



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

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DATE PREPARED:

6/12/2023

TABLE OF CONTENTS

1.0 Project Description

- 1.1 Project Purpose
- 1.2 Project Proposed facilities

2.0 Vicinity Map

3.0 Site Map

4.0 Description of Watershed

- 4.1 Existing Conditions Topography and Drainage Patterns
- 4.2 Post Conditions Topography and Drainage Patterns
- 4.3 Hydrologic Unit Contribution

5.0 Methodology

- 5.1 Hydrology Software
- 5.2 Routing Software
- 5.3 Soils Type Determination
- 5.4 Isopluvial Value Determination

6.0 Calculations

- 6.1 Calculate Runoff Coefficient
- 6.2 Manning Roughness Coefficient
- 6.3 Rational Method Calculation Summary

7.0 Summary

8.0 References

9.0 Declaration of Responsible Charge

10.0 Attachments

Attachment 1 – Site Map

Attachment 2 – Figures & Tables from the SD 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

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 storage 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.

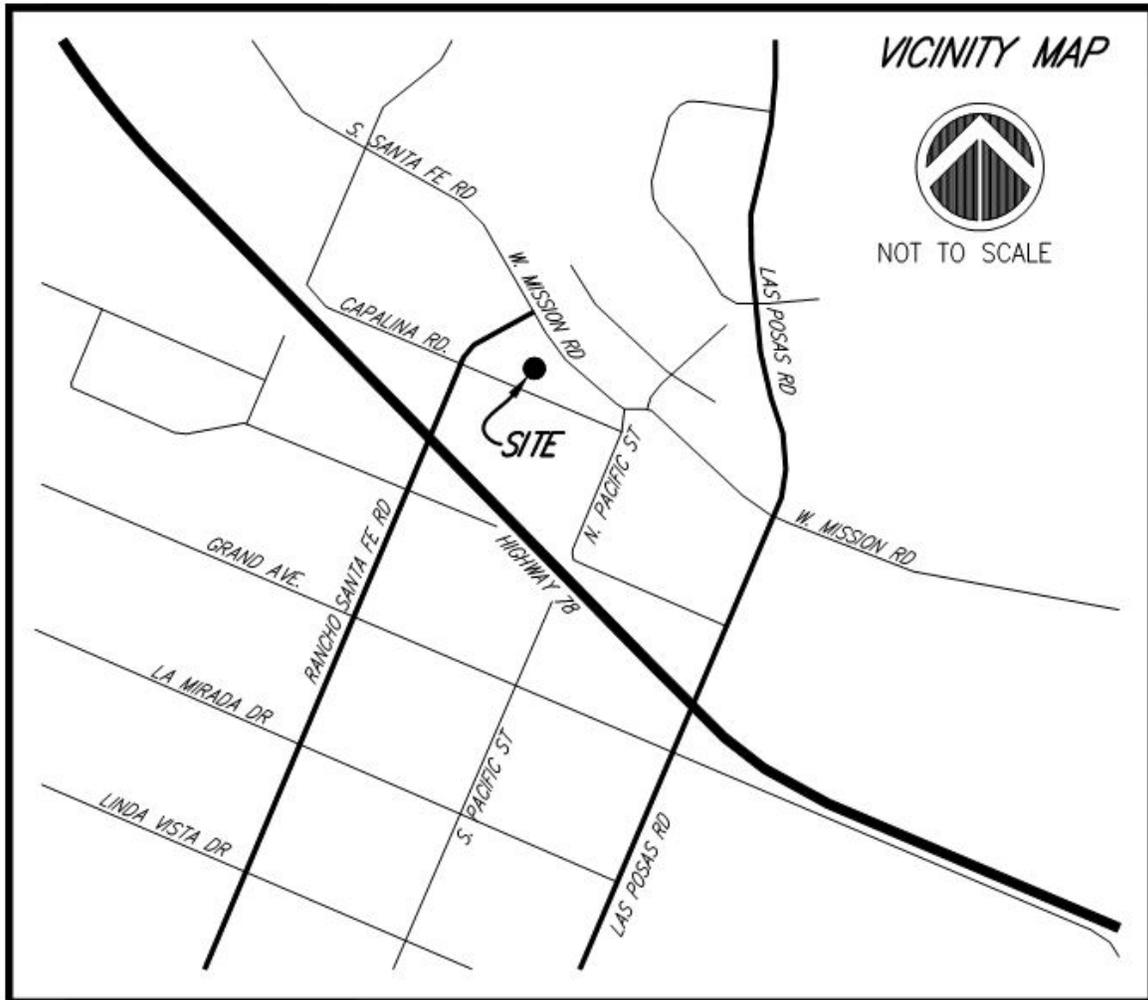


Fig. 1 Vicinity Map

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.

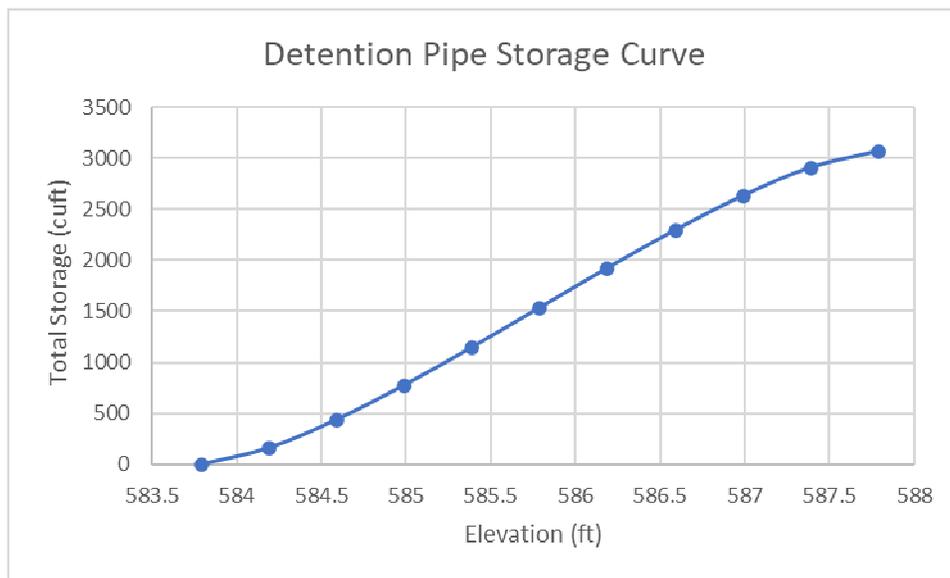


Fig. 2 – Detention Pipe Storage Cuve

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
Registration Expire: December 31, 2024

Date

ATTACHMENTS

Attachment 1 – Site Map

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Watershed Map

Soils Index Map

Soil Report

Rainfall Isopluvial Maps

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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

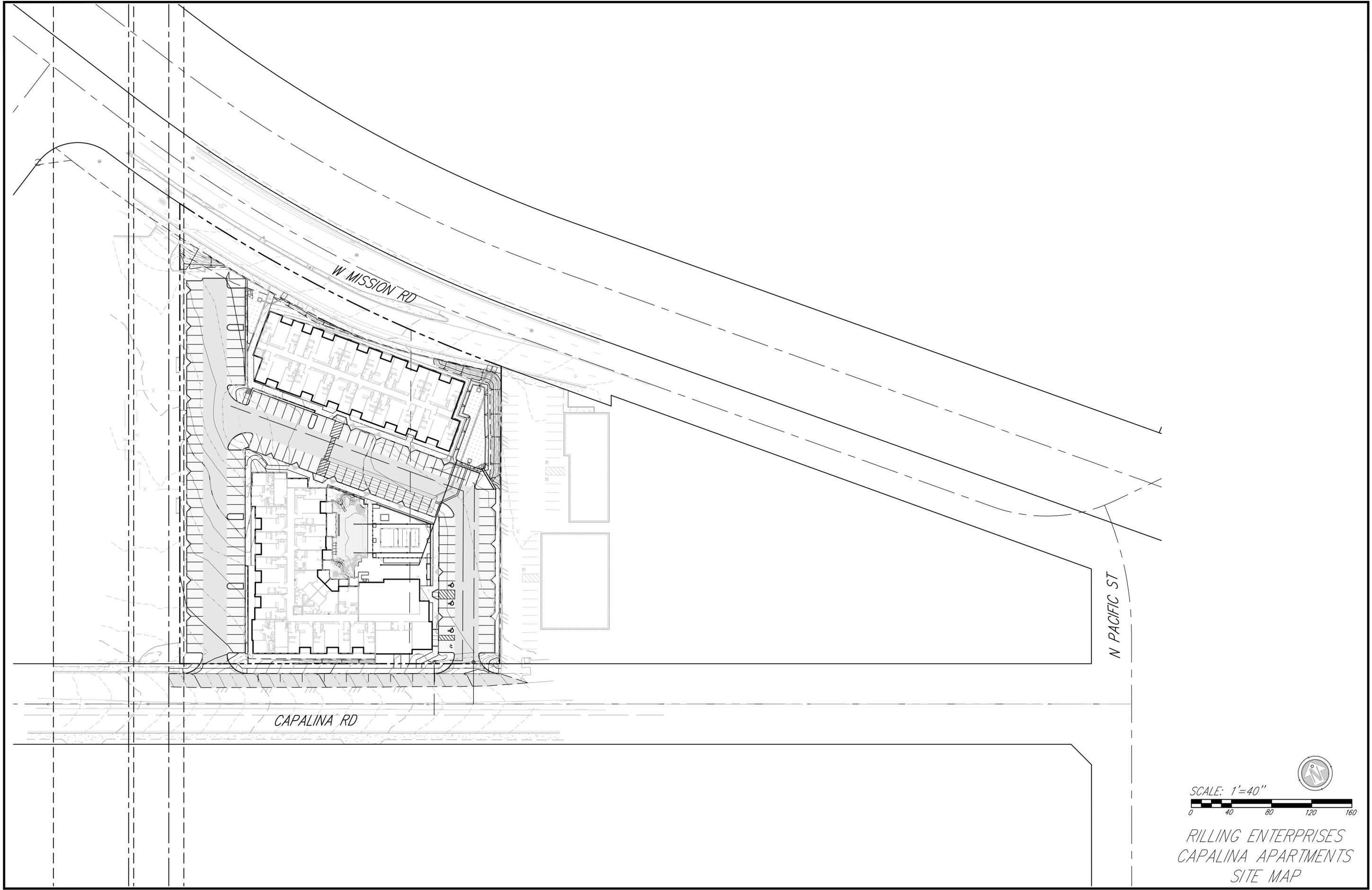
Attachment 7 – Hydrograph

7a. HEC-HMS Simulation Results

7b. Runoff Coefficient C After Detention Structure

ATTACHMENT 1
SITE MAP

K:\121\22060\Engineering\Storm-TM\Working Files\Hyd\22060 site map.dwg 10/7/2022 12:32 PM ORIGINAL PLOT SIZE: -----



W MISSION RD

N PACIFIC ST

CAPALINA RD

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.

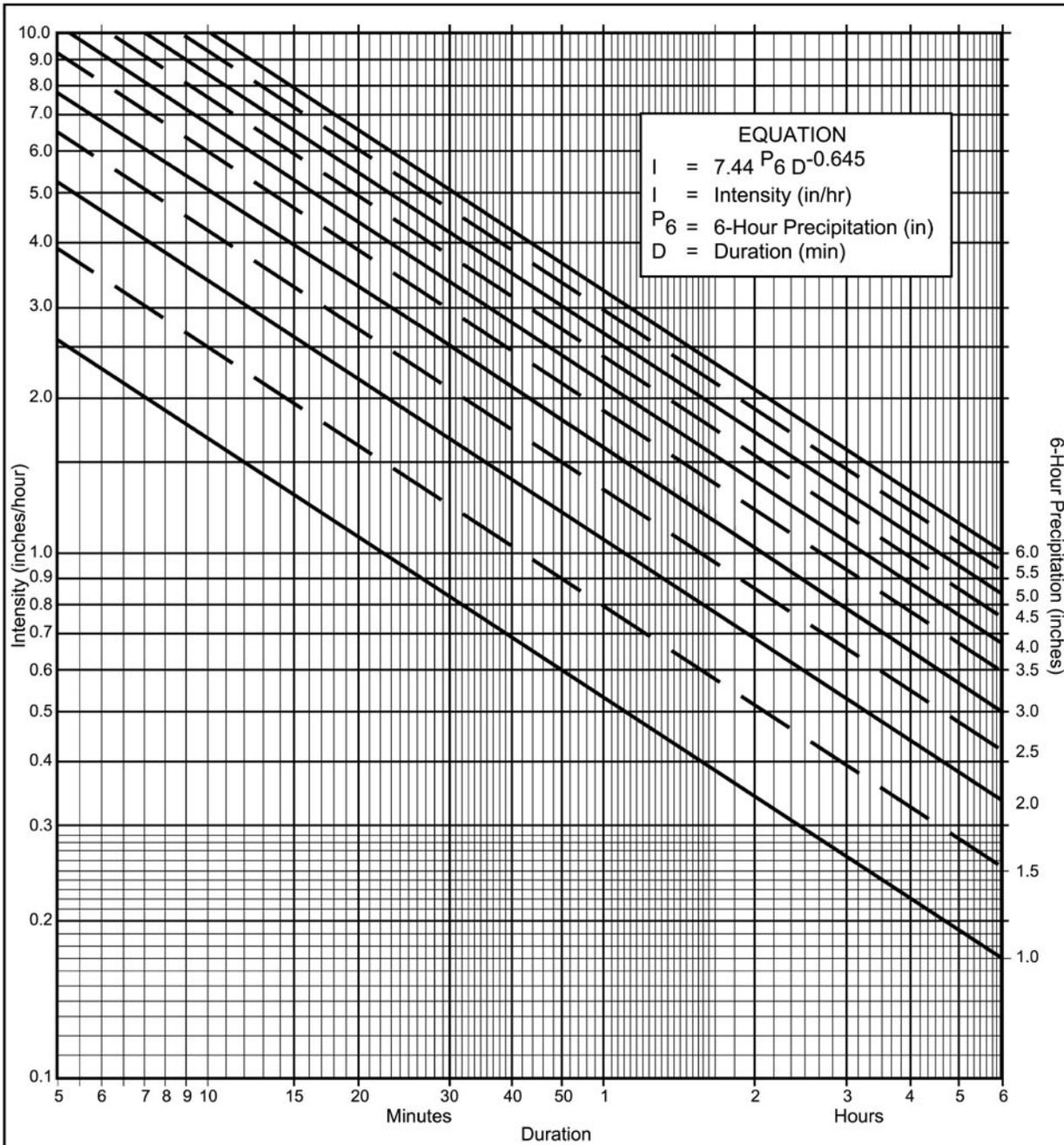
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved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

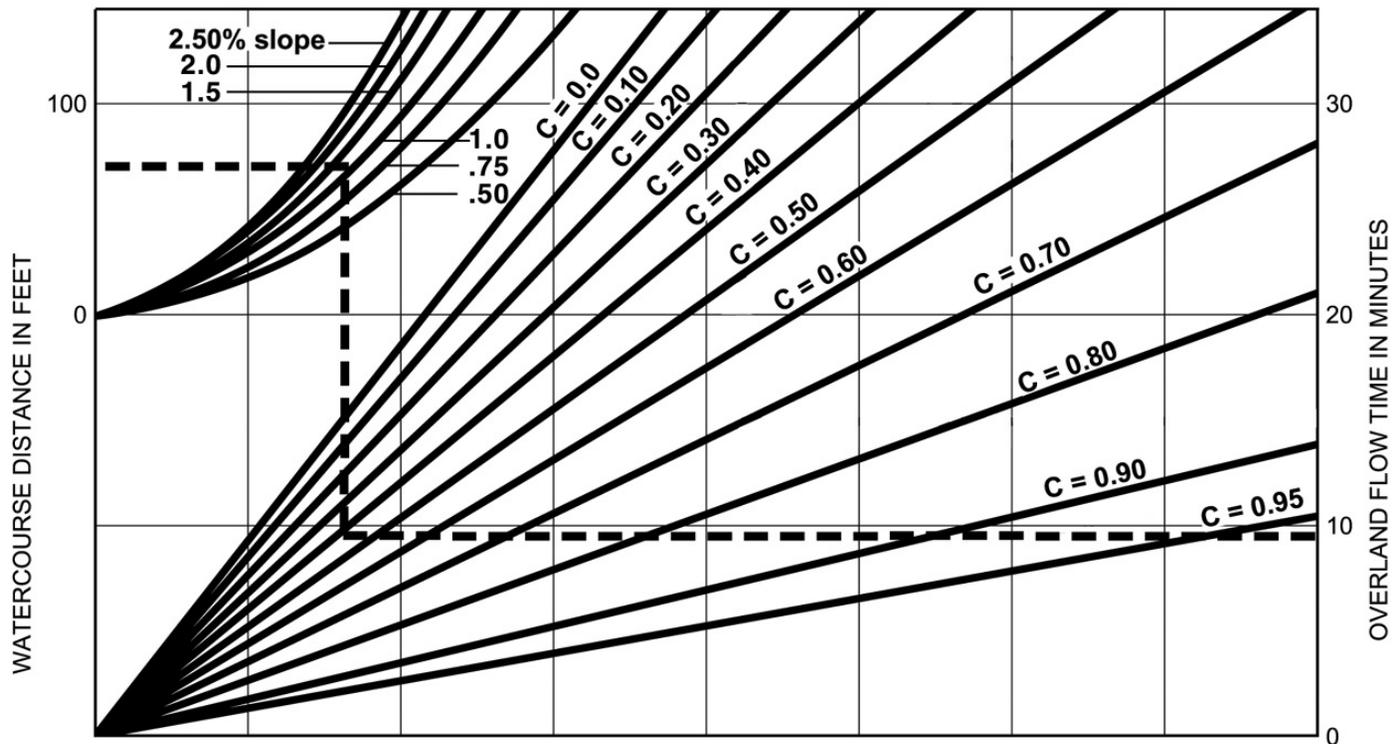
Application Form:

