
209       Upstream point/station elevation =   583.790(Ft.)
210       Downstream point/station elevation =   583.020(Ft.)
211       Pipe length  =   139.00(Ft.) Slope =   0.0055  Manning's N = 0.013
212       No. of pipes = 1  Required pipe flow  =    15.513(CFS)
213       Given pipe size =     12.00(In.)
214       NOTE: Normal flow is pressure flow in user selected pipe size.
215       The approximate hydraulic grade line above the pipe invert is
216           34.659(Ft.)  at the headworks or inlet of the pipe(s)
217        Pipe friction loss =     26.342(Ft.)
218        Minor friction loss =      9.086(Ft.)  K-factor =   1.50
219       Pipe flow velocity =     19.75(Ft/s)
220       Travel time through pipe =    0.12 min.
221       Time of concentration (TC) =     4.77 min.
222
223
224       ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
225       Process from Point/Station      105.000 to Point/Station      105.000
226       **** CONFLUENCE OF MAIN STREAMS ****
227       ----------------------------------------------------------------------
228       The following data inside Main Stream is listed:
229       In Main Stream number: 1
230       Stream flow area =      2.192(Ac.)
231       Runoff from this stream =     15.513(CFS)
232       Time of concentration =    4.77 min.
233       Rainfall intensity =     8.958(In/Hr)
234       Program is now starting with Main Stream No. 2
235
236
237       ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
238       Process from Point/Station      201.000 to Point/Station      202.000
239       **** INITIAL AREA EVALUATION ****
240       ----------------------------------------------------------------------
241       Decimal fraction soil group A = 0.000
242       Decimal fraction soil group B = 0.000
243       Decimal fraction soil group C = 0.000
244       Decimal fraction soil group D = 1.000
245       [HIGH DENSITY RESIDENTIAL                    ]
246       (43.0 DU/A or Less      )
247       Impervious value, Ai = 0.800
248       Sub-Area C Value = 0.790
249       Initial subarea total flow distance  =  144.000(Ft.)
250       Highest elevation =  594.410(Ft.)
251       Lowest elevation =  591.500(Ft.)
252       Elevation difference =    2.910(Ft.) Slope =  2.021 %
253       Top of Initial Area Slope adjusted by User to  1.674 %
254       INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
255       The maximum overland flow distance is 75.00 (Ft)
256       for the top area slope value of   1.67 %, in a development type of
257        43.0 DU/A or Less
258       In Accordance With Figure 3-3
259       Initial Area Time of Concentration =   4.07 minutes
260       TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
261       TC = [1.8*(1.1-0.7900)*(  75.000^.5)/(   1.674^(1/3)]=   4.07
262       Calculated TC of    4.070 minutes is less than 5 minutes,
263        resetting TC to 5.0 minutes for rainfall intensity calculations
264       Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
265       Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
266       Subarea runoff =      1.260(CFS)
267       Total initial stream area =        0.178(Ac.)
268
269
270       ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
271       Process from Point/Station      202.000 to Point/Station      203.000
272       **** PIPEFLOW TRAVEL TIME (User specified size) ****
273       ----------------------------------------------------------------------
274       Upstream point/station elevation =   587.600(Ft.)
275       Downstream point/station elevation =   587.530(Ft.)
276       Pipe length  =    14.00(Ft.) Slope =   0.0050  Manning's N = 0.013
```

```
No. of pipes = 1  Required pipe flow  =     1.260(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.260(CFS)
Normal flow depth in pipe =    6.00(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =    5.69(In.)
Pipe flow velocity =      3.21(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     4.14 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.178(Ac.)
Runoff from this stream =      1.260(CFS)
Time of concentration =    4.14 min.
Rainfall intensity =     8.958(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  589.000(Ft.)
Lowest elevation =  587.610(Ft.)
Elevation difference =    1.390(Ft.) Slope =  1.390 %
Top of Initial Area Slope adjusted by User to  1.620 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   1.62 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.11 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7900)*(  75.000^.5)/(   1.620^(1/3)]=   4.11
Calculated TC of    4.115 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff =      0.701(CFS)
Total initial stream area =        0.099(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      203.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.244(Ft.), Average velocity =   1.068(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              1.30              0.11
    4             19.00              0.50
Manning's 'N' friction factor =   0.015
```

```
------------------------------------------------------------------
Sub-Channel flow  =      0.701(CFS)
  '     '    flow top width =      7.397(Ft.)
  '     '    velocity=    1.069(Ft/s)
  '     '    area =      0.656(Sq.Ft)
  '     '    Froude number =     0.632

Upstream point elevation =   587.610(Ft.)
Downstream point elevation =   587.570(Ft.)
Flow length =    13.000(Ft.)
Travel time  =    0.20 min.
Time of concentration =    4.32 min.
Depth of flow =   0.244(Ft.)
Average velocity =   1.068(Ft/s)
Total irregular channel flow =     0.701(CFS)
Irregular channel normal depth above invert elev. =   0.244(Ft.)
Average velocity of channel(s) =   1.068(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.099(Ac.)
Runoff from this stream =      0.701(CFS)
Time of concentration =    4.32 min.
Rainfall intensity =     8.958(In/Hr)
Summary of stream data:

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


1        1.260      4.14             8.958
2        0.701      4.32             8.958
Qmax(1) =
       1.000 *    1.000 *     1.260) +
       1.000 *    0.960 *     0.701) + =       1.932
Qmax(2) =
       1.000 *    1.000 *     1.260) +
       1.000 *    1.000 *     0.701) + =       1.960

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.260       0.701
Maximum flow rates at confluence using above data:
        1.932        1.960
Area of streams before confluence:
        0.178        0.099
Results of confluence:
Total flow rate =      1.960(CFS)
Time of concentration =     4.317 min.
Effective stream area after confluence =      0.277(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      105.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.589(CFS)
Depth of flow =   0.274(Ft.), Average velocity =   2.905(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              1.30              0.11
```

```
    4             19.00              0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      2.589(CFS)
  '     '    flow top width =      8.724(Ft.)
  '     '    velocity=    2.905(Ft/s)
  '     '    area =      0.891(Sq.Ft)
  '     '    Froude number =     1.602

Upstream point elevation =   587.570(Ft.)
Downstream point elevation =   583.120(Ft.)
Flow length =   237.000(Ft.)
Travel time  =    1.36 min.
Time of concentration =    5.68 min.
Depth of flow =   0.274(Ft.)
Average velocity =   2.905(Ft/s)
Total irregular channel flow =     2.589(CFS)
Irregular channel normal depth above invert elev. =   0.274(Ft.)
Average velocity of channel(s) =   2.905(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.254(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Rainfall intensity =      8.254(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      0.382
Subarea runoff =      1.189(CFS) for      0.206(Ac.)
Total runoff =      3.149(CFS)  Total area =       0.483(Ac.)
Depth of flow =   0.289(Ft.), Average velocity =   3.045(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      0.483(Ac.)
Runoff from this stream =      3.149(CFS)
Time of concentration =    5.68 min.
Rainfall intensity =     8.254(In/Hr)
Summary of stream data:

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


1       15.513      4.77             8.958
2        3.149      5.68             8.254
Qmax(1) =
       1.000 *    1.000 *    15.513) +
       1.000 *    0.840 *     3.149) + =      18.158
Qmax(2) =
       0.921 *    1.000 *    15.513) +
       1.000 *    1.000 *     3.149) + =      17.442

Total of 2 main streams to confluence:
Flow rates before confluence point:
      15.513       3.149
Maximum flow rates at confluence using above data:
       18.158       17.442
Area of streams before confluence:
        2.192        0.483
```

```
Results of confluence:
Total flow rate =     18.158(CFS)
Time of concentration =     4.770 min.
Effective stream area after confluence  =      2.675(Ac.)
End of computations, total study area =          2.675 (Ac.)
```

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 01/09/23
------------------------------------------------------------------------
22060 POST DISCHARGE POINT 1
HYDROGRAPH FOR BMP A


------------------------------------------------------------------------
 *********   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) =  3.400
24 hour precipitation(inches) =  5.700
P6/P24 =    59.6%
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 = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  598.420(Ft.)
Lowest elevation =  596.140(Ft.)
Elevation difference =    2.280(Ft.) Slope =  2.280 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.28 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.67 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7900)*(  75.000^.5)/(   2.280^(1/3)]=   3.67
Calculated TC of    3.672 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff =      0.863(CFS)
Total initial stream area =        0.122(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 =      5.761(CFS)
```

```
Depth of flow =   1.164(Ft.), Average velocity =   7.312(Ft/s)
    ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.42
    2             56.50              1.29
    3             58.00              0.00
    4             58.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      5.761(CFS)
  '     '    flow top width =      1.354(Ft.)
  '     '    velocity=    7.312(Ft/s)
  '     '    area =      0.788(Sq.Ft)
  '     '    Froude number =     1.689

Upstream point elevation =   596.140(Ft.)
Downstream point elevation =   587.530(Ft.)
Flow length =   382.000(Ft.)
Travel time  =    0.87 min.
Time of concentration =    4.54 min.
Depth of flow =   1.164(Ft.)
Average velocity =   7.312(Ft/s)
Total irregular channel flow =     5.761(CFS)
Irregular channel normal depth above invert elev. =   1.164(Ft.)
Average velocity of channel(s) =   7.312(Ft/s)
 Adding area flow to channel
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.190
Subarea runoff =      9.794(CFS) for      1.384(Ac.)
Total runoff =     10.658(CFS)  Total area =       1.506(Ac.)
Depth of flow =   1.403(Ft.), Average velocity =   2.648(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Time of concentration =     4.54 min.
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.502
Subarea runoff =      2.795(CFS) for      0.395(Ac.)
Total runoff =     13.453(CFS)  Total area =       1.901(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Time of concentration =     4.54 min.
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.589
Subarea runoff =      0.786(CFS) for      0.111(Ac.)
Total runoff =     14.239(CFS)  Total area =       2.012(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      103.000
**** SUBAREA FLOW ADDITION ****

------------------------------------------------------------------------
Calculated TC of    4.542 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Time of concentration =     4.54 min.
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      1.732
Subarea runoff =      1.274(CFS) for      0.180(Ac.)
Total runoff =     15.513(CFS)  Total area =       2.192(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      103.000
**** 6 HOUR HYDROGRAPH ****

------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003


Time of Concentration =   4.54
Basin Area =     2.19 Acres
6 Hour Rainfall =  3.400 Inches
Runoff Coefficient =  0.790
Peak Discharge =    15.51 CFS
     Time (Min)     Discharge (CFS)
       0               0.000
       4               0.350
       8               0.353
       12               0.358
       16               0.361
       20               0.366
       24               0.369
       28               0.375
```

208	32	0.378
209	36	0.384
210	40	0.388
211	44	0.394
212	48	0.398
213	52	0.405
214	56	0.409
215	60	0.416
216	64	0.420
217	68	0.428
218	72	0.433
219	76	0.442
220	80	0.446
221	84	0.456
222	88	0.461
223	92	0.471
224	96	0.477
225	100	0.488
226	104	0.494
227	108	0.507
228	112	0.513
229	116	0.527
230	120	0.534
231	124	0.550
232	128	0.558
233	132	0.575
234	136	0.584
235	140	0.604
236	144	0.614
237	148	0.636
238	152	0.648
239	156	0.673
240	160	0.687
241	164	0.717
242	168	0.733
243	172	0.768
244	176	0.787
245	180	0.830
246	184	0.854
247	188	0.907
248	192	0.936
249	196	1.004
250	200	1.043
251	204	1.134
252	208	1.187
253	212	1.316
254	216	1.396
255	220	1.600
256	224	1.735
257	228	2.121
258	232	2.416
259	236	3.547
260	240	4.998
261	244	15.513
262	248	2.845
263	252	1.903
264	256	1.489
265	260	1.247
266	264	1.086
267	268	0.969
268	272	0.879
269	276	0.808
270	280	0.750
271	284	0.702
272	288	0.660
273	292	0.625
274	296	0.594
275	300	0.566
276	304	0.542

308	0.520	
312	0.500	
316	0.482	
320	0.466	
324	0.451	
328	0.437	
332	0.424	
336	0.412	
340	0.401	
344	0.391	
348	0.381	
352	0.372	
356	0.364	
360	0.355	
364	0.348	