- (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											
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



EXAMPLE:

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

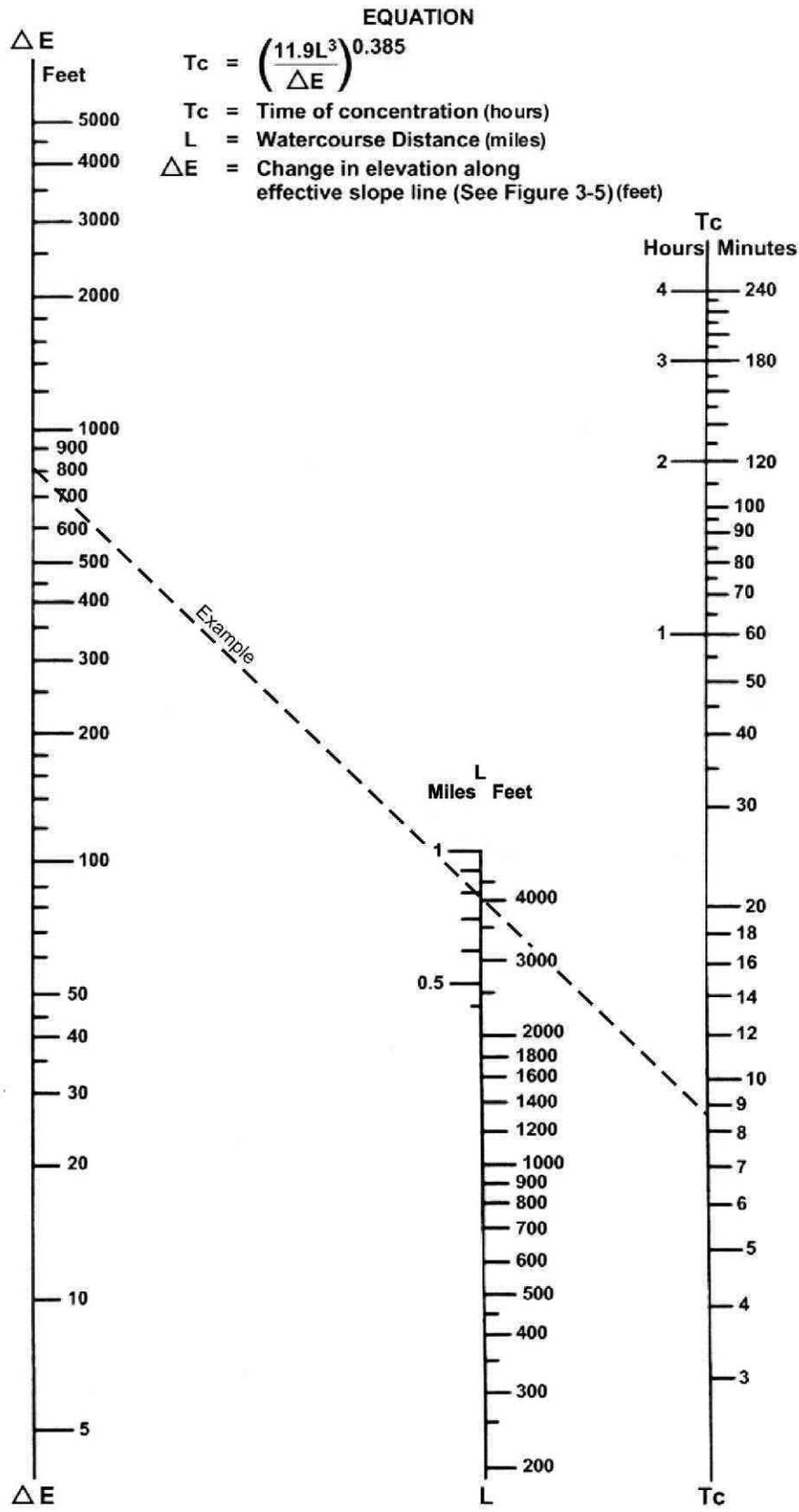
$$T = \frac{1.8 (1.1-C) \sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

F I G U R E

Rational Formula - Overland Time of Flow Nomograph

3-3

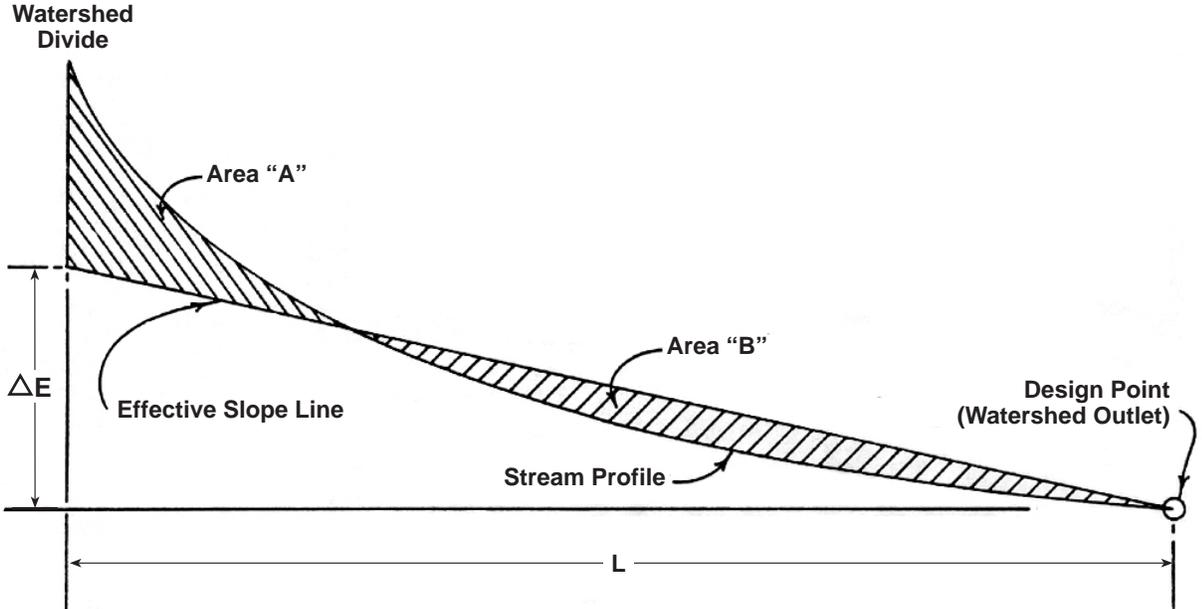
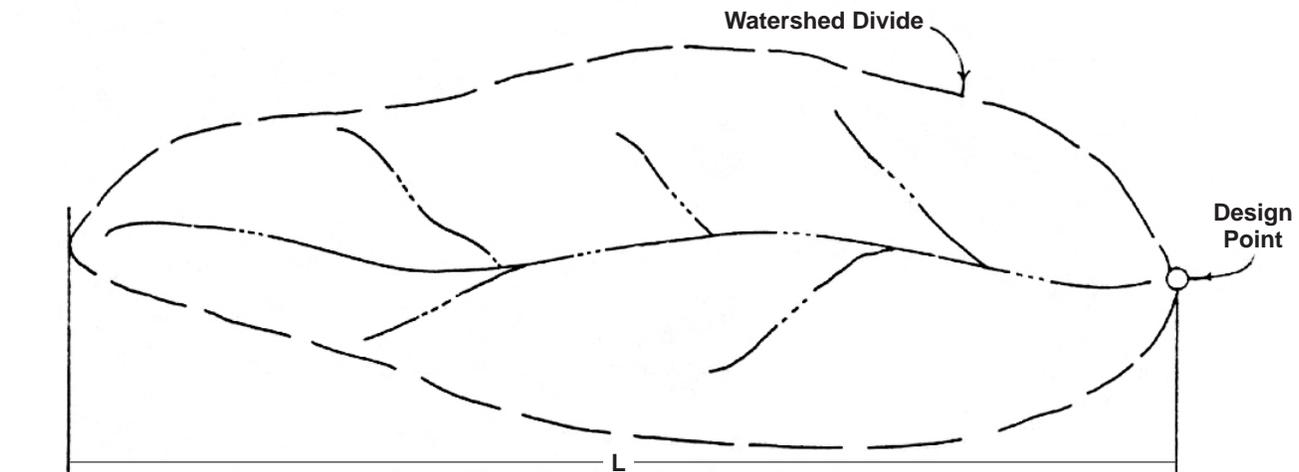


SOURCE: California Division of Highways (1941) and Kirpich (1940)

**Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds**

F I G U R E

3-4



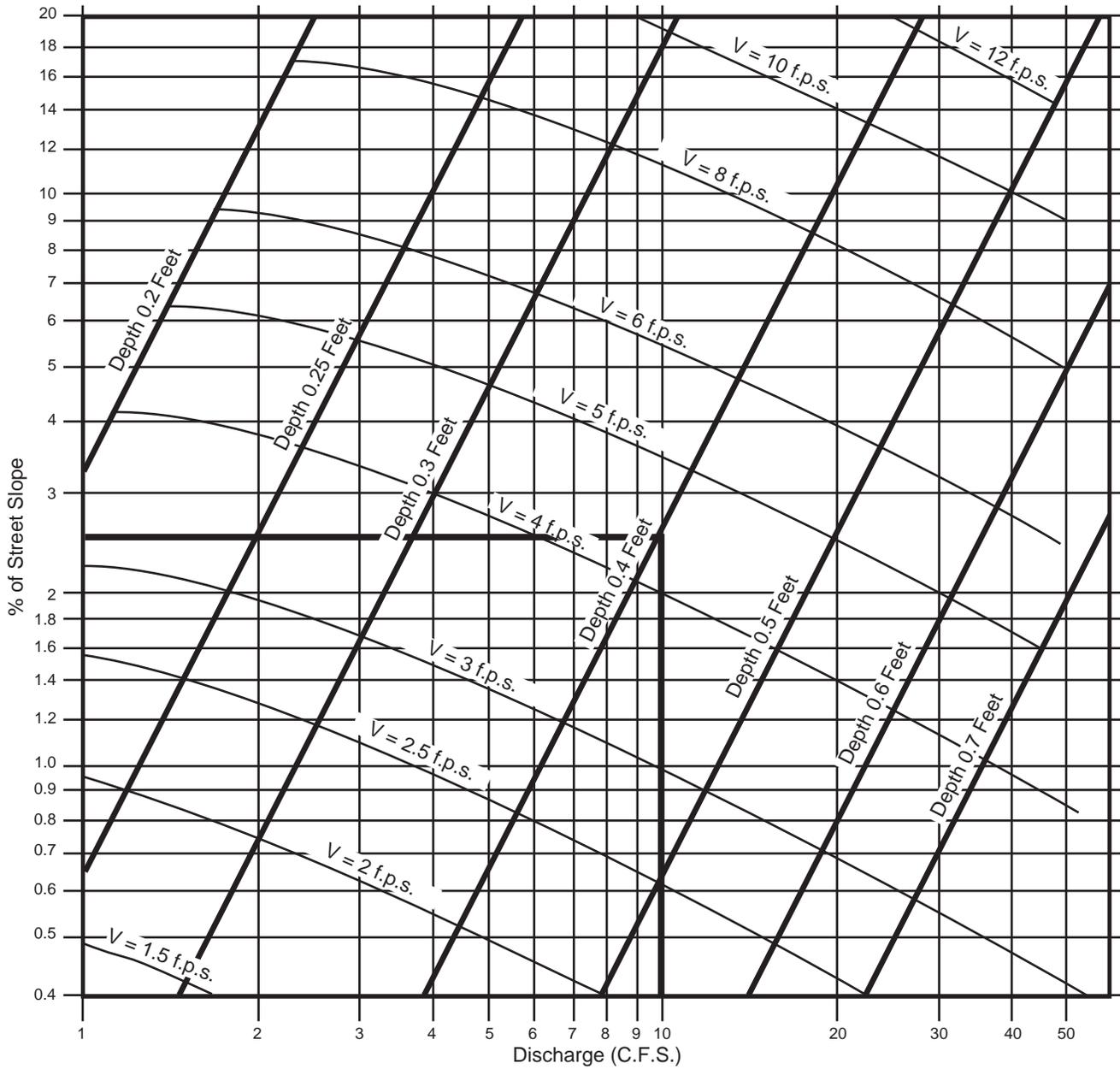
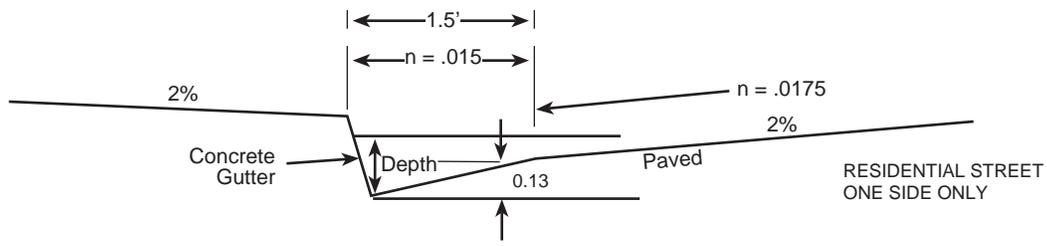
Area "A" = Area "B"

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

FIGURE

Computation of Effective Slope for Natural Watersheds

3-5



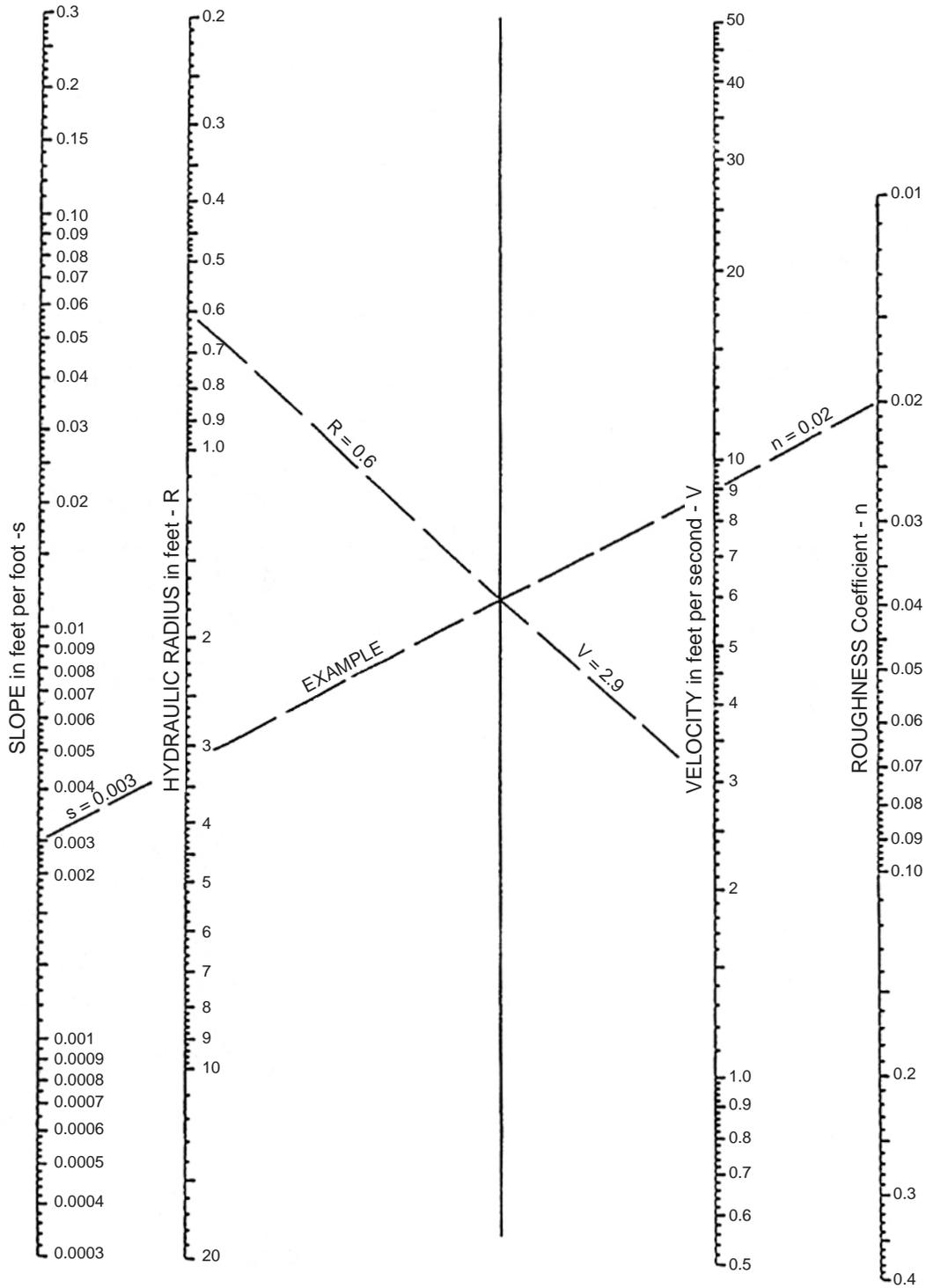
EXAMPLE:
 Given: $Q = 10$ $S = 2.5\%$
 Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

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

Gutter and Roadway Discharge - Velocity Chart

FIGURE
 3-6

EQUATION: $V = \frac{1.49}{n} R^{2/3} s^{1/2}$



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

Manning's Equation Nomograph

FIGURE

3-7

Table A-1 Average Manning Roughness Coefficients for Pavement and Gutters¹

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 Conduits³

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

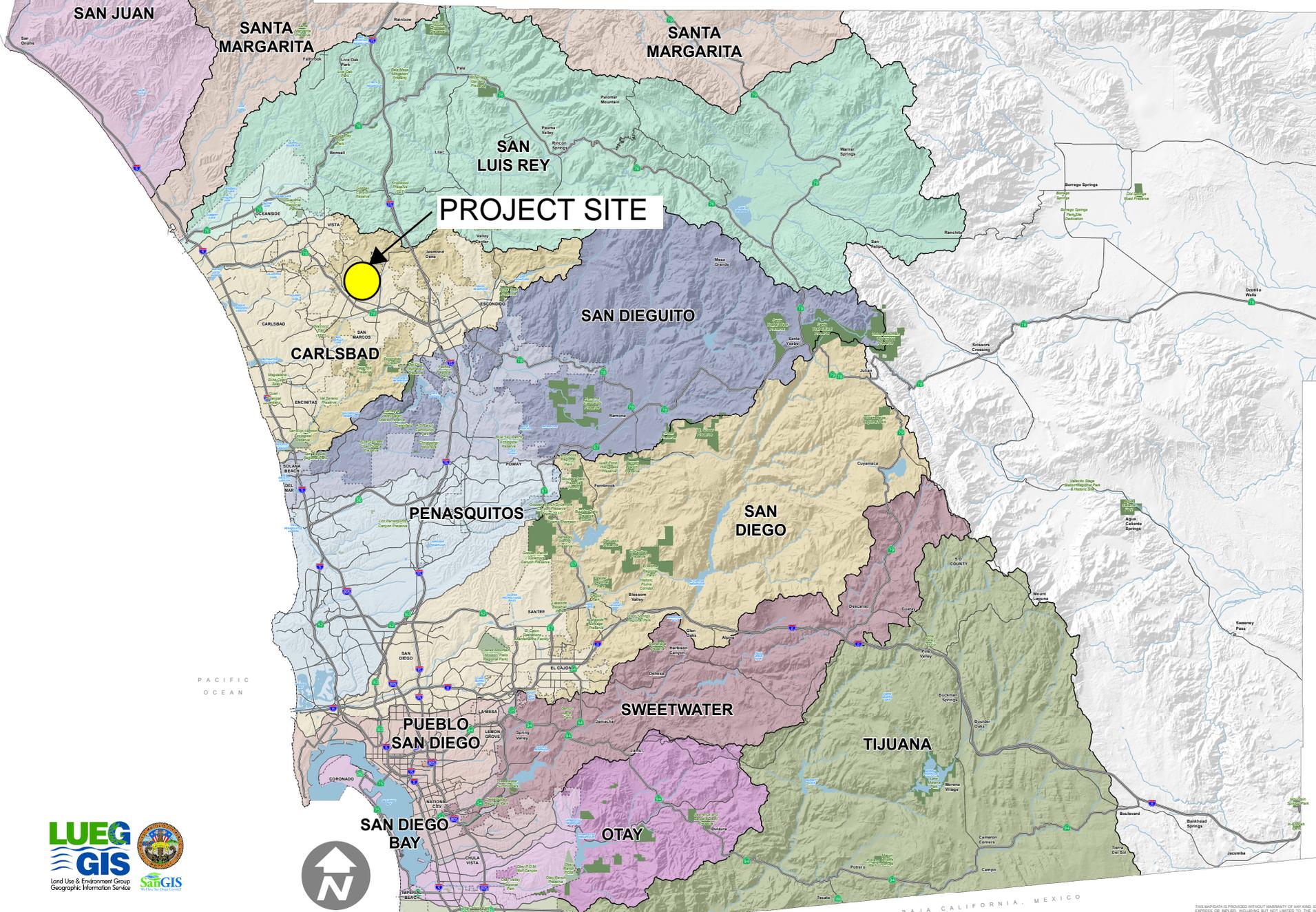
ATTACHMENT 3
WATERSHED INFORMATION
WATERSHED MAP

San Diego County Pacific Watersheds

ORANGE COUNTY

RIVERSIDE COUNTY

IMPERIAL COUNTY



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SOIL INDEX MAP

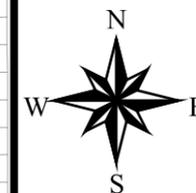
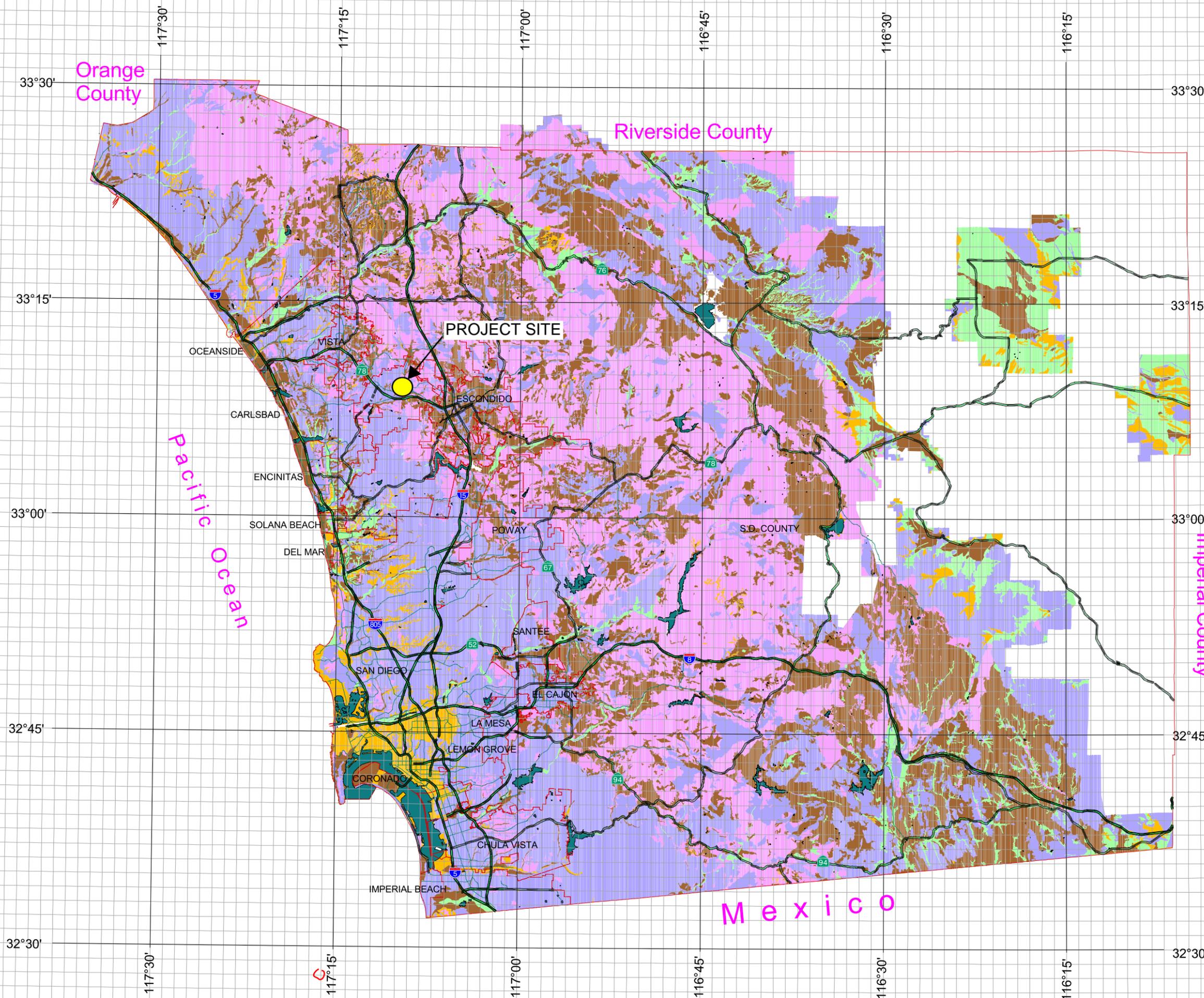
County of San Diego Hydrology Manual



Soil Hydrologic Groups

Legend

Soil Groups	
	Group A
	Group B
	Group C
	Group D
	Undetermined
	Data Unavailable



3 0 3 Miles

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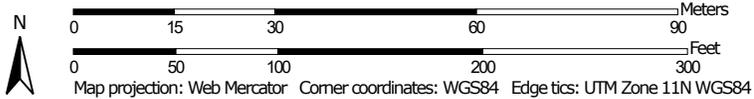
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SOIL REPORT

Hydrologic Soil Group—San Diego County Area, California



Map Scale: 1:1,120 if printed on A portrait (8.5" x 11") sheet.



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

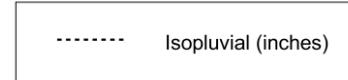
RAINFALL ISOPLUVIAL MAPS

County of San Diego Hydrology Manual



Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

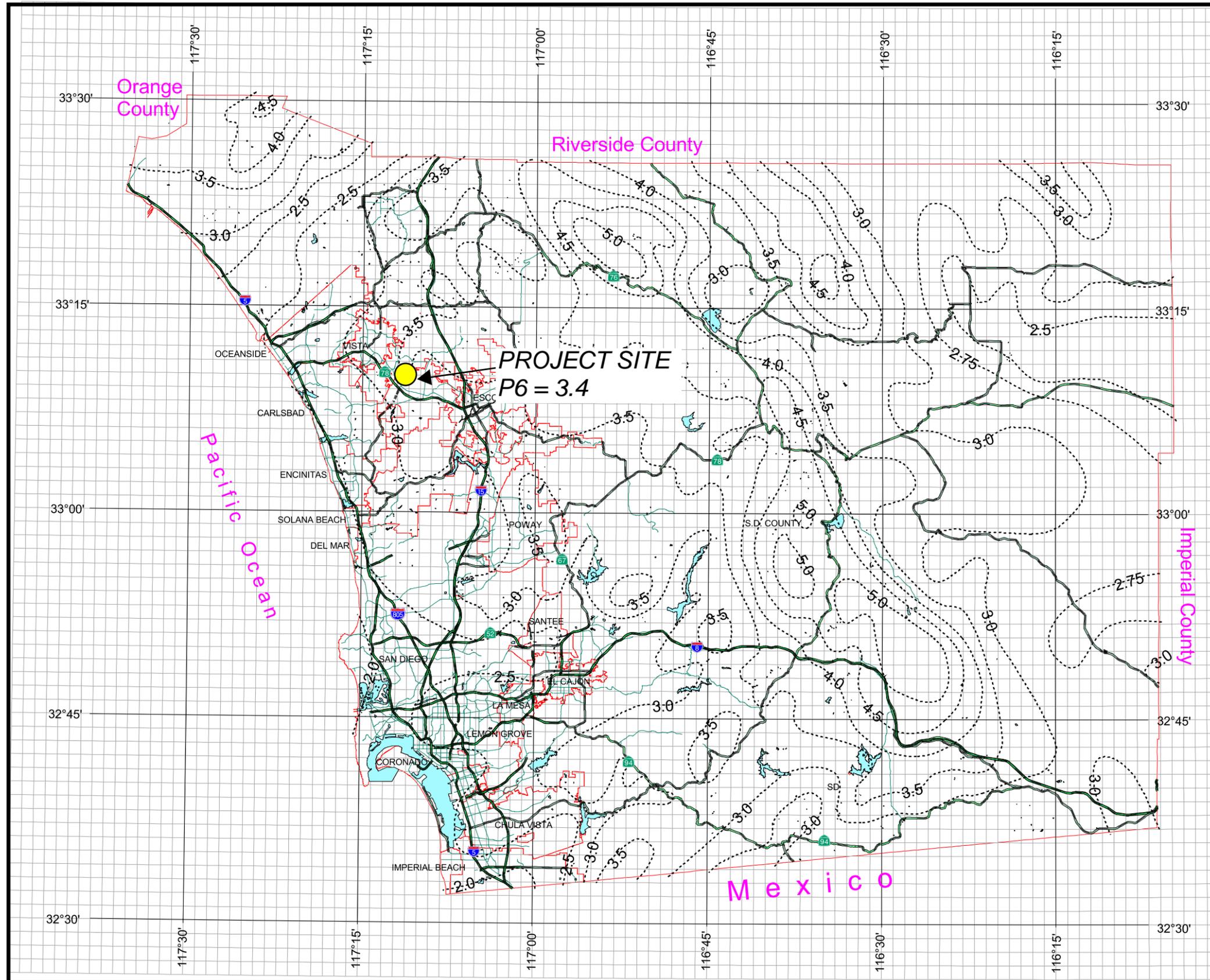


3 0 3 Miles

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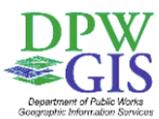