++

6 - H O U R S T O R M

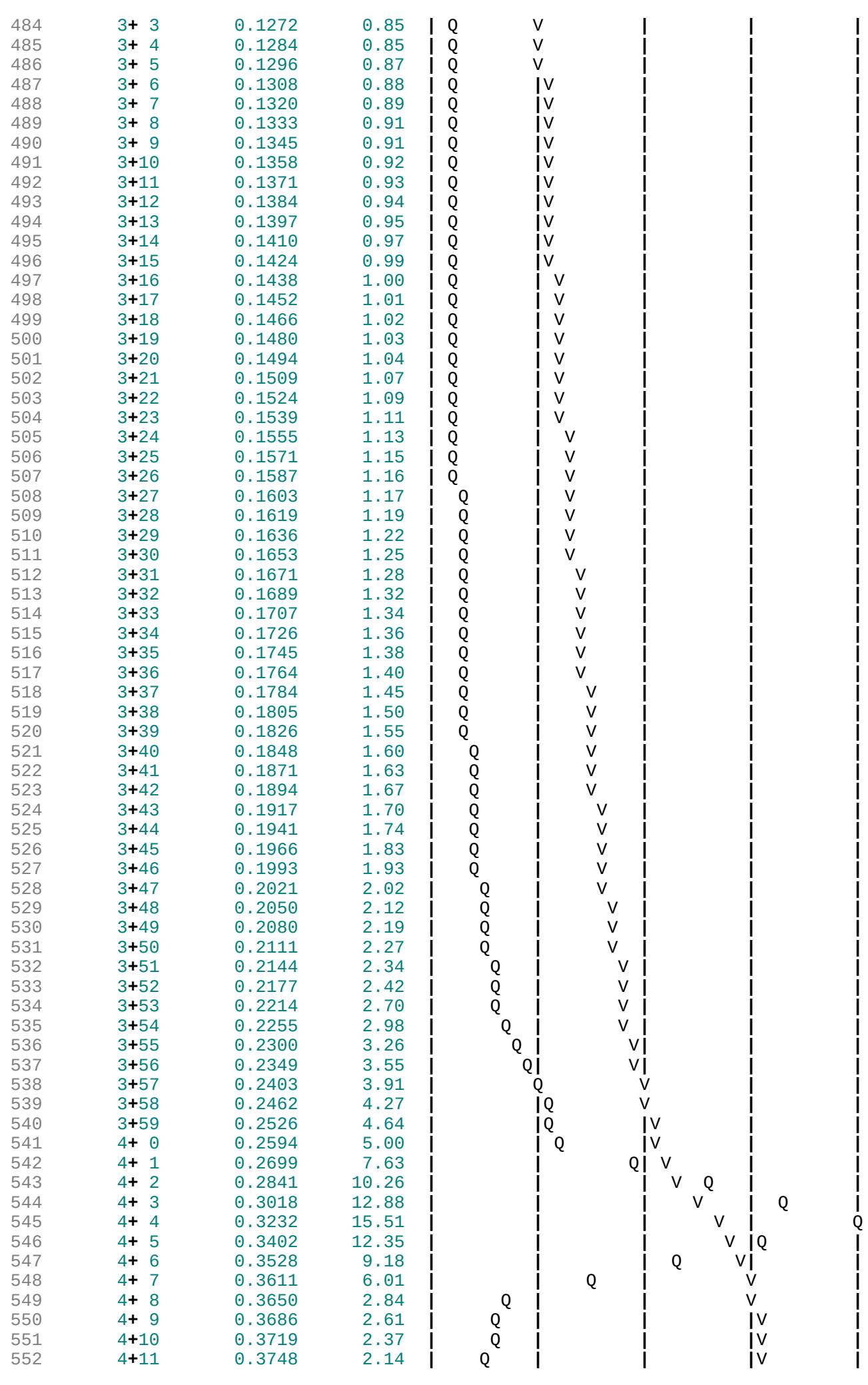
R u n o f f H y d r o g r a p h

Hydrograph in 1 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	3.9	7.8	11.6	15.5
0+ 0	0.0000	0.00	Q	|	|	|	|
0+ 1	0.0001	0.09	Q	|	|	|	|
0+ 2	0.0004	0.18	Q	|	|	|	|
0+ 3	0.0007	0.26	Q	|	|	|	|
0+ 4	0.0012	0.35	Q	|	|	|	|
0+ 5	0.0017	0.35	Q	|	|	|	|
0+ 6	0.0022	0.35	Q	|	|	|	|
0+ 7	0.0027	0.35	Q	|	|	|	|
0+ 8	0.0031	0.35	Q	|	|	|	|
0+ 9	0.0036	0.35	Q	|	|	|	|
0+10	0.0041	0.36	Q	|	|	|	|
0+11	0.0046	0.36	Q	|	|	|	|
0+12	0.0051	0.36	Q	|	|	|	|
0+13	0.0056	0.36	Q	|	|	|	|
0+14	0.0061	0.36	Q	|	|	|	|
0+15	0.0066	0.36	Q	|	|	|	|
0+16	0.0071	0.36	Q	|	|	|	|
0+17	0.0076	0.36	Q	|	|	|	|
0+18	0.0081	0.36	Q	|	|	|	|
0+19	0.0086	0.36	Q	|	|	|	|
0+20	0.0091	0.37	Q	|	|	|	|
0+21	0.0096	0.37	Q	|	|	|	|
0+22	0.0101	0.37	Q	|	|	|	|
0+23	0.0106	0.37	Q	|	|	|	|
0+24	0.0111	0.37	Q	|	|	|	|
0+25	0.0116	0.37	Q	|	|	|	|
0+26	0.0121	0.37	QV	|	|	|	|
0+27	0.0127	0.37	QV	|	|	|	|
0+28	0.0132	0.38	QV	|	|	|	|
0+29	0.0137	0.38	QV	|	|	|	|
0+30	0.0142	0.38	QV	|	|	|	|
0+31	0.0147	0.38	QV	|	|	|	|
0+32	0.0153	0.38	QV	|	|	|	|
0+33	0.0158	0.38	QV	|	|	|	|
0+34	0.0163	0.38	QV	|	|	|	|
0+35	0.0168	0.38	QV	|	|	|	|
0+36	0.0174	0.38	QV	|	|	|	|
0+37	0.0179	0.39	QV	|	|	|	|
0+38	0.0184	0.39	QV	|	|	|	|
0+39	0.0190	0.39	QV	|	|	|	|
0+40	0.0195	0.39	QV	|	|	|	|
0+41	0.0200	0.39	|Q	|	|	|	|
0+42	0.0206	0.39	|Q	|	|	|	|
0+43	0.0211	0.39	|Q	|	|	|	|
0+44	0.0217	0.39	|Q	|	|	|	|

346	0+45	0.0222	0.40	|Q |	|	|	|
347	0+46	0.0227	0.40	|Q |	|	|	|
348	0+47	0.0233	0.40	|Q |	|	|	|
349	0+48	0.0238	0.40	|QV |	|	|	|
350	0+49	0.0244	0.40	|QV |	|	|	|
351	0+50	0.0249	0.40	|QV |	|	|	|
352	0+51	0.0255	0.40	|QV |	|	|	|
353	0+52	0.0261	0.40	|QV |	|	|	|
354	0+53	0.0266	0.41	|QV |	|	|	|
355	0+54	0.0272	0.41	|QV |	|	|	|
356	0+55	0.0277	0.41	|QV |	|	|	|
357	0+56	0.0283	0.41	|QV |	|	|	|
358	0+57	0.0289	0.41	|QV |	|	|	|
359	0+58	0.0294	0.41	|QV |	|	|	|
360	0+59	0.0300	0.41	|QV |	|	|	|
361	1+ 0	0.0306	0.42	|QV |	|	|	|
362	1+ 1	0.0311	0.42	|QV |	|	|	|
363	1+ 2	0.0317	0.42	|QV |	|	|	|
364	1+ 3	0.0323	0.42	|QV |	|	|	|
365	1+ 4	0.0329	0.42	|QV |	|	|	|
366	1+ 5	0.0335	0.42	|QV |	|	|	|
367	1+ 6	0.0340	0.42	|QV |	|	|	|
368	1+ 7	0.0346	0.43	|QV |	|	|	|
369	1+ 8	0.0352	0.43	|QV |	|	|	|
370	1+ 9	0.0358	0.43	|Q V |	|	|	|
371	1+10	0.0364	0.43	|Q V |	|	|	|
372	1+11	0.0370	0.43	|Q V |	|	|	|
373	1+12	0.0376	0.43	|Q V |	|	|	|
374	1+13	0.0382	0.43	|Q V |	|	|	|
375	1+14	0.0388	0.44	|Q V |	|	|	|
376	1+15	0.0394	0.44	|Q V |	|	|	|
377	1+16	0.0400	0.44	|Q V |	|	|	|
378	1+17	0.0406	0.44	|Q V |	|	|	|
379	1+18	0.0412	0.44	|Q V |	|	|	|
380	1+19	0.0419	0.45	|Q V |	|	|	|
381	1+20	0.0425	0.45	|Q V |	|	|	|
382	1+21	0.0431	0.45	|Q V |	|	|	|
383	1+22	0.0437	0.45	|Q V |	|	|	|
384	1+23	0.0443	0.45	|Q V |	|	|	|
385	1+24	0.0450	0.46	|Q V |	|	|	|
386	1+25	0.0456	0.46	|Q V |	|	|	|
387	1+26	0.0462	0.46	|Q V |	|	|	|
388	1+27	0.0469	0.46	|Q V |	|	|	|
389	1+28	0.0475	0.46	|Q V |	|	|	|
390	1+29	0.0481	0.46	|Q V |	|	|	|
391	1+30	0.0488	0.47	|Q V |	|	|	|
392	1+31	0.0494	0.47	|Q V |	|	|	|
393	1+32	0.0501	0.47	|Q V |	|	|	|
394	1+33	0.0507	0.47	|Q V |	|	|	|
395	1+34	0.0514	0.47	|Q V |	|	|	|
396	1+35	0.0520	0.48	|Q V |	|	|	|
397	1+36	0.0527	0.48	|Q V |	|	|	|
398	1+37	0.0533	0.48	|Q V |	|	|	|
399	1+38	0.0540	0.48	|Q V |	|	|	|
400	1+39	0.0547	0.49	|Q V |	|	|	|
401	1+40	0.0553	0.49	|Q V |	|	|	|
402	1+41	0.0560	0.49	|Q V |	|	|	|
403	1+42	0.0567	0.49	|Q V |	|	|	|
404	1+43	0.0574	0.49	|Q V |	|	|	|
405	1+44	0.0581	0.49	|Q V |	|	|	|
406	1+45	0.0587	0.50	|Q V |	|	|	|
407	1+46	0.0594	0.50	|Q V |	|	|	|
408	1+47	0.0601	0.50	|Q V |	|	|	|
409	1+48	0.0608	0.51	|Q V |	|	|	|
410	1+49	0.0615	0.51	|Q V |	|	|	|
411	1+50	0.0622	0.51	|Q V |	|	|	|
412	1+51	0.0629	0.51	|Q V |	|	|	|
413	1+52	0.0636	0.51	|Q V |	|	|	|
414	1+53	0.0643	0.52	|Q V |	|	|	|

415	1+54	0.0651	0.52	|Q V |	|	|	|
416	1+55	0.0658	0.52	|Q V |	|	|	|
417	1+56	0.0665	0.53	|Q V |	|	|	|
418	1+57	0.0672	0.53	|Q V |	|	|	|
419	1+58	0.0680	0.53	|Q V |	|	|	|
420	1+59	0.0687	0.53	|Q V |	|	|	|
421	2+ 0	0.0694	0.53	|Q V |	|	|	|
422	2+ 1	0.0702	0.54	|Q V |	|	|	|
423	2+ 2	0.0709	0.54	|Q V |	|	|	|
424	2+ 3	0.0717	0.55	|Q V |	|	|	|
425	2+ 4	0.0724	0.55	|Q V |	|	|	|
426	2+ 5	0.0732	0.55	|Q V |	|	|	|
427	2+ 6	0.0740	0.55	|Q V |	|	|	|
428	2+ 7	0.0747	0.56	|Q V |	|	|	|
429	2+ 8	0.0755	0.56	|Q V |	|	|	|
430	2+ 9	0.0763	0.56	|Q V |	|	|	|
431	2+10	0.0771	0.57	|Q V |	|	|	|
432	2+11	0.0778	0.57	|Q V |	|	|	|
433	2+12	0.0786	0.58	|Q V |	|	|	|
434	2+13	0.0794	0.58	|Q V |	|	|	|
435	2+14	0.0802	0.58	|Q V |	|	|	|
436	2+15	0.0810	0.58	|Q V |	|	|	|
437	2+16	0.0818	0.58	|Q V |	|	|	|
438	2+17	0.0826	0.59	|Q V |	|	|	|
439	2+18	0.0835	0.59	|Q V |	|	|	|
440	2+19	0.0843	0.60	|Q V |	|	|	|
441	2+20	0.0851	0.60	|Q V |	|	|	|
442	2+21	0.0860	0.61	|Q V |	|	|	|
443	2+22	0.0868	0.61	|Q V |	|	|	|
444	2+23	0.0876	0.61	|Q V |	|	|	|
445	2+24	0.0885	0.61	|Q V |	|	|	|
446	2+25	0.0893	0.62	|Q V |	|	|	|
447	2+26	0.0902	0.63	|Q V |	|	|	|
448	2+27	0.0911	0.63	|Q V |	|	|	|
449	2+28	0.0919	0.64	|Q V |	|	|	|
450	2+29	0.0928	0.64	|Q V |	|	|	|
451	2+30	0.0937	0.64	|Q V |	|	|	|
452	2+31	0.0946	0.64	|Q V |	|	|	|
453	2+32	0.0955	0.65	|Q V |	|	|	|
454	2+33	0.0964	0.65	|Q V |	|	|	|
455	2+34	0.0973	0.66	|Q V |	|	|	|
456	2+35	0.0982	0.67	|Q V |	|	|	|
457	2+36	0.0991	0.67	|Q V |	|	|	|
458	2+37	0.1001	0.68	|Q V |	|	|	|
459	2+38	0.1010	0.68	|Q V |	|	|	|
460	2+39	0.1020	0.68	|Q V |	|	|	|
461	2+40	0.1029	0.69	|Q V |	|	|	|
462	2+41	0.1039	0.69	|Q V |	|	|	|
463	2+42	0.1048	0.70	|Q V |	|	|	|
464	2+43	0.1058	0.71	|Q V |	|	|	|
465	2+44	0.1068	0.72	|Q V |	|	|	|
466	2+45	0.1078	0.72	|Q V|	|	|	|
467	2+46	0.1088	0.72	|Q V|	|	|	|
468	2+47	0.1098	0.73	|Q V|	|	|	|
469	2+48	0.1108	0.73	|Q V|	|	|	|
470	2+49	0.1118	0.74	|Q V|	|	|	|
471	2+50	0.1128	0.75	|Q V|	|	|	|
472	2+51	0.1139	0.76	|Q V|	|	|	|
473	2+52	0.1149	0.77	|Q V|	|	|	|
474	2+53	0.1160	0.77	|Q V|	|	|	|
475	2+54	0.1171	0.78	| Q V|	|	|	|
476	2+55	0.1182	0.78	| Q V|	|	|	|
477	2+56	0.1192	0.79	| Q V |	|	|	|
478	2+57	0.1203	0.80	| Q V |	|	|	|
479	2+58	0.1215	0.81	| Q V |	|	|	|
480	2+59	0.1226	0.82	| Q V |	|	|	|
481	3+ 0	0.1237	0.83	| Q V |	|	|	|
482	3+ 1	0.1249	0.84	| Q V |	|	|	|
483	3+ 2	0.1260	0.84	| Q V |	|	|	|



553	4+12	0.3775	1.90	| Q |	|	|	|V |
554	4+13	0.3799	1.80	| Q |	|	|	|V |
555	4+14	0.3823	1.70	| Q |	|	|	| V |
556	4+15	0.3845	1.59	| Q |	|	|	| V |
557	4+16	0.3865	1.49	| Q |	|	|	| V |
558	4+17	0.3885	1.43	| Q |	|	|	| V |
559	4+18	0.3904	1.37	| Q |	|	|	| V |
560	4+19	0.3922	1.31	| Q |	|	|	| V |
561	4+20	0.3939	1.25	| Q |	|	|	| V |
562	4+21	0.3956	1.21	| Q |	|	|	| V |
563	4+22	0.3972	1.17	| Q |	|	|	| V |
564	4+23	0.3987	1.13	| Q |	|	|	| V |
565	4+24	0.4002	1.09	| Q |	|	|	| V |
566	4+25	0.4017	1.06	| Q |	|	|	| V |
567	4+26	0.4031	1.03	| Q |	|	|	| V |
568	4+27	0.4045	1.00	| Q |	|	|	| V |
569	4+28	0.4058	0.97	| Q |	|	|	| V |
570	4+29	0.4071	0.95	| Q |	|	|	| V |
571	4+30	0.4084	0.92	| Q |	|	|	| V |
572	4+31	0.4096	0.90	| Q |	|	|	| V |
573	4+32	0.4108	0.88	| Q |	|	|	| V |
574	4+33	0.4120	0.86	| Q |	|	|	| V |
575	4+34	0.4132	0.84	| Q |	|	|	| V |
576	4+35	0.4143	0.83	| Q |	|	|	| V |
577	4+36	0.4154	0.81	| Q |	|	|	| V |
578	4+37	0.4165	0.79	| Q |	|	|	| V |
579	4+38	0.4176	0.78	| Q |	|	|	| V |
580	4+39	0.4186	0.76	|Q |	|	|	| V |
581	4+40	0.4197	0.75	|Q |	|	|	| V |
582	4+41	0.4207	0.74	|Q |	|	|	| V |
583	4+42	0.4217	0.73	|Q |	|	|	| V |
584	4+43	0.4227	0.71	|Q |	|	|	| V |
585	4+44	0.4236	0.70	|Q |	|	|	| V |
586	4+45	0.4246	0.69	|Q |	|	|	| V |
587	4+46	0.4255	0.68	|Q |	|	|	| V |
588	4+47	0.4265	0.67	|Q |	|	|	| V |
589	4+48	0.4274	0.66	|Q |	|	|	| V |
590	4+49	0.4283	0.65	|Q |	|	|	| V |
591	4+50	0.4291	0.64	|Q |	|	|	| V |
592	4+51	0.4300	0.63	|Q |	|	|	| V |
593	4+52	0.4309	0.62	|Q |	|	|	| V |
594	4+53	0.4317	0.62	|Q |	|	|	| V |
595	4+54	0.4326	0.61	|Q |	|	|	| V |
596	4+55	0.4334	0.60	|Q |	|	|	| V |
597	4+56	0.4342	0.59	|Q |	|	|	| V |
598	4+57	0.4350	0.59	|Q |	|	|	| V |
599	4+58	0.4358	0.58	|Q |	|	|	| V |
600	4+59	0.4366	0.57	|Q |	|	|	| V |
601	5+ 0	0.4374	0.57	|Q |	|	|	| V |
602	5+ 1	0.4382	0.56	|Q |	|	|	| V |
603	5+ 2	0.4389	0.55	|Q |	|	|	| V |
604	5+ 3	0.4397	0.55	|Q |	|	|	| V |
605	5+ 4	0.4404	0.54	|Q |	|	|	| V |
606	5+ 5	0.4412	0.54	|Q |	|	|	| V |
607	5+ 6	0.4419	0.53	|Q |	|	|	| V |
608	5+ 7	0.4426	0.53	|Q |	|	|	| V |
609	5+ 8	0.4433	0.52	|Q |	|	|	| V |
610	5+ 9	0.4440	0.52	|Q |	|	|	| V |
611	5+10	0.4447	0.51	|Q |	|	|	| V |
612	5+11	0.4454	0.51	|Q |	|	|	| V |
613	5+12	0.4461	0.50	|Q |	|	|	| V |
614	5+13	0.4468	0.50	|Q |	|	|	| V |
615	5+14	0.4475	0.49	|Q |	|	|	| V |
616	5+15	0.4482	0.49	|Q |	|	|	| V |
617	5+16	0.4488	0.48	|Q |	|	|	| V |
618	5+17	0.4495	0.48	|Q |	|	|	| V |
619	5+18	0.4501	0.47	|Q |	|	|	| V |
620	5+19	0.4508	0.47	|Q |	|	|	| V |
621	5+20	0.4514	0.47	|Q |	|	|	| V |

```
      5+21       0.4521      0.46  |Q        |         |         |        V |
      5+22       0.4527      0.46  |Q        |         |         |        V |
      5+23       0.4533      0.45  |Q        |         |         |        V |
      5+24       0.4539      0.45  |Q        |         |         |        V |
      5+25       0.4546      0.45  |Q        |         |         |        V |
      5+26       0.4552      0.44  |Q        |         |         |        V |
      5+27       0.4558      0.44  |Q        |         |         |        V |
      5+28       0.4564      0.44  |Q        |         |         |        V |
      5+29       0.4570      0.43  |Q        |         |         |        V |
      5+30       0.4576      0.43  |Q        |         |         |        V |
      5+31       0.4582      0.43  |Q        |         |         |        V |
      5+32       0.4587      0.42  |Q        |         |         |        V |
      5+33       0.4593      0.42  |Q        |         |         |        V |
      5+34       0.4599      0.42  |Q        |         |         |        V |
      5+35       0.4605      0.42  |Q        |         |         |        V |
      5+36       0.4610      0.41  |Q        |         |         |        V |
      5+37       0.4616      0.41  |Q        |         |         |        V |
      5+38       0.4622      0.41  |Q        |         |         |        V |
      5+39       0.4627      0.40  |Q        |         |         |        V |
      5+40       0.4633      0.40  |Q        |         |         |        V |
      5+41       0.4638      0.40  |Q        |         |         |         V|
      5+42       0.4644      0.40  |Q        |         |         |         V|
      5+43       0.4649      0.39  |Q        |         |         |         V|
      5+44       0.4655      0.39  |Q        |         |         |         V|
      5+45       0.4660      0.39  |Q        |         |         |         V|
      5+46       0.4665      0.39  Q         |         |         |         V|
      5+47       0.4671      0.38  Q         |         |         |         V|
      5+48       0.4676      0.38  Q         |         |         |         V|
      5+49       0.4681      0.38  Q         |         |         |         V|
      5+50       0.4686      0.38  Q         |         |         |         V|
      5+51       0.4691      0.37  Q         |         |         |         V|
      5+52       0.4696      0.37  Q         |         |         |         V|
      5+53       0.4702      0.37  Q         |         |         |         V|
      5+54       0.4707      0.37  Q         |         |         |         V|
      5+55       0.4712      0.37  Q         |         |         |         V|
      5+56       0.4717      0.36  Q         |         |         |         V|
      5+57       0.4722      0.36  Q         |         |         |         V|
      5+58       0.4727      0.36  Q         |         |         |         V|
      5+59       0.4732      0.36  Q         |         |         |         V|
      6+ 0       0.4736      0.36  Q         |         |         |         V|
      6+ 1       0.4741      0.35  Q         |         |         |         V|
      6+ 2       0.4746      0.35  Q         |         |         |         V|
      6+ 3       0.4751      0.35  Q         |         |         |         V|
      6+ 4       0.4756      0.35  Q         |         |         |          V
-------------------------------------------------------------------------------



    End of computations, total study area =          2.192 (Ac.)
```