County of San Diego Hydrology Manual



Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours



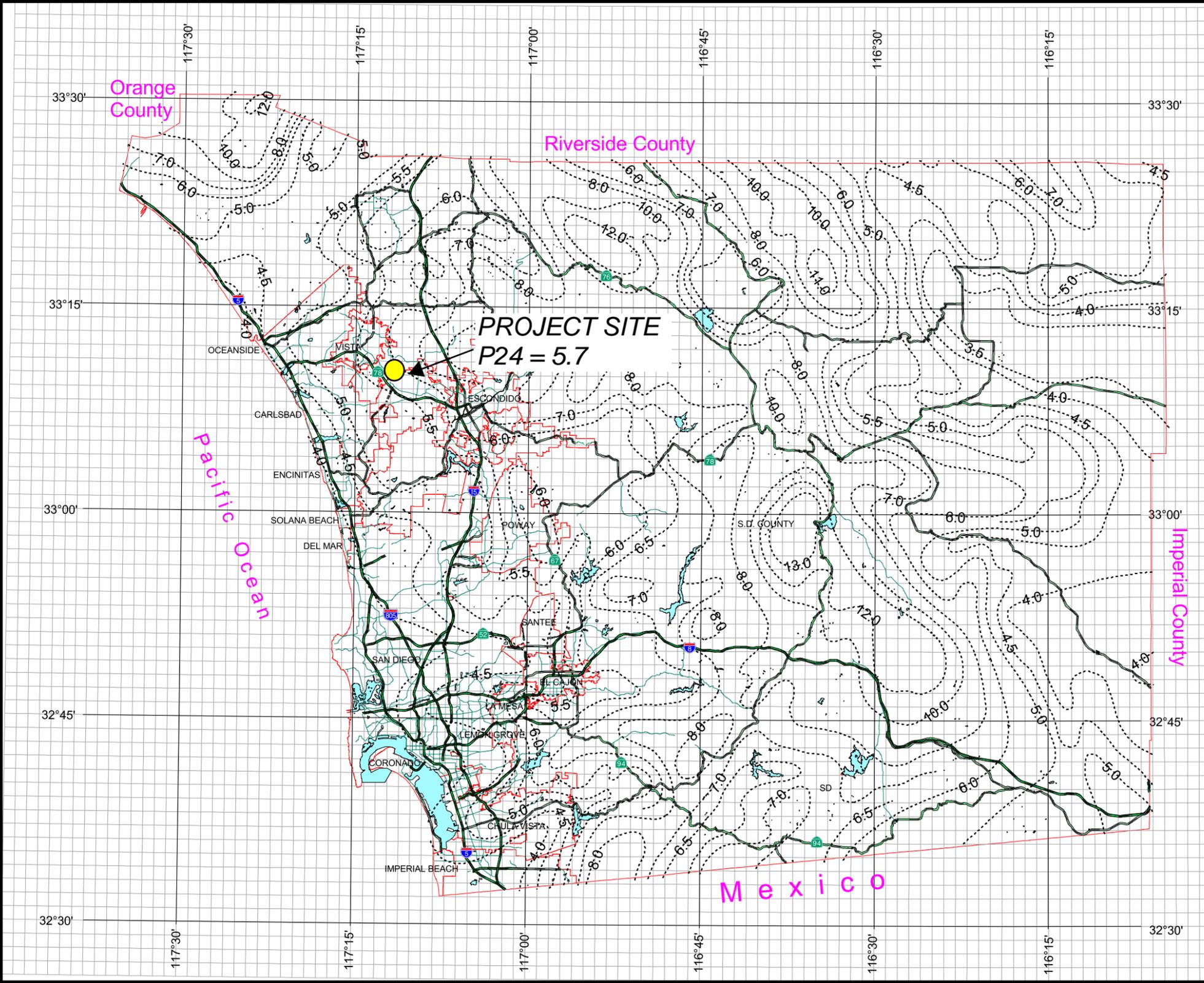
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PROJECT ISOPULIVIAL MAP



ATTACHMENT 4
PRE-DEVELOPMENT CONDITION EXHIBIT



LEGEND

- 101 NODE NUMBER
- \rightarrow SURFACE FLOW
- HYD BASIN BOUNDARY
- (xxx) ES EXISTING SURFACE ELEVATION

SCALE: 1"=40"



RILLING ENTERPRISES CAPALINA APARTMENTS PRE DEVELOPMENT HYDROLOGY EXHIBIT

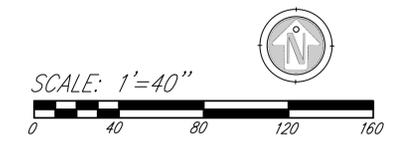
ATTACHMENT 5
POST-DEVELOPMENT CONDITION EXHIBIT

5a. Hydrology Map of Post-Development Condition Exhibit



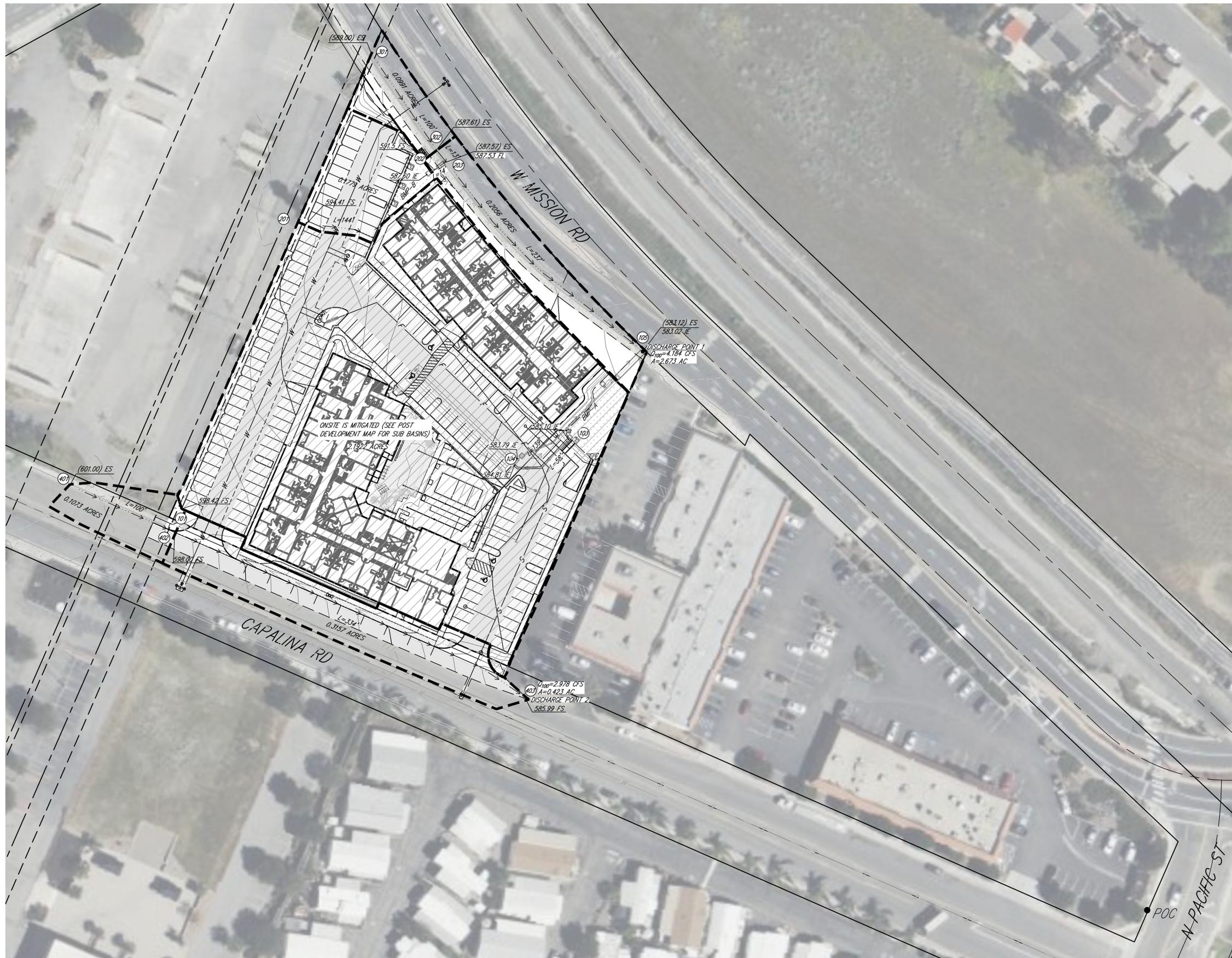
LEGEND

-  NODE NUMBER
-  SURFACE FLOW
-  PIPE FLOW
-  HYD BASIN BOUNDARY
-  EXISTING SURFACE ELEVATION
-  FINISH SURFACE ELEVATION



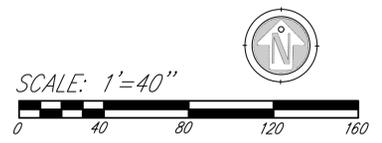
RILLING ENTERPRISES CAPALINA APARTMENTS POST DEVELOPMENT HYDROLOGY EXHIBIT

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



LEGEND

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



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 **Q₁₀₀**. The results are outlined/summarized in Section 6.

6a. CivilD Pre-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: 09/29/22

22060 PRE 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 = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 601.000(Ft.)
Lowest elevation = 597.300(Ft.)
Elevation difference = 3.700(Ft.) Slope = 3.700 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 3.70 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 9.31 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3000)*(100.000^0.5)]/(3.700^(1/3))= 9.31
Rainfall intensity (I) = 5.999(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.050(CFS)
Total initial stream area = 0.028(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 = 2.277(CFS)
Depth of flow = 0.767(Ft.), Average velocity = 3.867(Ft/s)
***** Irregular Channel Data *****

```

70 -----
71 Information entered for subchannel number 1 :
72 Point number      'X' coordinate      'Y' coordinate
73     1              0.00              1.00
74     2              1.00              0.00
75     3              2.00              1.00
76 Manning's 'N' friction factor = 0.030
77 -----
78 Sub-Channel flow = 2.277(CFS)
79 '   '   flow top width = 1.535(Ft.)
80 '   '   velocity= 3.867(Ft/s)
81 '   '   area = 0.589(Sq.Ft)
82 '   '   Froude number = 1.100
83
84 Upstream point elevation = 597.300(Ft.)
85 Downstream point elevation = 582.790(Ft.)
86 Flow length = 418.000(Ft.)
87 Travel time = 1.80 min.
88 Time of concentration = 11.11 min.
89 Depth of flow = 0.767(Ft.)
90 Average velocity = 3.867(Ft/s)
91 Total irregular channel flow = 2.277(CFS)
92 Irregular channel normal depth above invert elev. = 0.767(Ft.)
93 Average velocity of channel(s) = 3.867(Ft/s)
94 Adding area flow to channel
95 Rainfall intensity (I) = 5.352(In/Hr) for a 100.0 year storm
96 Decimal fraction soil group A = 0.000
97 Decimal fraction soil group B = 0.000
98 Decimal fraction soil group C = 0.000
99 Decimal fraction soil group D = 1.000
100 [UNDISTURBED NATURAL TERRAIN ]
101 (Permanent Open Space )
102 Impervious value, Ai = 0.000
103 Sub-Area C Value = 0.350
104 Rainfall intensity = 5.352(In/Hr) for a 100.0 year storm
105 Effective runoff coefficient used for total area
106 (Q=KCIA) is C = 0.349 CA = 0.858
107 Subarea runoff = 4.541(CFS) for 2.427(Ac.)
108 Total runoff = 4.591(CFS) Total area = 2.455(Ac.)
109 Depth of flow = 0.998(Ft.), Average velocity = 4.609(Ft/s)
110
111
112 *****
113 Process from Point/Station 103.000 to Point/Station 103.000
114 **** CONFLUENCE OF MINOR STREAMS ****
115
116 -----
117 Along Main Stream number: 1 in normal stream number 1
118 Stream flow area = 2.455(Ac.)
119 Runoff from this stream = 4.591(CFS)
120 Time of concentration = 11.11 min.
121 Rainfall intensity = 5.352(In/Hr)
122
123 *****
124 Process from Point/Station 201.000 to Point/Station 202.000
125 **** INITIAL AREA EVALUATION ****
126
127 -----
128 Decimal fraction soil group A = 0.000
129 Decimal fraction soil group B = 0.000
130 Decimal fraction soil group C = 0.000
131 Decimal fraction soil group D = 1.000
132 [HIGH DENSITY RESIDENTIAL ]
133 (43.0 DU/A or Less )
134 Impervious value, Ai = 0.800
135 Sub-Area C Value = 0.790
136 Initial subarea total flow distance = 100.000(Ft.)
137 Highest elevation = 589.000(Ft.)
138 Lowest elevation = 587.420(Ft.)
139 Elevation difference = 1.580(Ft.) Slope = 1.580 %

```

```

139 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
140 The maximum overland flow distance is 75.00 (Ft)
141 for the top area slope value of 1.58 %, in a development type of
142 43.0 DU/A or Less
143 In Accordance With Figure 3-3
144 Initial Area Time of Concentration = 4.15 minutes
145 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
146 TC = [1.8*(1.1-0.7900)*( 75.000^.5)/( 1.580^(1/3))]= 4.15
147 Calculated TC of 4.149 minutes is less than 5 minutes,
148 resetting TC to 5.0 minutes for rainfall intensity calculations
149 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
150 Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
151 Subarea runoff = 0.729(CFS)
152 Total initial stream area = 0.103(Ac.)
153
154
155 ++++++
156 Process from Point/Station 202.000 to Point/Station 103.000
157 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
158
159 -----
160 Estimated mean flow rate at midpoint of channel = 1.188(CFS)
161 Depth of flow = 0.221(Ft.), Average velocity = 2.398(Ft/s)
162 ***** Irregular Channel Data *****
163 -----
164 Information entered for subchannel number 1 :
165 Point number 'X' coordinate 'Y' coordinate
166 1 0.00 0.50
167 2 0.00 0.00
168 3 1.30 0.11
169 4 19.00 0.50
170 Manning's 'N' friction factor = 0.015
171 -----
172 Sub-Channel flow = 1.188(CFS)
173 ' ' flow top width = 6.338(Ft.)
174 ' ' velocity= 2.398(Ft/s)
175 ' ' area = 0.495(Sq.Ft)
176 ' ' Froude number = 1.512
177
178 Upstream point elevation = 587.420(Ft.)
179 Downstream point elevation = 582.790(Ft.)
180 Flow length = 252.000(Ft.)
181 Travel time = 1.75 min.
182 Time of concentration = 5.90 min.
183 Depth of flow = 0.221(Ft.)
184 Average velocity = 2.398(Ft/s)
185 Total irregular channel flow = 1.188(CFS)
186 Irregular channel normal depth above invert elev. = 0.221(Ft.)
187 Average velocity of channel(s) = 2.398(Ft/s)
188 Adding area flow to channel
189 Rainfall intensity (I) = 8.051(In/Hr) for a 100.0 year storm
190 Decimal fraction soil group A = 0.000
191 Decimal fraction soil group B = 0.000
192 Decimal fraction soil group C = 0.000
193 Decimal fraction soil group D = 1.000
194 [HIGH DENSITY RESIDENTIAL ]
195 (43.0 DU/A or Less )
196 Impervious value, Ai = 0.800
197 Sub-Area C Value = 0.790
198 Rainfall intensity = 8.051(In/Hr) for a 100.0 year storm
199 Effective runoff coefficient used for total area
200 (Q=KCIA) is C = 0.790 CA = 0.194
201 Subarea runoff = 0.829(CFS) for 0.142(Ac.)
202 Total runoff = 1.558(CFS) Total area = 0.245(Ac.)
203 Depth of flow = 0.238(Ft.), Average velocity = 2.554(Ft/s)
204
205 ++++++
206 Process from Point/Station 103.000 to Point/Station 103.000
207 **** CONFLUENCE OF MINOR STREAMS ****

```

208
209 Along Main Stream number: 1 in normal stream number 2
210 Stream flow area = 0.245(Ac.)
211 Runoff from this stream = 1.558(CFS)
212 Time of concentration = 5.90 min.
213 Rainfall intensity = 8.051(In/Hr)
214 Summary of stream data:
215
216 Stream Flow rate TC Rainfall Intensity
217 No. (CFS) (min) (In/Hr)
218
219
220 1 4.591 11.11 5.352
221 2 1.558 5.90 8.051
222 Qmax(1) =
223 1.000 * 1.000 * 4.591) +
224 0.665 * 1.000 * 1.558) + = 5.627
225 Qmax(2) =
226 1.000 * 0.531 * 4.591) +
227 1.000 * 1.000 * 1.558) + = 3.996
228
229 Total of 2 streams to confluence:
230 Flow rates before confluence point:
231 4.591 1.558
232 Maximum flow rates at confluence using above data:
233 5.627 3.996
234 Area of streams before confluence:
235 2.455 0.245
236 Results of confluence:
237 Total flow rate = 5.627(CFS)
238 Time of concentration = 11.112 min.
239 Effective stream area after confluence = 2.700(Ac.)
240 End of computations, total study area = 2.700 (Ac.)
241
242
243