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 04/06/23
--------------------------------------------------------------------------
22060 POST POC2



--------------------------------------------------------------------------
 *********   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) =  3.400
24 hour precipitation(inches) =  5.700
P6/P24 =    59.6%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** 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 =  601.000(Ft.)
Lowest elevation =  598.000(Ft.)
Elevation difference =    3.000(Ft.) Slope =  3.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   3.00 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.68 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7800)*(  85.000^.5)/(   3.000^(1/3)]=   3.68
Calculated TC of    3.682 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.780
Subarea runoff =      0.748(CFS)
Total initial stream area =        0.107(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      403.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
__________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.852(CFS)
```

```
Depth of flow =   0.592(Ft.), Average velocity =   6.020(Ft/s)
    ******* Irregular Channel Data **********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              1.00
    2             28.50              0.85
    3             30.00              0.00
    4             30.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.852(CFS)
  '     '    flow top width =      1.039(Ft.)
  '     '    velocity=    6.020(Ft/s)
  '     '    area =      0.308(Sq.Ft)
  '     '    Froude number =     1.950

Upstream point elevation =   598.000(Ft.)
Downstream point elevation =   585.990(Ft.)
Flow length =   334.000(Ft.)
Travel time  =    0.92 min.
Time of concentration =    4.61 min.
Depth of flow =   0.592(Ft.)
Average velocity =   6.020(Ft/s)
Total irregular channel flow =     1.852(CFS)
Irregular channel normal depth above invert elev. =   0.592(Ft.)
Average velocity of channel(s) =   6.020(Ft/s)
 Adding area flow to channel
Calculated TC of    4.607 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(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 = 0.200
Decimal fraction soil group D = 0.800
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.788
Rainfall intensity =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.786  CA =      0.332
Subarea runoff =      2.231(CFS) for      0.316(Ac.)
Total runoff =      2.978(CFS)  Total area =       0.423(Ac.)
Depth of flow =   0.700(Ft.), Average velocity =   6.938(Ft/s)
End of computations, total study area =           0.423 (Ac.)
```

6c. CivilD Mitigated Post-Development Calculations

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 04/06/23
--------------------------------------------------------------------------
22060 POST DISCHARGE POINT 1 MITIGATION
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) =  3.400
24 hour precipitation(inches) =  5.700
P6/P24 =    59.6%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      104.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
__________________________________________________________________________
User specified 'C' value of 0.062 given for subarea
Rainfall intensity (I) =      8.385(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.54 min.  Rain intensity =       8.38(In/Hr)
Total area =        2.190(Ac.)  Total runoff =     1.140(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
__________________________________________________________________________
Upstream point/station elevation =   583.790(Ft.)
Downstream point/station elevation =   583.020(Ft.)
Pipe length  =   139.00(Ft.) Slope =   0.0055  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.140(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.140(CFS)
Normal flow depth in pipe =    5.50(In.)
Flow top width inside pipe =   11.96(In.)
Critical Depth =    5.40(In.)
Pipe flow velocity =      3.25(Ft/s)
Travel time through pipe =    0.71 min.
Time of concentration (TC) =     6.25 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MAIN STREAMS ****
__________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      2.190(Ac.)
Runoff from this stream =      1.140(CFS)
```

```
Time of concentration =    6.25 min.
Rainfall intensity =     7.755(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance  =  144.000(Ft.)
Highest elevation =  594.410(Ft.)
Lowest elevation =  591.500(Ft.)
Elevation difference =    2.910(Ft.) Slope =  2.021 %
Top of Initial Area Slope adjusted by User to  1.674 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   1.67 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.07 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7900)*(  75.000^.5)/(   1.674^(1/3)]=   4.07
Calculated TC of    4.070 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff =      1.260(CFS)
Total initial stream area =        0.178(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   587.600(Ft.)
Downstream point/station elevation =   587.530(Ft.)
Pipe length  =    14.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.260(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.260(CFS)
Normal flow depth in pipe =    6.00(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =    5.69(In.)
Pipe flow velocity =      3.21(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     4.14 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.178(Ac.)
Runoff from this stream =      1.260(CFS)
Time of concentration =    4.14 min.
Rainfall intensity =     8.958(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
```

```
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  589.000(Ft.)
Lowest elevation =  587.610(Ft.)
Elevation difference =    1.390(Ft.) Slope =  1.390 %
Top of Initial Area Slope adjusted by User to  1.620 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   1.62 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.11 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7900)*(  75.000^.5)/(   1.620^(1/3)]=   4.11
Calculated TC of    4.115 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff =      0.701(CFS)
Total initial stream area =        0.099(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      203.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------
Depth of flow =   0.244(Ft.), Average velocity =   1.068(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              1.30              0.11
    4             19.00              0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      0.701(CFS)
  '     '    flow top width =      7.397(Ft.)
  '     '    velocity=    1.069(Ft/s)
  '     '    area =      0.656(Sq.Ft)
  '     '    Froude number =     0.632

Upstream point elevation =   587.610(Ft.)
Downstream point elevation =   587.570(Ft.)
Flow length =    13.000(Ft.)
Travel time  =    0.20 min.
Time of concentration =    4.32 min.
Depth of flow =   0.244(Ft.)
Average velocity =   1.068(Ft/s)
Total irregular channel flow =     0.701(CFS)
Irregular channel normal depth above invert elev. =   0.244(Ft.)
Average velocity of channel(s) =   1.068(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
```

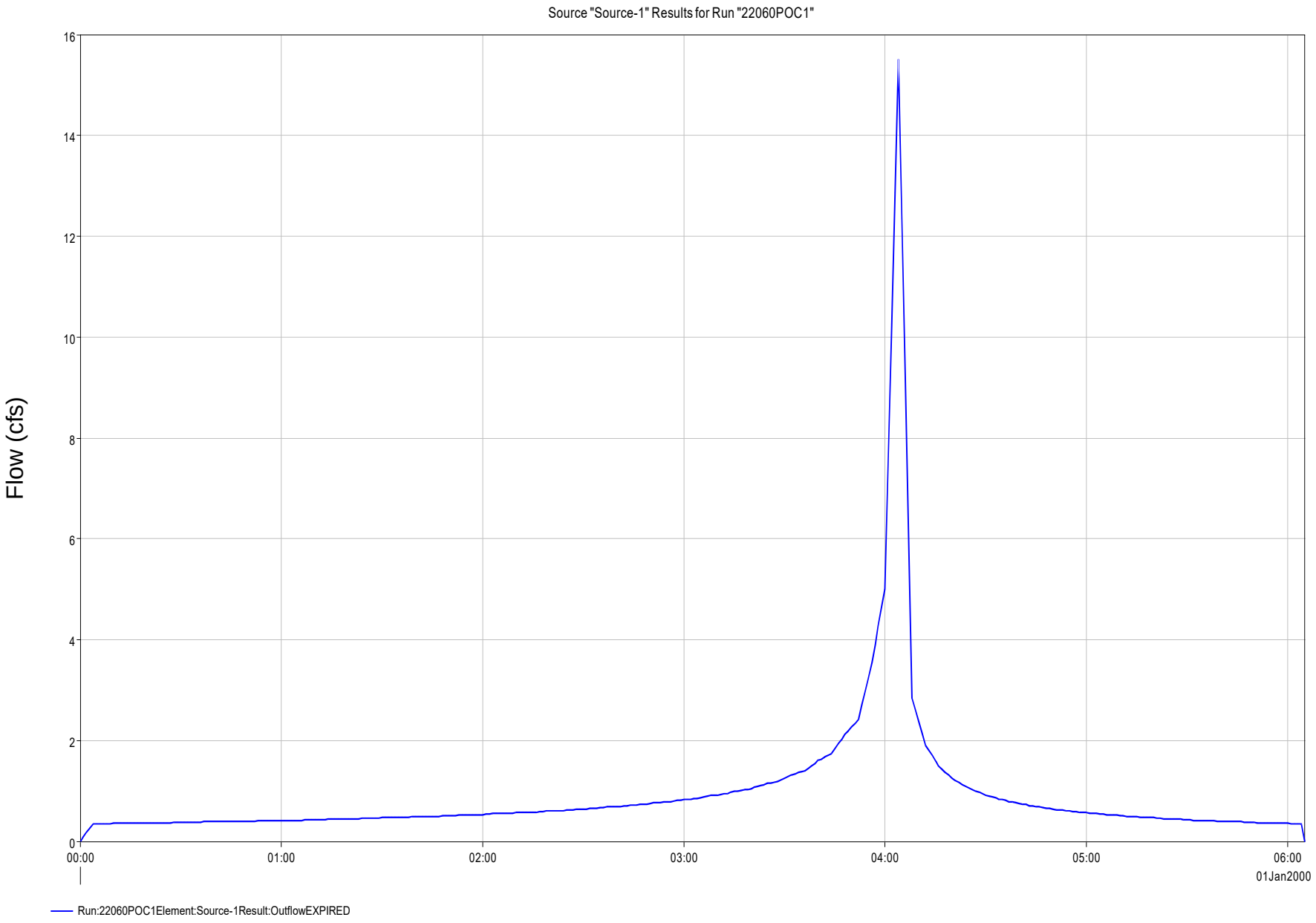
```
      Stream flow area =      0.099(Ac.)
      Runoff from this stream =      0.701(CFS)
      Time of concentration =    4.32 min.
      Rainfall intensity =     8.958(In/Hr)
      Summary of stream data:

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


      1        1.260      4.14             8.958
      2        0.701      4.32             8.958
      Qmax(1) =
             1.000 *    1.000 *     1.260) +
             1.000 *    0.960 *     0.701) + =       1.932
      Qmax(2) =
             1.000 *    1.000 *     1.260) +
             1.000 *    1.000 *     0.701) + =       1.960

      Total of 2 streams to confluence:
      Flow rates before confluence point:
             1.260       0.701
      Maximum flow rates at confluence using above data:
              1.932        1.960
      Area of streams before confluence:
              0.178        0.099
      Results of confluence:
      Total flow rate =      1.960(CFS)
      Time of concentration =     4.317 min.
      Effective stream area after confluence =      0.277(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      203.000 to Point/Station      105.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
      ----------------------------------------------------------------------
      Estimated mean flow rate at midpoint of channel =      2.589(CFS)
      Depth of flow =   0.274(Ft.), Average velocity =   2.905(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              1.30              0.11
          4             19.00              0.50
      Manning's 'N' friction factor =   0.015
      ----------------------------------------------------------------------
      Sub-Channel flow  =      2.589(CFS)
        '      '    flow top width =      8.724(Ft.)
        '      '    velocity=    2.905(Ft/s)
        '      '    area =      0.891(Sq.Ft)
        '      '    Froude number =     1.602

      Upstream point elevation =   587.570(Ft.)
      Downstream point elevation =   583.120(Ft.)
      Flow length =   237.000(Ft.)
      Travel time  =    1.36 min.
      Time of concentration =    5.68 min.
      Depth of flow =   0.274(Ft.)
      Average velocity =   2.905(Ft/s)
      Total irregular channel flow =     2.589(CFS)
      Irregular channel normal depth above invert elev. =   0.274(Ft.)
      Average velocity of channel(s) =   2.905(Ft/s)
       Adding area flow to channel
      Rainfall intensity (I) =      8.254(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 = 0.000
```

```
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Rainfall intensity =      8.254(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.790  CA =      0.382
Subarea runoff =      1.189(CFS) for      0.206(Ac.)
Total runoff =      3.149(CFS)  Total area =       0.483(Ac.)
Depth of flow =   0.289(Ft.), Average velocity =   3.045(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      0.483(Ac.)
Runoff from this stream =      3.149(CFS)
Time of concentration =    5.68 min.
Rainfall intensity =     8.254(In/Hr)
Summary of stream data:

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


1        1.140      6.25             7.755
2        3.149      5.68             8.254
Qmax(1) =
       1.000 *    1.000 *     1.140) +
       0.940 *    1.000 *     3.149) + =       4.099
Qmax(2) =
       1.000 *    0.908 *     1.140) +
       1.000 *    1.000 *     3.149) + =       4.184

Total of 2 main streams to confluence:
Flow rates before confluence point:
       1.140       3.149
Maximum flow rates at confluence using above data:
        4.099        4.184
Area of streams before confluence:
        2.190        0.483


Results of confluence:
Total flow rate =      4.184(CFS)
Time of concentration =     5.677 min.
Effective stream area after confluence  =      2.673(Ac.)
End of computations, total study area =          2.673 (Ac.)
```