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)

```

70 Depth of flow = 0.598(Ft.), Average velocity = 3.250(Ft/s)
71 ***** Irregular Channel Data *****
72 -----
73 Information entered for subchannel number 1 :
74 Point number 'X' coordinate 'Y' coordinate
75 1 0.00 1.00
76 2 1.00 0.00
77 3 2.00 1.00
78 Manning's 'N' friction factor = 0.030
79 -----
80 Sub-Channel flow = 1.162(CFS)
81 ' ' flow top width = 1.196(Ft.)
82 ' ' velocity= 3.250(Ft/s)
83 ' ' area = 0.358(Sq.Ft)
84 ' ' Froude number = 1.047
85
86 Upstream point elevation = 597.520(Ft.)
87 Downstream point elevation = 586.000(Ft.)
88 Flow length = 337.000(Ft.)
89 Travel time = 1.73 min.
90 Time of concentration = 5.23 min.
91 Depth of flow = 0.598(Ft.)
92 Average velocity = 3.250(Ft/s)
93 Total irregular channel flow = 1.162(CFS)
94 Irregular channel normal depth above invert elev. = 0.598(Ft.)
95 Average velocity of channel(s) = 3.250(Ft/s)
96 Adding area flow to channel
97 Rainfall intensity (I) = 8.699(In/Hr) for a 100.0 year storm
98 Decimal fraction soil group A = 0.000
99 Decimal fraction soil group B = 0.000
100 Decimal fraction soil group C = 0.000
101 Decimal fraction soil group D = 1.000
102 [UNDISTURBED NATURAL TERRAIN ]
103 (Permanent Open Space )
104 Impervious value, Ai = 0.000
105 Sub-Area C Value = 0.350
106 Rainfall intensity = 8.699(In/Hr) for a 100.0 year storm
107 Effective runoff coefficient used for total area
108 (Q=KCIA) is C = 0.454 CA = 0.181
109 Subarea runoff = 0.900(CFS) for 0.302(Ac.)
110 Total runoff = 1.571(CFS) Total area = 0.398(Ac.)
111 Depth of flow = 0.670(Ft.), Average velocity = 3.504(Ft/s)
112 End of computations, total study area = 0.398 (Ac.)
113
114
115

```

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)

```

70 Depth of flow = 1.164(Ft.), Average velocity = 7.312(Ft/s)
71 ***** Irregular Channel Data *****
72 -----
73 Information entered for subchannel number 1 :
74 Point number 'X' coordinate 'Y' coordinate
75 1 0.00 1.42
76 2 56.50 1.29
77 3 58.00 0.00
78 4 58.00 0.50
79 Manning's 'N' friction factor = 0.015
80 -----
81 Sub-Channel flow = 5.761(CFS)
82 ' ' flow top width = 1.354(Ft.)
83 ' ' velocity= 7.312(Ft/s)
84 ' ' area = 0.788(Sq.Ft)
85 ' ' Froude number = 1.689
86
87 Upstream point elevation = 596.140(Ft.)
88 Downstream point elevation = 587.530(Ft.)
89 Flow length = 382.000(Ft.)
90 Travel time = 0.87 min.
91 Time of concentration = 4.54 min.
92 Depth of flow = 1.164(Ft.)
93 Average velocity = 7.312(Ft/s)
94 Total irregular channel flow = 5.761(CFS)
95 Irregular channel normal depth above invert elev. = 1.164(Ft.)
96 Average velocity of channel(s) = 7.312(Ft/s)
97 Adding area flow to channel
98 Calculated TC of 4.542 minutes is less than 5 minutes,
99 resetting TC to 5.0 minutes for rainfall intensity calculations
100 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
101 Decimal fraction soil group A = 0.000
102 Decimal fraction soil group B = 0.000
103 Decimal fraction soil group C = 0.000
104 Decimal fraction soil group D = 1.000
105 [HIGH DENSITY RESIDENTIAL ]
106 (43.0 DU/A or Less )
107 Impervious value, Ai = 0.800
108 Sub-Area C Value = 0.790
109 Rainfall intensity = 8.958(In/Hr) for a 100.0 year storm
110 Effective runoff coefficient used for total area
111 (Q=KCIA) is C = 0.790 CA = 1.190
112 Subarea runoff = 9.794(CFS) for 1.384(Ac.)
113 Total runoff = 10.658(CFS) Total area = 1.506(Ac.)
114 Depth of flow = 1.403(Ft.), Average velocity = 2.648(Ft/s)
115
116
117 *****
118 Process from Point/Station 106.000 to Point/Station 103.000
119 **** SUBAREA FLOW ADDITION ****
120 -----
121 Calculated TC of 4.542 minutes is less than 5 minutes,
122 resetting TC to 5.0 minutes for rainfall intensity calculations
123 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
124 Decimal fraction soil group A = 0.000
125 Decimal fraction soil group B = 0.000
126 Decimal fraction soil group C = 0.000
127 Decimal fraction soil group D = 1.000
128 [HIGH DENSITY RESIDENTIAL ]
129 (43.0 DU/A or Less )
130 Impervious value, Ai = 0.800
131 Sub-Area C Value = 0.790
132 Time of concentration = 4.54 min.
133 Rainfall intensity = 8.958(In/Hr) for a 100.0 year storm
134 Effective runoff coefficient used for total area
135 (Q=KCIA) is C = 0.790 CA = 1.502
136 Subarea runoff = 2.795(CFS) for 0.395(Ac.)
137 Total runoff = 13.453(CFS) Total area = 1.901(Ac.)
138

```

```

139
140 *****
141 Process from Point/Station      107.000 to Point/Station      103.000
142 **** SUBAREA FLOW ADDITION ****
143
144 -----
145 Calculated TC of      4.542 minutes is less than 5 minutes,
146 resetting TC to 5.0 minutes for rainfall intensity calculations
147 Rainfall intensity (I) =      8.958(In/Hr) for a 100.0 year storm
148 Decimal fraction soil group A = 0.000
149 Decimal fraction soil group B = 0.000
150 Decimal fraction soil group C = 0.000
151 Decimal fraction soil group D = 1.000
152 [HIGH DENSITY RESIDENTIAL                ]
153 (43.0 DU/A or Less                )
154 Impervious value, Ai = 0.800
155 Sub-Area C Value = 0.790
156 Time of concentration =      4.54 min.
157 Rainfall intensity =      8.958(In/Hr) for a 100.0 year storm
158 Effective runoff coefficient used for total area
159 (Q=KCIA) is C = 0.790 CA =      1.589
160 Subarea runoff =      0.786(CFS) for      0.111(Ac.)
161 Total runoff =      14.239(CFS) Total area =      2.012(Ac.)
162
163 *****
164 Process from Point/Station      108.000 to Point/Station      103.000
165 **** SUBAREA FLOW ADDITION ****
166
167 -----
168 Calculated TC of      4.542 minutes is less than 5 minutes,
169 resetting TC to 5.0 minutes for rainfall intensity calculations
170 Rainfall intensity (I) =      8.958(In/Hr) for a 100.0 year storm
171 Decimal fraction soil group A = 0.000
172 Decimal fraction soil group B = 0.000
173 Decimal fraction soil group C = 0.000
174 Decimal fraction soil group D = 1.000
175 [HIGH DENSITY RESIDENTIAL                ]
176 (43.0 DU/A or Less                )
177 Impervious value, Ai = 0.800
178 Sub-Area C Value = 0.790
179 Time of concentration =      4.54 min.
180 Rainfall intensity =      8.958(In/Hr) for a 100.0 year storm
181 Effective runoff coefficient used for total area
182 (Q=KCIA) is C = 0.790 CA =      1.732
183 Subarea runoff =      1.274(CFS) for      0.180(Ac.)
184 Total runoff =      15.513(CFS) Total area =      2.192(Ac.)
185
186 *****
187 Process from Point/Station      103.000 to Point/Station      104.000
188 **** PIPEFLOW TRAVEL TIME (User specified size) ****
189
190 -----
191 Upstream point/station elevation = 585.100(Ft.)
192 Downstream point/station elevation = 584.810(Ft.)
193 Pipe length = 58.00(Ft.) Slope = 0.0050 Manning's N = 0.013
194 No. of pipes = 1 Required pipe flow = 15.513(CFS)
195 Given pipe size = 18.00(In.)
196 NOTE: Normal flow is pressure flow in user selected pipe size.
197 The approximate hydraulic grade line above the pipe invert is
198 2.769(Ft.) at the headworks or inlet of the pipe(s)
199 Pipe friction loss = 1.264(Ft.)
200 Minor friction loss = 1.795(Ft.) K-factor = 1.50
201 Pipe flow velocity = 8.78(Ft/s)
202 Travel time through pipe = 0.11 min.
203 Time of concentration (TC) = 4.65 min.
204
205 *****
206 Process from Point/Station      104.000 to Point/Station      105.000
207 **** 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 *****
226 Process from Point/Station 105.000 to Point/Station 105.000
227 **** CONFLUENCE OF MAIN STREAMS ****
228
229 The following data inside Main Stream is listed:
230 In Main Stream number: 1
231 Stream flow area = 2.192(Ac.)
232 Runoff from this stream = 15.513(CFS)
233 Time of concentration = 4.77 min.
234 Rainfall intensity = 8.958(In/Hr)
235 Program is now starting with Main Stream No. 2
236
237
238 *****
239 Process from Point/Station 201.000 to Point/Station 202.000
240 **** INITIAL AREA EVALUATION ****
241
242 Decimal fraction soil group A = 0.000
243 Decimal fraction soil group B = 0.000
244 Decimal fraction soil group C = 0.000
245 Decimal fraction soil group D = 1.000
246 [HIGH DENSITY RESIDENTIAL ]
247 (43.0 DU/A or Less )
248 Impervious value, Ai = 0.800
249 Sub-Area C Value = 0.790
250 Initial subarea total flow distance = 144.000(Ft.)
251 Highest elevation = 594.410(Ft.)
252 Lowest elevation = 591.500(Ft.)
253 Elevation difference = 2.910(Ft.) Slope = 2.021 %
254 Top of Initial Area Slope adjusted by User to 1.674 %
255 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
256 The maximum overland flow distance is 75.00 (Ft)
257 for the top area slope value of 1.67 %, in a development type of
258 43.0 DU/A or Less
259 In Accordance With Figure 3-3
260 Initial Area Time of Concentration = 4.07 minutes
261 TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
262 TC = [1.8*(1.1-0.7900)*( 75.000^0.5)]/( 1.674^(1/3))= 4.07
263 Calculated TC of 4.070 minutes is less than 5 minutes,
264 resetting TC to 5.0 minutes for rainfall intensity calculations
265 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
266 Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
267 Subarea runoff = 1.260(CFS)
268 Total initial stream area = 0.178(Ac.)
269
270
271 *****
272 Process from Point/Station 202.000 to Point/Station 203.000
273 **** PIPEFLOW TRAVEL TIME (User specified size) ****
274
275 Upstream point/station elevation = 587.600(Ft.)
276 Downstream point/station elevation = 587.530(Ft.)
277 Pipe length = 14.00(Ft.) Slope = 0.0050 Manning's N = 0.013

```

```

277 No. of pipes = 1 Required pipe flow = 1.260(CFS)
278 Given pipe size = 12.00(In.)
279 Calculated individual pipe flow = 1.260(CFS)
280 Normal flow depth in pipe = 6.00(In.)
281 Flow top width inside pipe = 12.00(In.)
282 Critical Depth = 5.69(In.)
283 Pipe flow velocity = 3.21(Ft/s)
284 Travel time through pipe = 0.07 min.
285 Time of concentration (TC) = 4.14 min.
286
287
288 *****
289 Process from Point/Station 203.000 to Point/Station 203.000
290 **** CONFLUENCE OF MINOR STREAMS ****
291
292 Along Main Stream number: 2 in normal stream number 1
293 Stream flow area = 0.178(Ac.)
294 Runoff from this stream = 1.260(CFS)
295 Time of concentration = 4.14 min.
296 Rainfall intensity = 8.958(In/Hr)
297
298
299 *****
300 Process from Point/Station 301.000 to Point/Station 302.000
301 **** INITIAL AREA EVALUATION ****
302
303 Decimal fraction soil group A = 0.000
304 Decimal fraction soil group B = 0.000
305 Decimal fraction soil group C = 0.000
306 Decimal fraction soil group D = 1.000
307 [HIGH DENSITY RESIDENTIAL ]
308 (43.0 DU/A or Less )
309 Impervious value, Ai = 0.800
310 Sub-Area C Value = 0.790
311 Initial subarea total flow distance = 100.000(Ft.)
312 Highest elevation = 589.000(Ft.)
313 Lowest elevation = 587.610(Ft.)
314 Elevation difference = 1.390(Ft.) Slope = 1.390 %
315 Top of Initial Area Slope adjusted by User to 1.620 %
316 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
317 The maximum overland flow distance is 75.00 (Ft)
318 for the top area slope value of 1.62 %, in a development type of
319 43.0 DU/A or Less
320 In Accordance With Figure 3-3
321 Initial Area Time of Concentration = 4.11 minutes
322 TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
323 TC = [1.8*(1.1-0.790)*( 75.000^0.5)/( 1.620^(1/3))]= 4.11
324 Calculated TC of 4.115 minutes is less than 5 minutes,
325 resetting TC to 5.0 minutes for rainfall intensity calculations
326 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
327 Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
328 Subarea runoff = 0.701(CFS)
329 Total initial stream area = 0.099(Ac.)
330
331
332 *****
333 Process from Point/Station 302.000 to Point/Station 203.000
334 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
335
336 Depth of flow = 0.244(Ft.), Average velocity = 1.068(Ft/s)
337 ***** Irregular Channel Data *****
338 -----
339 Information entered for subchannel number 1 :
340 Point number 'X' coordinate 'Y' coordinate
341 1 0.00 0.50
342 2 0.00 0.00
343 3 1.30 0.11
344 4 19.00 0.50
345 Manning's 'N' friction factor = 0.015

```

```

346 -----
347 Sub-Channel flow = 0.701(CFS)
348 ' ' flow top width = 7.397(Ft.)
349 ' ' velocity= 1.069(Ft/s)
350 ' ' area = 0.656(Sq.Ft)
351 ' ' Froude number = 0.632
352
353 Upstream point elevation = 587.610(Ft.)
354 Downstream point elevation = 587.570(Ft.)
355 Flow length = 13.000(Ft.)
356 Travel time = 0.20 min.
357 Time of concentration = 4.32 min.
358 Depth of flow = 0.244(Ft.)
359 Average velocity = 1.068(Ft/s)
360 Total irregular channel flow = 0.701(CFS)
361 Irregular channel normal depth above invert elev. = 0.244(Ft.)
362 Average velocity of channel(s) = 1.068(Ft/s)
363
364

```

```

365 +-----+
366 Process from Point/Station 203.000 to Point/Station 203.000
367 **** CONFLUENCE OF MINOR STREAMS ****
368

```

```

369 Along Main Stream number: 2 in normal stream number 2
370 Stream flow area = 0.099(Ac.)
371 Runoff from this stream = 0.701(CFS)
372 Time of concentration = 4.32 min.
373 Rainfall intensity = 8.958(In/Hr)
374 Summary of stream data:
375

```

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

```

388
389 Total of 2 streams to confluence:
390 Flow rates before confluence point:
391 1.260 0.701
392 Maximum flow rates at confluence using above data:
393 1.932 1.960
394 Area of streams before confluence:
395 0.178 0.099
396 Results of confluence:
397 Total flow rate = 1.960(CFS)
398 Time of concentration = 4.317 min.
399 Effective stream area after confluence = 0.277(Ac.)
400
401

```

```

402 +-----+
403 Process from Point/Station 203.000 to Point/Station 105.000
404 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
405

```

```

406 Estimated mean flow rate at midpoint of channel = 2.589(CFS)
407 Depth of flow = 0.274(Ft.), Average velocity = 2.905(Ft/s)
408 ***** Irregular Channel Data *****
409 -----

```

```

410 Information entered for subchannel number 1 :
411 Point number 'X' coordinate 'Y' coordinate
412 1 0.00 0.50
413 2 0.00 0.00
414 3 1.30 0.11

```

```

415         4           19.00           0.50
416 Manning's 'N' friction factor = 0.015
417 -----
418 Sub-Channel flow = 2.589(CFS)
419 ' ' flow top width = 8.724(Ft.)
420 ' ' velocity= 2.905(Ft/s)
421 ' ' area = 0.891(Sq.Ft)
422 ' ' Froude number = 1.602
423
424 Upstream point elevation = 587.570(Ft.)
425 Downstream point elevation = 583.120(Ft.)
426 Flow length = 237.000(Ft.)
427 Travel time = 1.36 min.
428 Time of concentration = 5.68 min.
429 Depth of flow = 0.274(Ft.)
430 Average velocity = 2.905(Ft/s)
431 Total irregular channel flow = 2.589(CFS)
432 Irregular channel normal depth above invert elev. = 0.274(Ft.)
433 Average velocity of channel(s) = 2.905(Ft/s)
434 Adding area flow to channel
435 Rainfall intensity (I) = 8.254(In/Hr) for a 100.0 year storm
436 Decimal fraction soil group A = 0.000
437 Decimal fraction soil group B = 0.000
438 Decimal fraction soil group C = 0.000
439 Decimal fraction soil group D = 1.000
440 [HIGH DENSITY RESIDENTIAL ]
441 (43.0 DU/A or Less )
442 Impervious value, Ai = 0.800
443 Sub-Area C Value = 0.790
444 Rainfall intensity = 8.254(In/Hr) for a 100.0 year storm
445 Effective runoff coefficient used for total area
446 (Q=KCIA) is C = 0.790 CA = 0.382
447 Subarea runoff = 1.189(CFS) for 0.206(Ac.)
448 Total runoff = 3.149(CFS) Total area = 0.483(Ac.)
449 Depth of flow = 0.289(Ft.), Average velocity = 3.045(Ft/s)
450
451

```

```

452 +-----+
453 Process from Point/Station 105.000 to Point/Station 105.000
454 **** CONFLUENCE OF MAIN STREAMS ****
455

```

The following data inside Main Stream is listed:

```

456 In Main Stream number: 2
457 Stream flow area = 0.483(Ac.)
458 Runoff from this stream = 3.149(CFS)
459 Time of concentration = 5.68 min.
460 Rainfall intensity = 8.254(In/Hr)
461 Summary of stream data:
462

```

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (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:

```

479 15.513 3.149

```

Maximum flow rates at confluence using above data:

```

481 18.158 17.442

```

Area of streams before confluence:

```

483 2.192 0.483

```

484
485
486 Results of confluence:
487 Total flow rate = 18.158(CFS)
488 Time of concentration = 4.770 min.
489 Effective stream area after confluence = 2.675(Ac.)
490 End of computations, total study area = 2.675 (Ac.)
491
492
493

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.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.7900)*(75.000^0.5)/(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)

```

70 Depth of flow = 1.164(Ft.), Average velocity = 7.312(Ft/s)
71 ***** Irregular Channel Data *****
72 -----
73 Information entered for subchannel number 1 :
74 Point number      'X' coordinate      'Y' coordinate
75     1              0.00              1.42
76     2              56.50             1.29
77     3              58.00              0.00
78     4              58.00              0.50
79 Manning's 'N' friction factor = 0.015
80 -----
81 Sub-Channel flow = 5.761(CFS)
82   '   '   flow top width = 1.354(Ft.)
83   '   '   velocity= 7.312(Ft/s)
84   '   '   area = 0.788(Sq.Ft)
85   '   '   Froude number = 1.689
86
87 Upstream point elevation = 596.140(Ft.)
88 Downstream point elevation = 587.530(Ft.)
89 Flow length = 382.000(Ft.)
90 Travel time = 0.87 min.
91 Time of concentration = 4.54 min.
92 Depth of flow = 1.164(Ft.)
93 Average velocity = 7.312(Ft/s)
94 Total irregular channel flow = 5.761(CFS)
95 Irregular channel normal depth above invert elev. = 1.164(Ft.)
96 Average velocity of channel(s) = 7.312(Ft/s)
97 Adding area flow to channel
98 Calculated TC of 4.542 minutes is less than 5 minutes,
99 resetting TC to 5.0 minutes for rainfall intensity calculations
100 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
101 Decimal fraction soil group A = 0.000
102 Decimal fraction soil group B = 0.000
103 Decimal fraction soil group C = 0.000
104 Decimal fraction soil group D = 1.000
105 [HIGH DENSITY RESIDENTIAL ]
106 (43.0 DU/A or Less )
107 Impervious value, Ai = 0.800
108 Sub-Area C Value = 0.790
109 Rainfall intensity = 8.958(In/Hr) for a 100.0 year storm
110 Effective runoff coefficient used for total area
111 (Q=KCIA) is C = 0.790 CA = 1.190
112 Subarea runoff = 9.794(CFS) for 1.384(Ac.)
113 Total runoff = 10.658(CFS) Total area = 1.506(Ac.)
114 Depth of flow = 1.403(Ft.), Average velocity = 2.648(Ft/s)
115
116
117 *****
118 Process from Point/Station 106.000 to Point/Station 103.000
119 **** SUBAREA FLOW ADDITION ****
120 -----
121 Calculated TC of 4.542 minutes is less than 5 minutes,
122 resetting TC to 5.0 minutes for rainfall intensity calculations
123 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
124 Decimal fraction soil group A = 0.000
125 Decimal fraction soil group B = 0.000
126 Decimal fraction soil group C = 0.000
127 Decimal fraction soil group D = 1.000
128 [HIGH DENSITY RESIDENTIAL ]
129 (43.0 DU/A or Less )
130 Impervious value, Ai = 0.800
131 Sub-Area C Value = 0.790
132 Time of concentration = 4.54 min.
133 Rainfall intensity = 8.958(In/Hr) for a 100.0 year storm
134 Effective runoff coefficient used for total area
135 (Q=KCIA) is C = 0.790 CA = 1.502
136 Subarea runoff = 2.795(CFS) for 0.395(Ac.)
137 Total runoff = 13.453(CFS) Total area = 1.901(Ac.)
138

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139
140 *****
141 Process from Point/Station      107.000 to Point/Station      103.000
142 **** SUBAREA FLOW ADDITION ****
143
144 -----
144 Calculated TC of      4.542 minutes is less than 5 minutes,
145   resetting TC to 5.0 minutes for rainfall intensity calculations
146 Rainfall intensity (I) =      8.958(In/Hr) for a  100.0 year storm
147 Decimal fraction soil group A = 0.000
148 Decimal fraction soil group B = 0.000
149 Decimal fraction soil group C = 0.000
150 Decimal fraction soil group D = 1.000
151 [HIGH DENSITY RESIDENTIAL                ]
152 (43.0 DU/A or Less                )
153 Impervious value, Ai = 0.800
154 Sub-Area C Value = 0.790
155 Time of concentration =      4.54 min.
156 Rainfall intensity =      8.958(In/Hr) for a  100.0 year storm
157 Effective runoff coefficient used for total area
158 (Q=KCIA) is C = 0.790  CA =      1.589
159 Subarea runoff =      0.786(CFS) for      0.111(Ac.)
160 Total runoff =      14.239(CFS)  Total area =      2.012(Ac.)
161
162

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163 *****
164 Process from Point/Station      108.000 to Point/Station      103.000
165 **** SUBAREA FLOW ADDITION ****
166
167 -----
167 Calculated TC of      4.542 minutes is less than 5 minutes,
168   resetting TC to 5.0 minutes for rainfall intensity calculations
169 Rainfall intensity (I) =      8.958(In/Hr) for a  100.0 year storm
170 Decimal fraction soil group A = 0.000
171 Decimal fraction soil group B = 0.000
172 Decimal fraction soil group C = 0.000
173 Decimal fraction soil group D = 1.000
174 [HIGH DENSITY RESIDENTIAL                ]
175 (43.0 DU/A or Less                )
176 Impervious value, Ai = 0.800
177 Sub-Area C Value = 0.790
178 Time of concentration =      4.54 min.
179 Rainfall intensity =      8.958(In/Hr) for a  100.0 year storm
180 Effective runoff coefficient used for total area
181 (Q=KCIA) is C = 0.790  CA =      1.732
182 Subarea runoff =      1.274(CFS) for      0.180(Ac.)
183 Total runoff =      15.513(CFS)  Total area =      2.192(Ac.)
184
185

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```

186 *****
187 Process from Point/Station      101.000 to Point/Station      103.000
188 **** 6 HOUR HYDROGRAPH ****
189

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190 -----
191 Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003
192
193

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194 Time of Concentration = 4.54
195 Basin Area = 2.19 Acres
196 6 Hour Rainfall = 3.400 Inches
197 Runoff Coefficient = 0.790
198 Peak Discharge = 15.51 CFS
199   Time (Min)      Discharge (CFS)
200     0             0.000
201     4             0.350
202     8             0.353
203    12             0.358
204    16             0.361
205    20             0.366
206    24             0.369
207    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

277	308	0.520
278	312	0.500
279	316	0.482
280	320	0.466
281	324	0.451
282	328	0.437
283	332	0.424
284	336	0.412
285	340	0.401
286	344	0.391
287	348	0.381
288	352	0.372
289	356	0.364
290	360	0.355
291	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

Time(h+m)	Volume	Ac.Ft	Q(CFS)	0	3.9	7.8	11.6	15.5
301	0+ 0	0.0000	0.00	Q				
302	0+ 1	0.0001	0.09	Q				
303	0+ 2	0.0004	0.18	Q				
304	0+ 3	0.0007	0.26	Q				
305	0+ 4	0.0012	0.35	Q				
306	0+ 5	0.0017	0.35	Q				
307	0+ 6	0.0022	0.35	Q				
308	0+ 7	0.0027	0.35	Q				
309	0+ 8	0.0031	0.35	Q				
310	0+ 9	0.0036	0.35	Q				
311	0+10	0.0041	0.36	Q				
312	0+11	0.0046	0.36	Q				
313	0+12	0.0051	0.36	Q				
314	0+13	0.0056	0.36	Q				
315	0+14	0.0061	0.36	Q				
316	0+15	0.0066	0.36	Q				
317	0+16	0.0071	0.36	Q				
318	0+17	0.0076	0.36	Q				
319	0+18	0.0081	0.36	Q				
320	0+19	0.0086	0.36	Q				
321	0+20	0.0091	0.37	Q				
322	0+21	0.0096	0.37	Q				
323	0+22	0.0101	0.37	Q				
324	0+23	0.0106	0.37	Q				
325	0+24	0.0111	0.37	Q				
326	0+25	0.0116	0.37	Q				
327	0+26	0.0121	0.37	QV				
328	0+27	0.0127	0.37	QV				
329	0+28	0.0132	0.38	QV				
330	0+29	0.0137	0.38	QV				
331	0+30	0.0142	0.38	QV				
332	0+31	0.0147	0.38	QV				
333	0+32	0.0153	0.38	QV				
334	0+33	0.0158	0.38	QV				
335	0+34	0.0163	0.38	QV				
336	0+35	0.0168	0.38	QV				
337	0+36	0.0174	0.38	QV				
338	0+37	0.0179	0.39	QV				
339	0+38	0.0184	0.39	QV				
340	0+39	0.0190	0.39	QV				
341	0+40	0.0195	0.39	QV				
342	0+41	0.0200	0.39	Q				
343	0+42	0.0206	0.39	Q				
344	0+43	0.0211	0.39	Q				
345	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

484	3+ 3	0.1272	0.85	Q	V				
485	3+ 4	0.1284	0.85	Q	V				
486	3+ 5	0.1296	0.87	Q	V				
487	3+ 6	0.1308	0.88	Q	V				
488	3+ 7	0.1320	0.89	Q	V				
489	3+ 8	0.1333	0.91	Q	V				
490	3+ 9	0.1345	0.91	Q	V				
491	3+10	0.1358	0.92	Q	V				
492	3+11	0.1371	0.93	Q	V				
493	3+12	0.1384	0.94	Q	V				
494	3+13	0.1397	0.95	Q	V				
495	3+14	0.1410	0.97	Q	V				
496	3+15	0.1424	0.99	Q	V				
497	3+16	0.1438	1.00	Q	V				
498	3+17	0.1452	1.01	Q	V				
499	3+18	0.1466	1.02	Q	V				
500	3+19	0.1480	1.03	Q	V				
501	3+20	0.1494	1.04	Q	V				
502	3+21	0.1509	1.07	Q	V				
503	3+22	0.1524	1.09	Q	V				
504	3+23	0.1539	1.11	Q	V				
505	3+24	0.1555	1.13	Q	V				
506	3+25	0.1571	1.15	Q	V				
507	3+26	0.1587	1.16	Q	V				
508	3+27	0.1603	1.17	Q	V				
509	3+28	0.1619	1.19	Q	V				
510	3+29	0.1636	1.22	Q	V				
511	3+30	0.1653	1.25	Q	V				
512	3+31	0.1671	1.28	Q	V				
513	3+32	0.1689	1.32	Q	V				
514	3+33	0.1707	1.34	Q	V				
515	3+34	0.1726	1.36	Q	V				
516	3+35	0.1745	1.38	Q	V				
517	3+36	0.1764	1.40	Q	V				
518	3+37	0.1784	1.45	Q	V				
519	3+38	0.1805	1.50	Q	V				
520	3+39	0.1826	1.55	Q	V				
521	3+40	0.1848	1.60	Q	V				
522	3+41	0.1871	1.63	Q	V				
523	3+42	0.1894	1.67	Q	V				
524	3+43	0.1917	1.70	Q	V				
525	3+44	0.1941	1.74	Q	V				
526	3+45	0.1966	1.83	Q	V				
527	3+46	0.1993	1.93	Q	V				
528	3+47	0.2021	2.02	Q	V				
529	3+48	0.2050	2.12	Q	V				
530	3+49	0.2080	2.19	Q	V				
531	3+50	0.2111	2.27	Q	V				
532	3+51	0.2144	2.34	Q	V				
533	3+52	0.2177	2.42	Q	V				
534	3+53	0.2214	2.70	Q	V				
535	3+54	0.2255	2.98	Q	V				
536	3+55	0.2300	3.26	Q	V				
537	3+56	0.2349	3.55	Q	V				
538	3+57	0.2403	3.91	Q	V				
539	3+58	0.2462	4.27	Q	V				
540	3+59	0.2526	4.64	Q	V				
541	4+ 0	0.2594	5.00	Q	V				
542	4+ 1	0.2699	7.63	Q	V				
543	4+ 2	0.2841	10.26	Q	V				
544	4+ 3	0.3018	12.88	Q	V				
545	4+ 4	0.3232	15.51	Q	V				
546	4+ 5	0.3402	12.35	Q	V				
547	4+ 6	0.3528	9.18	Q	V				
548	4+ 7	0.3611	6.01	Q	V				
549	4+ 8	0.3650	2.84	Q	V				
550	4+ 9	0.3686	2.61	Q	V				
551	4+10	0.3719	2.37	Q	V				
552	4+11	0.3748	2.14	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

622	5+21	0.4521	0.46	Q	V
623	5+22	0.4527	0.46	Q	V
624	5+23	0.4533	0.45	Q	V
625	5+24	0.4539	0.45	Q	V
626	5+25	0.4546	0.45	Q	V
627	5+26	0.4552	0.44	Q	V
628	5+27	0.4558	0.44	Q	V
629	5+28	0.4564	0.44	Q	V
630	5+29	0.4570	0.43	Q	V
631	5+30	0.4576	0.43	Q	V
632	5+31	0.4582	0.43	Q	V
633	5+32	0.4587	0.42	Q	V
634	5+33	0.4593	0.42	Q	V
635	5+34	0.4599	0.42	Q	V
636	5+35	0.4605	0.42	Q	V
637	5+36	0.4610	0.41	Q	V
638	5+37	0.4616	0.41	Q	V
639	5+38	0.4622	0.41	Q	V
640	5+39	0.4627	0.40	Q	V
641	5+40	0.4633	0.40	Q	V
642	5+41	0.4638	0.40	Q	V
643	5+42	0.4644	0.40	Q	V
644	5+43	0.4649	0.39	Q	V
645	5+44	0.4655	0.39	Q	V
646	5+45	0.4660	0.39	Q	V
647	5+46	0.4665	0.39	Q	V
648	5+47	0.4671	0.38	Q	V
649	5+48	0.4676	0.38	Q	V
650	5+49	0.4681	0.38	Q	V
651	5+50	0.4686	0.38	Q	V
652	5+51	0.4691	0.37	Q	V
653	5+52	0.4696	0.37	Q	V
654	5+53	0.4702	0.37	Q	V
655	5+54	0.4707	0.37	Q	V
656	5+55	0.4712	0.37	Q	V
657	5+56	0.4717	0.36	Q	V
658	5+57	0.4722	0.36	Q	V
659	5+58	0.4727	0.36	Q	V
660	5+59	0.4732	0.36	Q	V
661	6+ 0	0.4736	0.36	Q	V
662	6+ 1	0.4741	0.35	Q	V
663	6+ 2	0.4746	0.35	Q	V
664	6+ 3	0.4751	0.35	Q	V
665	6+ 4	0.4756	0.35	Q	V

666
667
668
669
670
671 End of computations, total study area = 2.192 (Ac.)
672
673
674

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.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.7800)*(85.000^0.5)/(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)