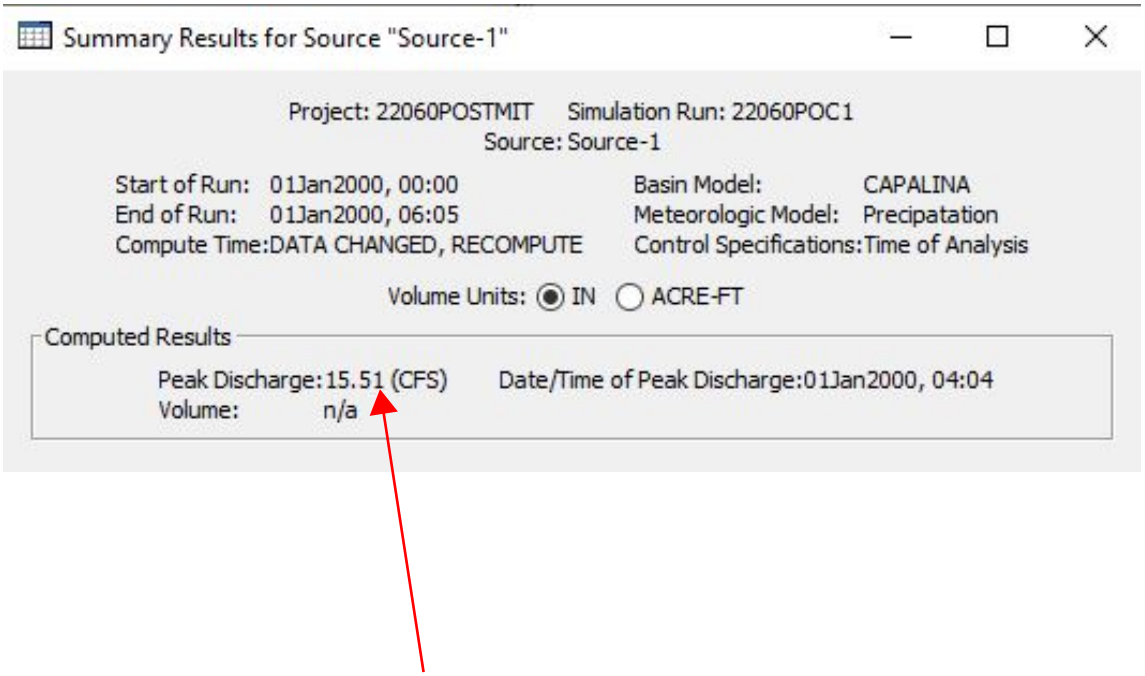
ATTACHMENT 7
HYDROGRAPH

7a. HEC-HMS Simulations Results

BMP-A INFLOW HYDROGRAPH

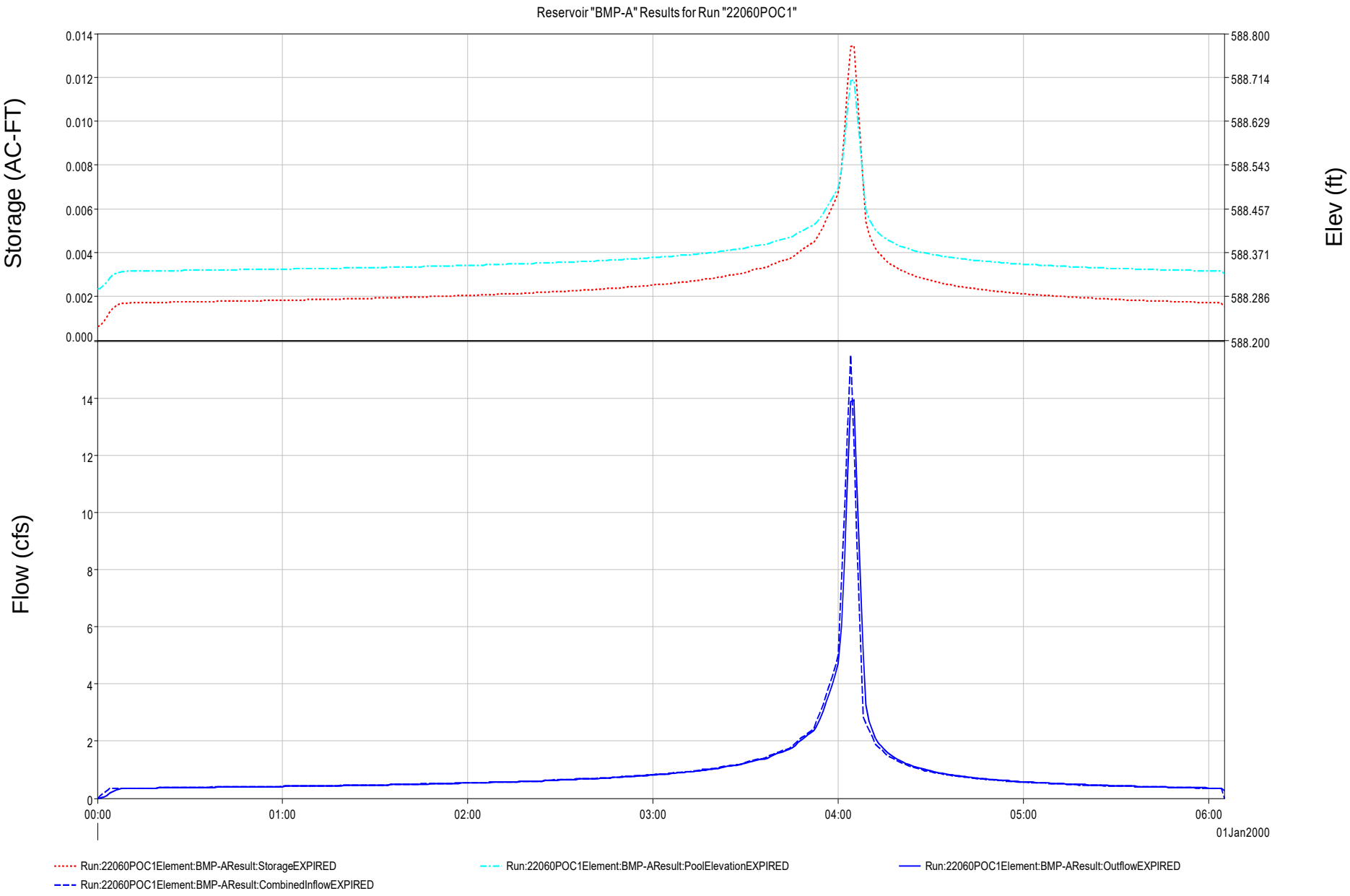


22060-CAPALINA-Q100 HYDRLOGY DETENTION INFLOW SUMMARY TABLE

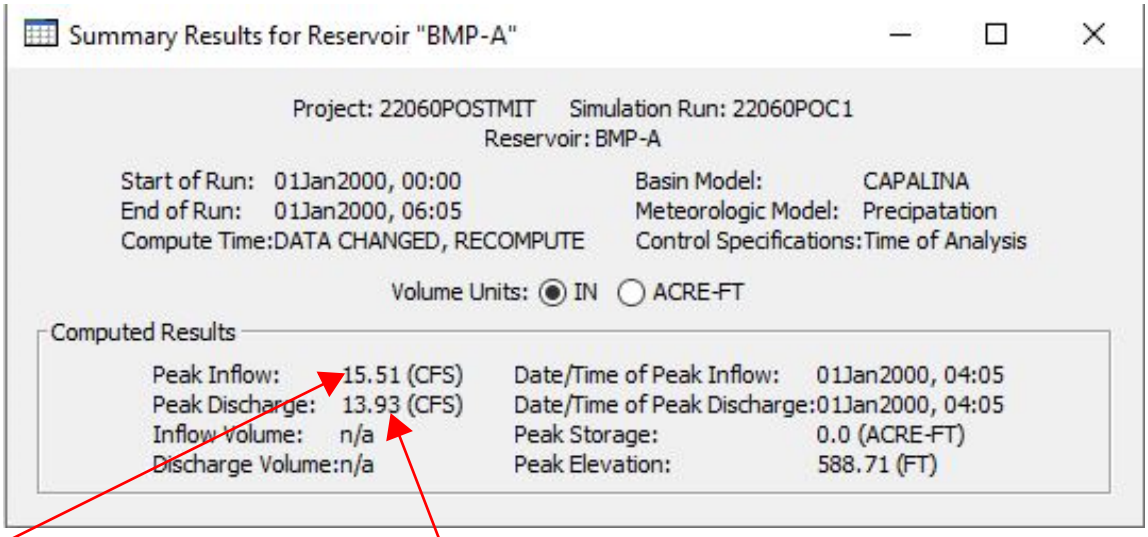


Inflow of BMP-A, which is consistent with CIVILD file of hydrograph for BMP-A. Please refer detail post development hydrograph for BMP-A to Attachment 6b of this report.