```

70 Depth of flow = 0.592(Ft.), Average velocity = 6.020(Ft/s)
71 ***** Irregular Channel Data *****
72 -----
73 Information entered for subchannel number 1 :
74 Point number      'X' coordinate      'Y' coordinate
75      1              0.00              1.00
76      2              28.50             0.85
77      3              30.00             0.00
78      4              30.00             0.50
79 Manning's 'N' friction factor = 0.015
80 -----
81 Sub-Channel flow = 1.852(CFS)
82   '   '   flow top width = 1.039(Ft.)
83   '   '   velocity= 6.020(Ft/s)
84   '   '   area = 0.308(Sq.Ft)
85   '   '   Froude number = 1.950
86
87 Upstream point elevation = 598.000(Ft.)
88 Downstream point elevation = 585.990(Ft.)
89 Flow length = 334.000(Ft.)
90 Travel time = 0.92 min.
91 Time of concentration = 4.61 min.
92 Depth of flow = 0.592(Ft.)
93 Average velocity = 6.020(Ft/s)
94 Total irregular channel flow = 1.852(CFS)
95 Irregular channel normal depth above invert elev. = 0.592(Ft.)
96 Average velocity of channel(s) = 6.020(Ft/s)
97 Adding area flow to channel
98 Calculated TC of 4.607 minutes is less than 5 minutes,
99 resetting TC to 5.0 minutes for rainfall intensity calculations
100 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
101 Decimal fraction soil group A = 0.000
102 Decimal fraction soil group B = 0.000
103 Decimal fraction soil group C = 0.200
104 Decimal fraction soil group D = 0.800
105 [HIGH DENSITY RESIDENTIAL ]
106 (43.0 DU/A or Less )
107 Impervious value, Ai = 0.800
108 Sub-Area C Value = 0.788
109 Rainfall intensity = 8.958(In/Hr) for a 100.0 year storm
110 Effective runoff coefficient used for total area
111 (Q=KCIA) is C = 0.786 CA = 0.332
112 Subarea runoff = 2.231(CFS) for 0.316(Ac.)
113 Total runoff = 2.978(CFS) Total area = 0.423(Ac.)
114 Depth of flow = 0.700(Ft.), Average velocity = 6.938(Ft/s)
115 End of computations, total study area = 0.423 (Ac.)
116
117
118

```

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)

```

70 Time of concentration = 6.25 min.
71 Rainfall intensity = 7.755(In/Hr)
72 Program is now starting with Main Stream No. 2
73
74
75 ++++++
76 Process from Point/Station 201.000 to Point/Station 202.000
77 **** INITIAL AREA EVALUATION ****
78
79 Decimal fraction soil group A = 0.000
80 Decimal fraction soil group B = 0.000
81 Decimal fraction soil group C = 0.000
82 Decimal fraction soil group D = 1.000
83 [HIGH DENSITY RESIDENTIAL ]
84 (43.0 DU/A or Less )
85 Impervious value, Ai = 0.800
86 Sub-Area C Value = 0.790
87 Initial subarea total flow distance = 144.000(Ft.)
88 Highest elevation = 594.410(Ft.)
89 Lowest elevation = 591.500(Ft.)
90 Elevation difference = 2.910(Ft.) Slope = 2.021 %
91 Top of Initial Area Slope adjusted by User to 1.674 %
92 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
93 The maximum overland flow distance is 75.00 (Ft)
94 for the top area slope value of 1.67 %, in a development type of
95 43.0 DU/A or Less
96 In Accordance With Figure 3-3
97 Initial Area Time of Concentration = 4.07 minutes
98 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
99 TC = [1.8*(1.1-0.7900)*( 75.000^.5)/( 1.674^(1/3)]= 4.07
100 Calculated TC of 4.070 minutes is less than 5 minutes,
101 resetting TC to 5.0 minutes for rainfall intensity calculations
102 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
103 Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
104 Subarea runoff = 1.260(CFS)
105 Total initial stream area = 0.178(Ac.)
106
107
108 ++++++
109 Process from Point/Station 202.000 to Point/Station 203.000
110 **** PIPEFLOW TRAVEL TIME (User specified size) ****
111
112 Upstream point/station elevation = 587.600(Ft.)
113 Downstream point/station elevation = 587.530(Ft.)
114 Pipe length = 14.00(Ft.) Slope = 0.0050 Manning's N = 0.013
115 No. of pipes = 1 Required pipe flow = 1.260(CFS)
116 Given pipe size = 12.00(In.)
117 Calculated individual pipe flow = 1.260(CFS)
118 Normal flow depth in pipe = 6.00(In.)
119 Flow top width inside pipe = 12.00(In.)
120 Critical Depth = 5.69(In.)
121 Pipe flow velocity = 3.21(Ft/s)
122 Travel time through pipe = 0.07 min.
123 Time of concentration (TC) = 4.14 min.
124
125
126 ++++++
127 Process from Point/Station 203.000 to Point/Station 203.000
128 **** CONFLUENCE OF MINOR STREAMS ****
129
130 Along Main Stream number: 2 in normal stream number 1
131 Stream flow area = 0.178(Ac.)
132 Runoff from this stream = 1.260(CFS)
133 Time of concentration = 4.14 min.
134 Rainfall intensity = 8.958(In/Hr)
135
136
137 ++++++
138 Process from Point/Station 301.000 to Point/Station 302.000

```

```

139 **** INITIAL AREA EVALUATION ****
140
141 Decimal fraction soil group A = 0.000
142 Decimal fraction soil group B = 0.000
143 Decimal fraction soil group C = 0.000
144 Decimal fraction soil group D = 1.000
145 [HIGH DENSITY RESIDENTIAL ]
146 (43.0 DU/A or Less )
147 Impervious value, Ai = 0.800
148 Sub-Area C Value = 0.790
149 Initial subarea total flow distance = 100.000(Ft.)
150 Highest elevation = 589.000(Ft.)
151 Lowest elevation = 587.610(Ft.)
152 Elevation difference = 1.390(Ft.) Slope = 1.390 %
153 Top of Initial Area Slope adjusted by User to 1.620 %
154 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
155 The maximum overland flow distance is 75.00 (Ft)
156 for the top area slope value of 1.62 %, in a development type of
157 43.0 DU/A or Less
158 In Accordance With Figure 3-3
159 Initial Area Time of Concentration = 4.11 minutes
160 TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3)]
161 TC = [1.8*(1.1-0.7900)*( 75.000^.5)/( 1.620^(1/3))]= 4.11
162 Calculated TC of 4.115 minutes is less than 5 minutes,
163 resetting TC to 5.0 minutes for rainfall intensity calculations
164 Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
165 Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
166 Subarea runoff = 0.701(CFS)
167 Total initial stream area = 0.099(Ac.)
168
169
170 ++++++
171 Process from Point/Station 302.000 to Point/Station 203.000
172 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
173
174 Depth of flow = 0.244(Ft.), Average velocity = 1.068(Ft/s)
175 ***** Irregular Channel Data *****
176 -----
177 Information entered for subchannel number 1 :
178 Point number 'X' coordinate 'Y' coordinate
179 1 0.00 0.50
180 2 0.00 0.00
181 3 1.30 0.11
182 4 19.00 0.50
183 Manning's 'N' friction factor = 0.015
184 -----
185 Sub-Channel flow = 0.701(CFS)
186 ' ' flow top width = 7.397(Ft.)
187 ' ' velocity= 1.069(Ft/s)
188 ' ' area = 0.656(Sq.Ft)
189 ' ' Froude number = 0.632
190
191 Upstream point elevation = 587.610(Ft.)
192 Downstream point elevation = 587.570(Ft.)
193 Flow length = 13.000(Ft.)
194 Travel time = 0.20 min.
195 Time of concentration = 4.32 min.
196 Depth of flow = 0.244(Ft.)
197 Average velocity = 1.068(Ft/s)
198 Total irregular channel flow = 0.701(CFS)
199 Irregular channel normal depth above invert elev. = 0.244(Ft.)
200 Average velocity of channel(s) = 1.068(Ft/s)
201
202
203 ++++++
204 Process from Point/Station 203.000 to Point/Station 203.000
205 **** CONFLUENCE OF MINOR STREAMS ****
206
207 Along Main Stream number: 2 in normal stream number 2

```

```

208 Stream flow area = 0.099(Ac.)
209 Runoff from this stream = 0.701(CFS)
210 Time of concentration = 4.32 min.
211 Rainfall intensity = 8.958(In/Hr)
212 Summary of stream data:
213
214 Stream Flow rate TC Rainfall Intensity
215 No. (CFS) (min) (In/Hr)
216
217
218 1 1.260 4.14 8.958
219 2 0.701 4.32 8.958
220 Qmax(1) =
221 1.000 * 1.000 * 1.260) +
222 1.000 * 0.960 * 0.701) + = 1.932
223 Qmax(2) =
224 1.000 * 1.000 * 1.260) +
225 1.000 * 1.000 * 0.701) + = 1.960
226
227 Total of 2 streams to confluence:
228 Flow rates before confluence point:
229 1.260 0.701
230 Maximum flow rates at confluence using above data:
231 1.932 1.960
232 Area of streams before confluence:
233 0.178 0.099
234 Results of confluence:
235 Total flow rate = 1.960(CFS)
236 Time of concentration = 4.317 min.
237 Effective stream area after confluence = 0.277(Ac.)
238
239
240
241 *****
242 Process from Point/Station 203.000 to Point/Station 105.000
243 **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
244
245 -----
246 Estimated mean flow rate at midpoint of channel = 2.589(CFS)
247 Depth of flow = 0.274(Ft.), Average velocity = 2.905(Ft/s)
248 ***** Irregular Channel Data *****
249 -----
250 Information entered for subchannel number 1 :
251 Point number 'X' coordinate 'Y' coordinate
252 1 0.00 0.50
253 2 0.00 0.00
254 3 1.30 0.11
255 4 19.00 0.50
256 Manning's 'N' friction factor = 0.015
257 -----
258 Sub-Channel flow = 2.589(CFS)
259 ' ' flow top width = 8.724(Ft.)
260 ' ' velocity= 2.905(Ft/s)
261 ' ' area = 0.891(Sq.Ft)
262 ' ' Froude number = 1.602
263
264 Upstream point elevation = 587.570(Ft.)
265 Downstream point elevation = 583.120(Ft.)
266 Flow length = 237.000(Ft.)
267 Travel time = 1.36 min.
268 Time of concentration = 5.68 min.
269 Depth of flow = 0.274(Ft.)
270 Average velocity = 2.905(Ft/s)
271 Total irregular channel flow = 2.589(CFS)
272 Irregular channel normal depth above invert elev. = 0.274(Ft.)
273 Average velocity of channel(s) = 2.905(Ft/s)
274 Adding area flow to channel
275 Rainfall intensity (I) = 8.254(In/Hr) for a 100.0 year storm
276 Decimal fraction soil group A = 0.000
277 Decimal fraction soil group B = 0.000
278 Decimal fraction soil group C = 0.000

```

277 Decimal fraction soil group D = 1.000
 278 [HIGH DENSITY RESIDENTIAL]
 279 (43.0 DU/A or Less)
 280 Impervious value, Ai = 0.800
 281 Sub-Area C Value = 0.790
 282 Rainfall intensity = 8.254(In/Hr) for a 100.0 year storm
 283 Effective runoff coefficient used for total area
 284 (Q=KCIA) is C = 0.790 CA = 0.382
 285 Subarea runoff = 1.189(CFS) for 0.206(Ac.)
 286 Total runoff = 3.149(CFS) Total area = 0.483(Ac.)
 287 Depth of flow = 0.289(Ft.), Average velocity = 3.045(Ft/s)

289
 290 *****
 291 Process from Point/Station 105.000 to Point/Station 105.000
 292 **** CONFLUENCE OF MAIN STREAMS ****
 293

294 The following data inside Main Stream is listed:

295 In Main Stream number: 2
 296 Stream flow area = 0.483(Ac.)
 297 Runoff from this stream = 3.149(CFS)
 298 Time of concentration = 5.68 min.
 299 Rainfall intensity = 8.254(In/Hr)
 300 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	1.140	6.25	7.755
2	3.149	5.68	8.254

301
 302
 303
 304
 305
 306
 307
 308 Qmax(1) =
 309 1.000 * 1.000 * 1.140) +
 310 0.940 * 1.000 * 3.149) + = 4.099
 311 Qmax(2) =
 312 1.000 * 0.908 * 1.140) +
 313 1.000 * 1.000 * 3.149) + = 4.184
 314

315 Total of 2 main streams to confluence:
 316 Flow rates before confluence point:
 317 1.140 3.149
 318 Maximum flow rates at confluence using above data:
 319 4.099 4.184
 320 Area of streams before confluence:
 321 2.190 0.483
 322

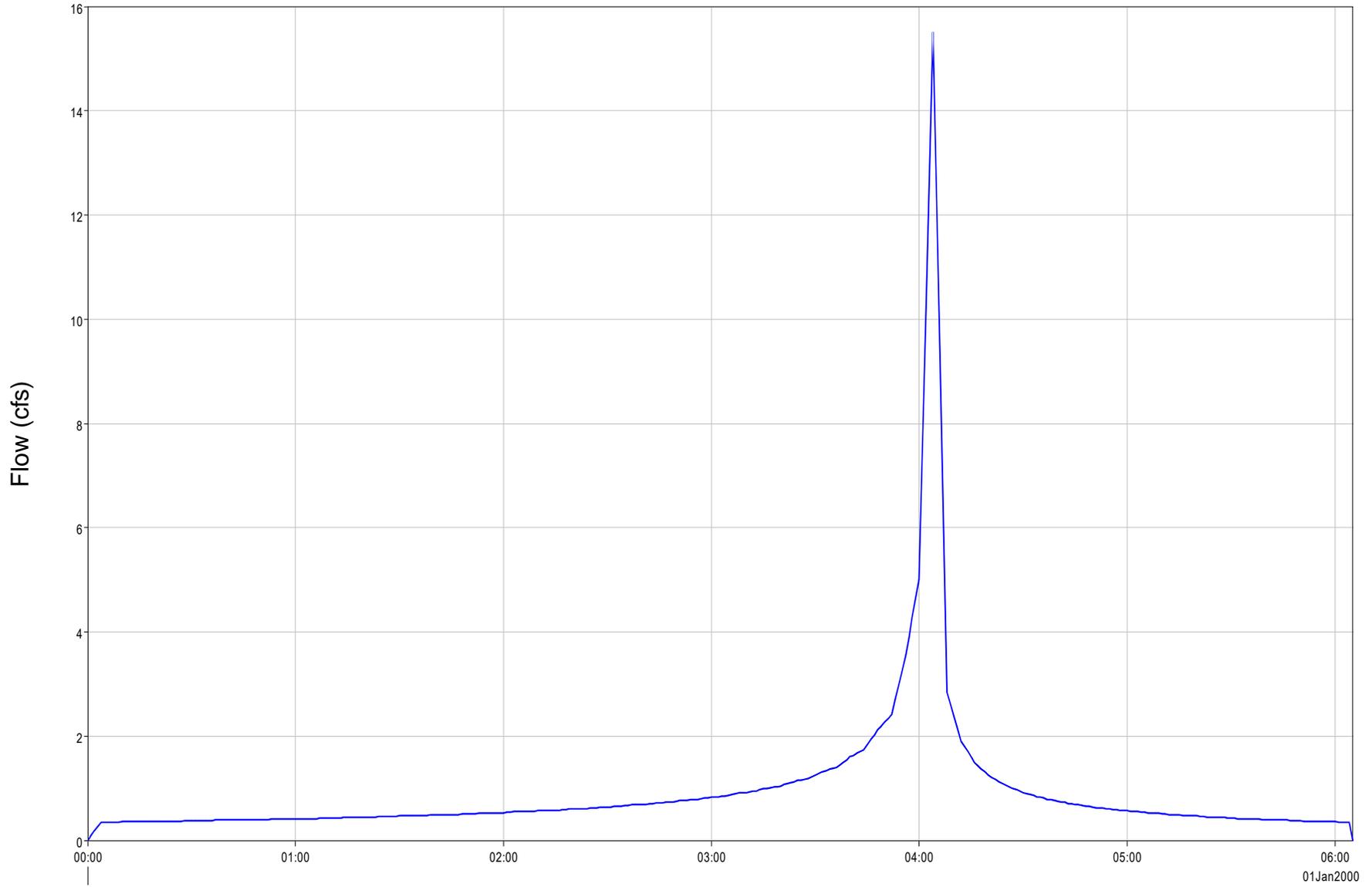
323
 324 Results of confluence:
 325 Total flow rate = 4.184(CFS)
 326 Time of concentration = 5.677 min.
 327 Effective stream area after confluence = 2.673(Ac.)
 328 End of computations, total study area = 2.673 (Ac.)
 329
 330
 331

**ATTACHMENT 7
HYDROGRAPH**

7a. HEC-HMS Simulations Results

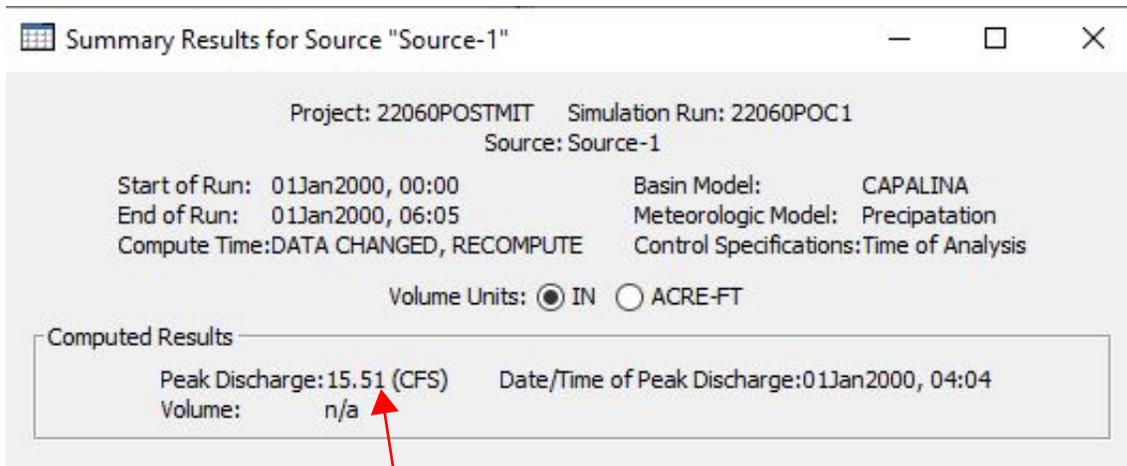
BMP-A INFLOW HYDROGRAPH

Source "Source-1" Results for Run "22060POC1"



Run:22060POC1Element:Source-1Result:OutflowEXPIRED

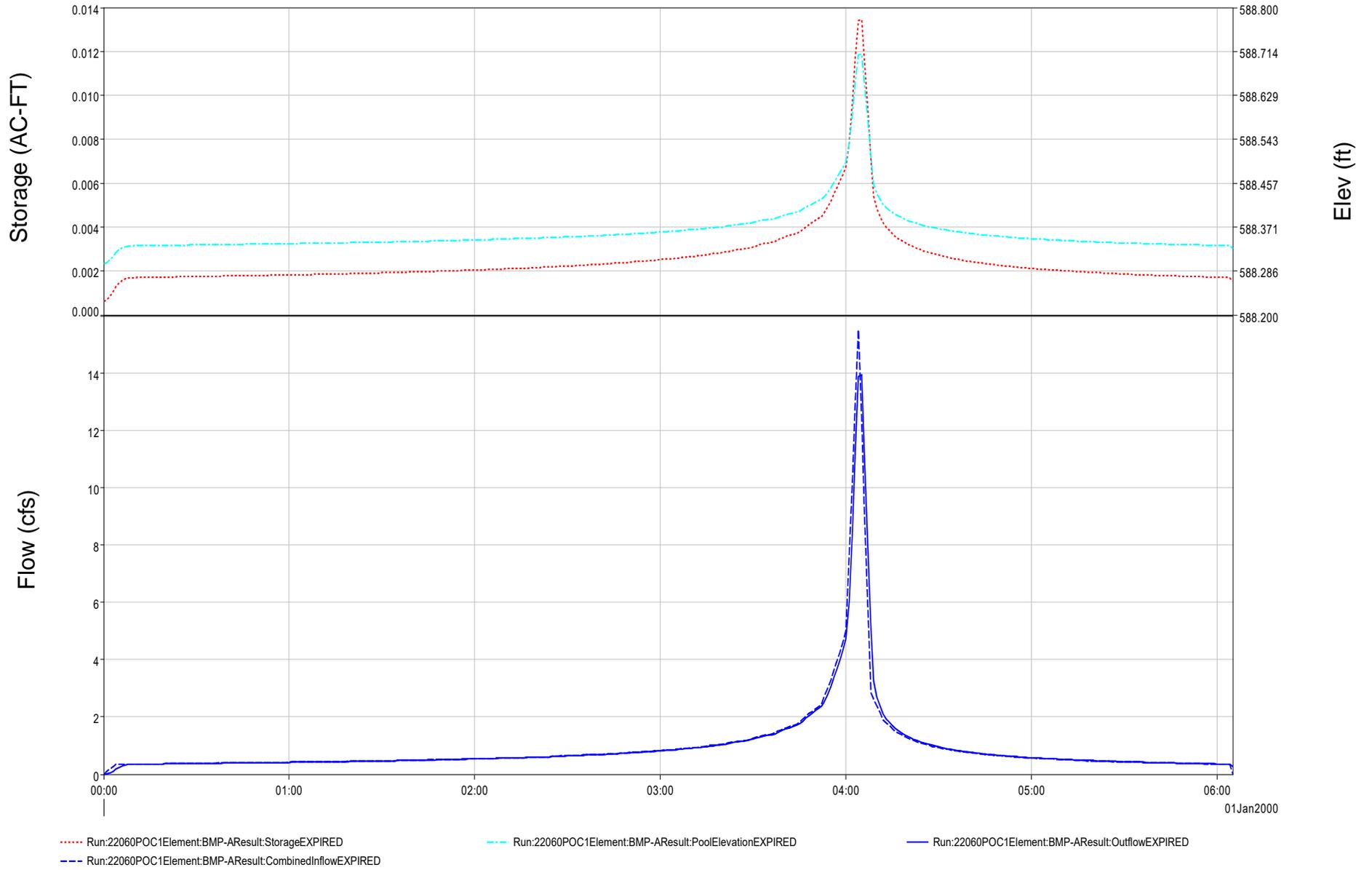
22060-CAPALINA-Q100 HYDRLOGY DETENTION INFLOW SUMMARY TABLE



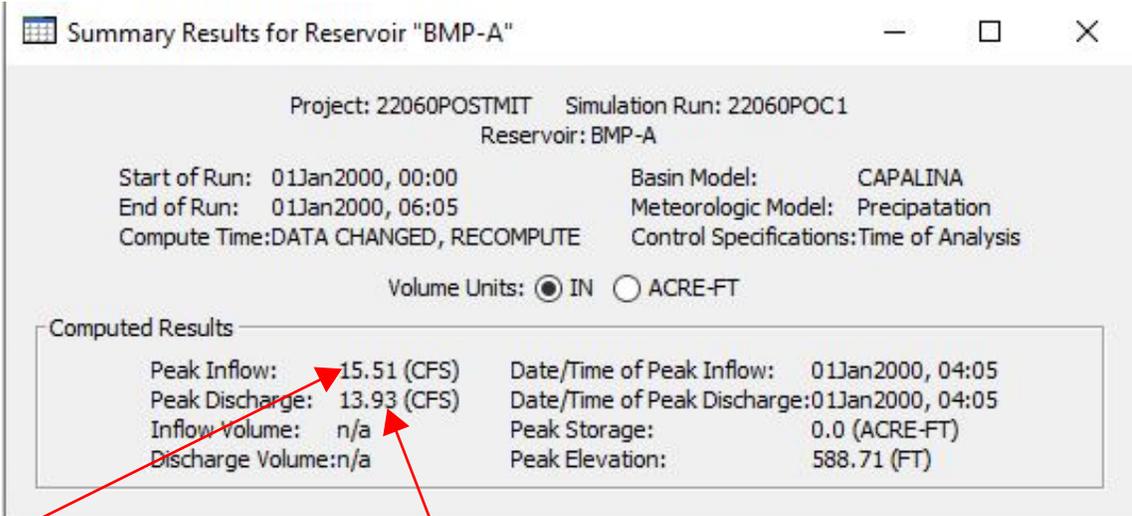
Inflow of BMP-A, which is consistent with CIVILD file of hydrograph for BMP-A. Please refer detail post development hydrograph for BMP-A to Attachment 6b of this report.

BMP-A INFLOW V.S. OUTFLOWHYDROGRAPH

Reservoir "BMP-A" Results for Run "22060POC1"



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



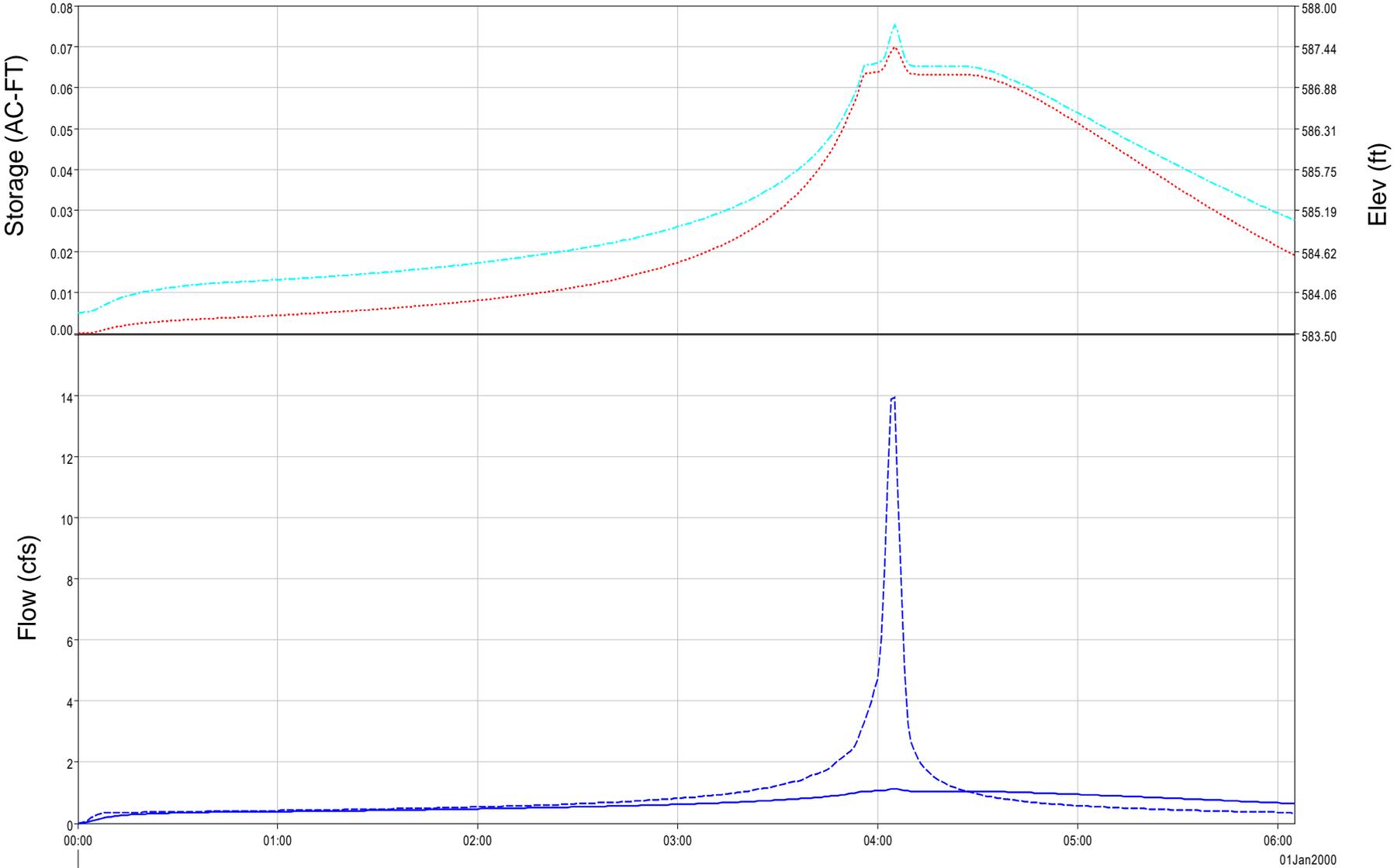
Project: 22060POSTMIT		Simulation Run: 22060POC1	
Reservoir: BMP-A			
Start of Run:	01Jan2000, 00:00	Basin Model:	CAPALINA
End of Run:	01Jan2000, 06:05	Meteorologic Model:	Precipatation
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Time of Analysis
Volume Units: <input checked="" type="radio"/> IN <input type="radio"/> ACRE-FT			
Computed Results			
Peak Inflow:	15.51 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 04:05
Peak Discharge:	13.93 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:05
Inflow Volume:	n/a	Peak Storage:	0.0 (ACRE-FT)
Discharge Volume:	n/a	Peak Elevation:	588.71 (FT)

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

Reservoir "Detention pipe 1" Results for Run "22060POC1"



Run:22060POC1Element:Detentionpipe1Result:StorageEXPIRED
Run:22060POC1Element:Detentionpipe1Result:CombinedInflowEXPIRED

Run:22060POC1Element:Detentionpipe1Result:PoolElevationEXPIRED

Run:22060POC1Element:Detentionpipe1Result:OutflowEXPIRED

01Jan2000

22060-CAPALINA-Q100 HYDRLOGY DETENTION PIPE SUMMARY TABLE

Summary Results for Reservoir "Detention pipe 1"

Project: 22060POSTMIT Simulation Run: 22060POC1
Reservoir: Detention pipe 1

Start of Run: 01Jan2000, 00:00 Basin Model: CAPALINA
End of Run: 01Jan2000, 06:05 Meteorologic Model: Precipitation
Compute Time: DATA CHANGED, RECOMPUTE Control Specifications: Time of Analysis

Volume Units: IN ACRE-FT

Computed Results

Peak Inflow:	13.93 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 04:05
Peak Discharge:	1.14 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:05
Inflow Volume:	n/a	Peak Storage:	0.1 (ACRE-FT)
Discharge Volume:	n/a	Peak Elevation:	587.74 (FT)

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

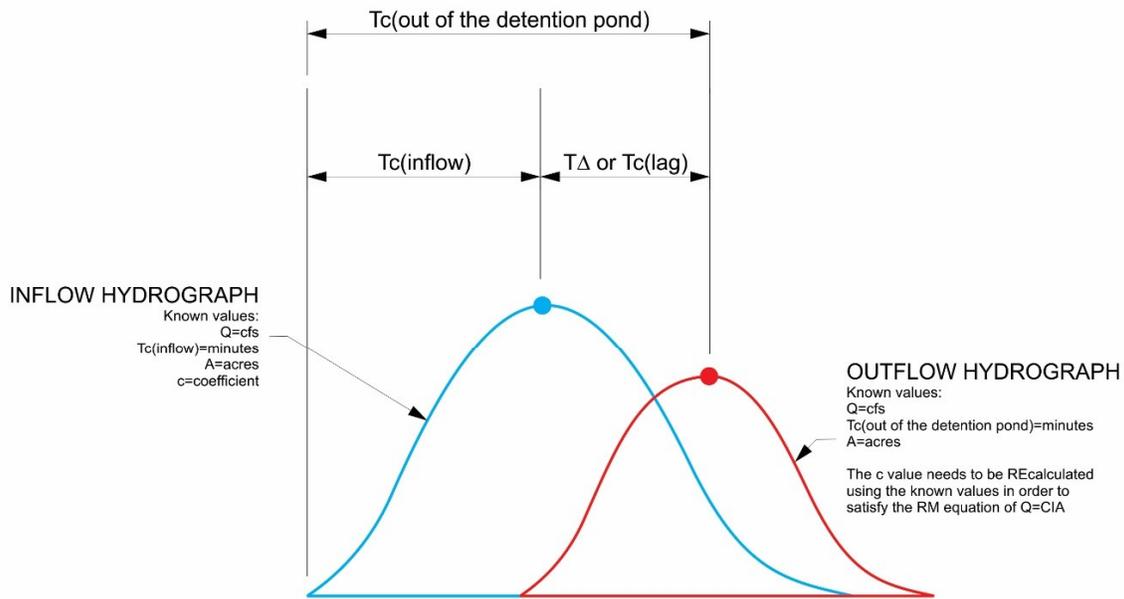
A = Area of the tributary area being examined; (This value does not change)

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 (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 (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 $T\Delta$ time lag between $Q_{(\text{inflow})}$ & $Q_{(\text{out of the detention structure})}$.

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

- $Q = \text{cfs}$
- $T_c(\text{out of the detention structure}) = \text{minutes}$
- $A = \text{acres}$
- *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 $T_c(\text{out of the detention structure})$ 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

$$\text{this stage: } Q = CIA \quad I = \frac{7.44P_6D^{-0.645}}{C}$$

Where:

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

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

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

(minutes) $T_{c(\text{out of the detention structure})} = T_{c(\text{inflow})} + T\Delta$ (minutes)

P_6 = 6 hour precipitation (inches), known value.

I = intensity (inches/hour), calculated based on the value of $T_{c(\text{out of the detention structure})}$

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 , T_c 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 $T_{c(\text{out of the detention structure})}$, 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 , T_c 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.