BMP-A INFLOW V.S. OUTFLOWHYDROGRAPH



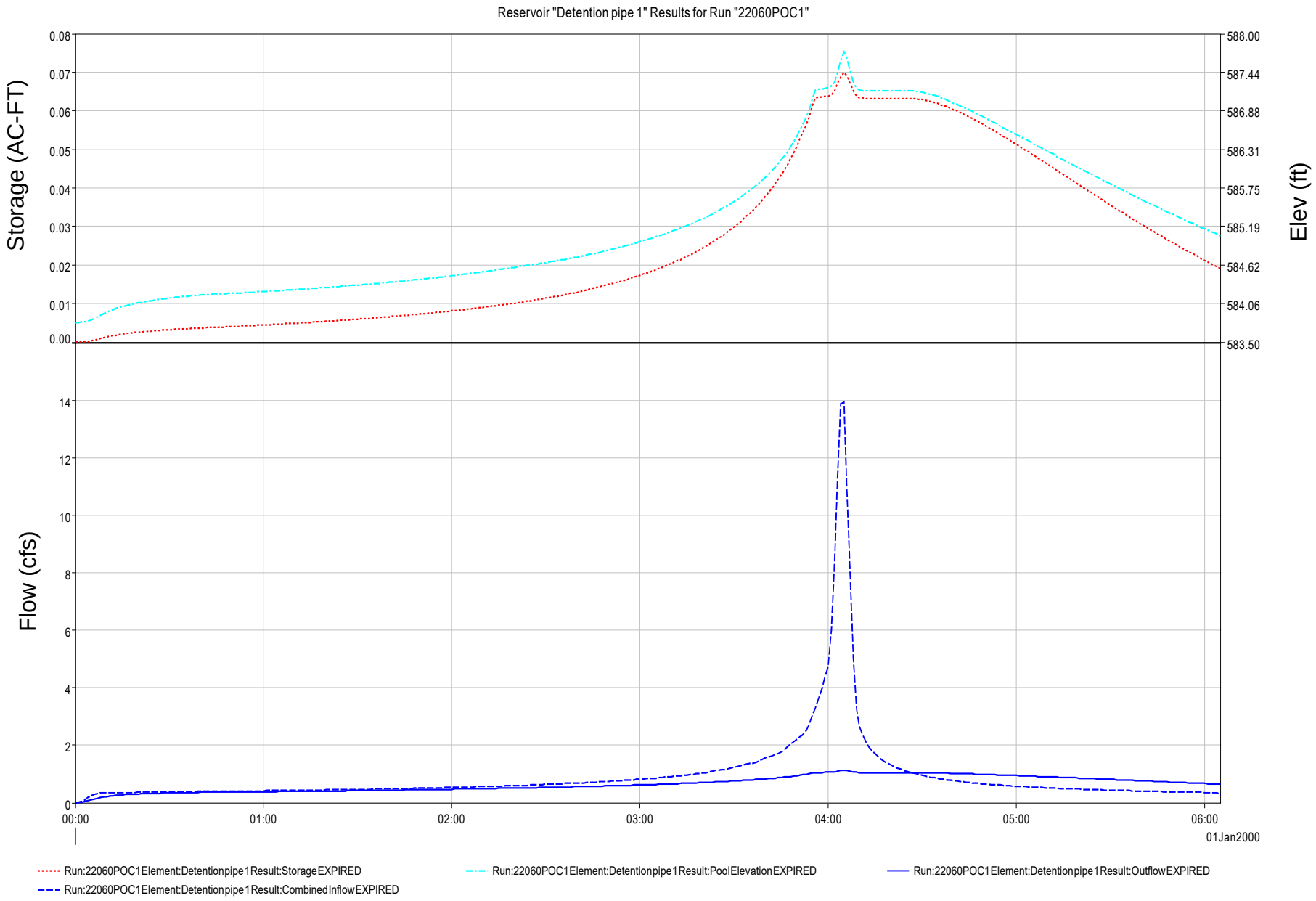
22060-CAPALINA-Q100 HYDRLOGY BMP-A OUTFLOW SUMMARY TABLE



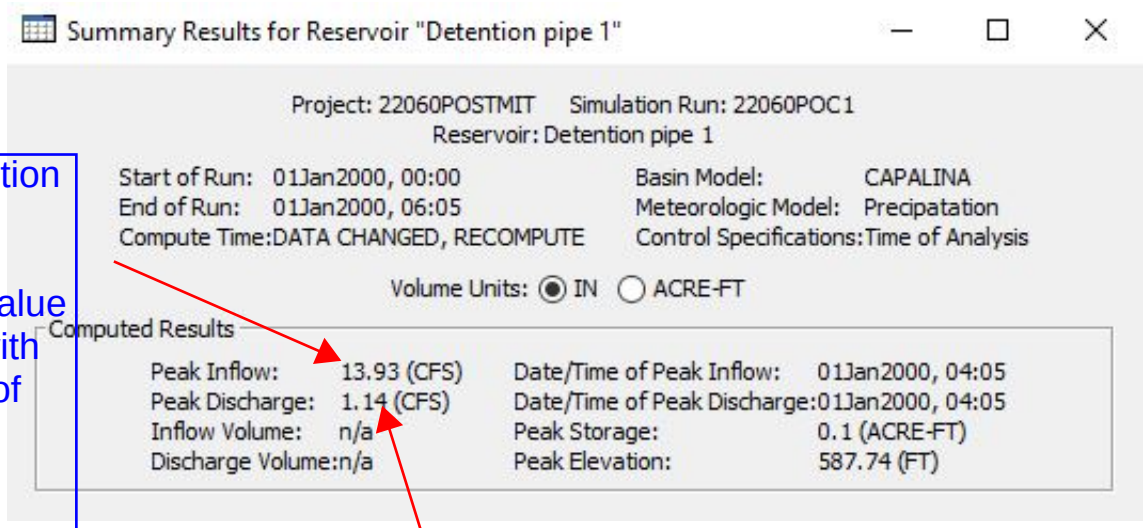
Inflow to BMP-A, which is consistent with CIVILD file of hydrograph for BMP-A. Please refer detail calculation of post development hydrograph for BMP-A to Attachment 6b of this report.

Outflow from BMP-A, which is also inflow to detention pipe.

DETENTION PIPE INFLOW V.S. OUTFLOW HYDROGRAPH



22060-CAPALINA-Q100 HYDRLOGY DETENTION PIPE SUMMARY TABLE



Inflow of detention pipe, which is outflow from BMP-A. This value is consistent with the last sheet of BMP-A SUMMARY TABLE.

Outflow of detention pipe. This will be the amount of discharge input in mitigation CIVILD file as user defined value. Please refer detail mitigation calculations in Attachment 6c of this report.

7b. Runoff Coefficient C After Detention Structure

CALCULATION AFTER THE DETENTION STRUCTURE

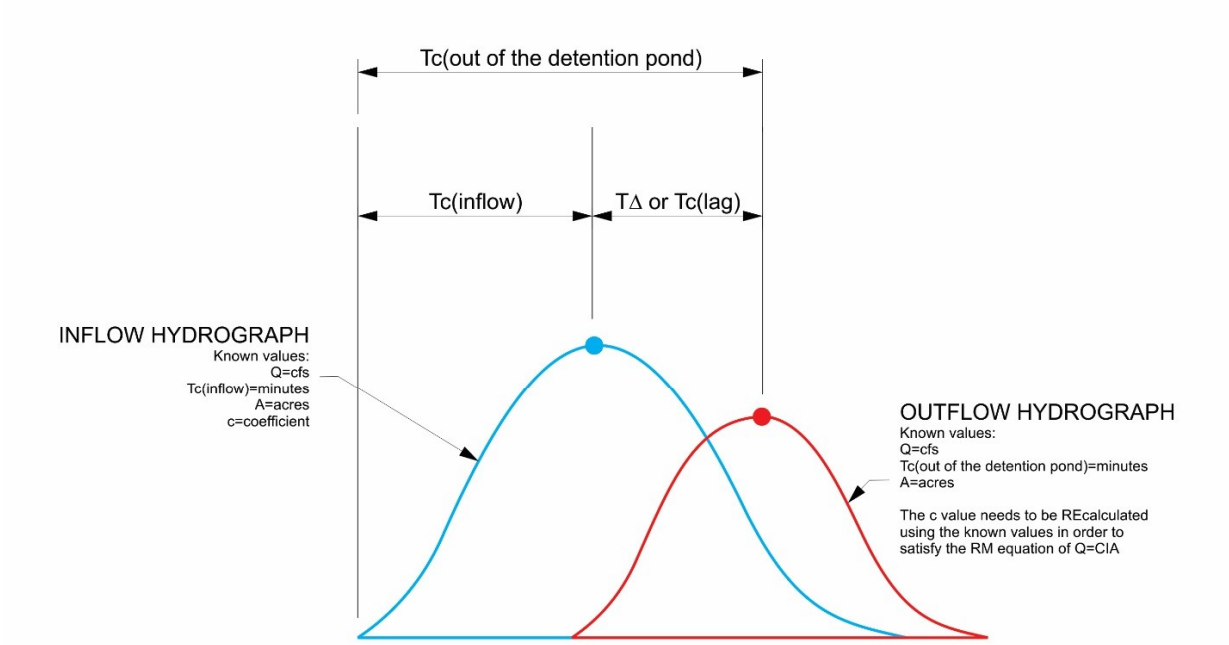
The purpose of the detention structure is to alter the peak flow and or time to peak of a given storm so it will not have a negative impact on the downstream facilities. There are different methods on how to use the resulting values of the outflow hydrograph.

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

CALCULATIONS For Nodes 802 to 802; BMP-802			
LINE	ITEM	AT THE OUTFLOW OF NODE 802	REMARKS
1	P6 inch	3.4	KNOWN VALUE
2	TC (inflow) mins	4.54	KNOWN VALUE
3	TC (lag) mins	1	FROM THE OUTFLOW HYDROGRAPH
4	TC (ouflow) mins	5.54	LINE 2+3
5	I inches/hour	8.385	FROM THE INTENSITY FORMULA
6	Q(outflow)	1.14	KNOWN VALUE
7	A (inflow=outflow)	2.19	KNOWN VALUE
8	c(inflow)	0.79	KNOWN VALUE FROM THE CONTRIBUTING BASIN(S)
9	c(outflow)	0.062	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.