ESCONDIDO 7-ELEVEN

900 W. MISSION AVENUE
ESCONDIDO, CA 92025

PRELIMINARY HYDROLOGIC REPORT

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ESCONDIDO 7-ELEVEN

PRELIMINARY HYDROLOGY REPORT

TABLE OF CONTENTS:

I. PURPOSE AND SCOPE

This report was prepared in support of the Escondido 7-Eleven Entitlement package application and Preliminary Storm Water Quality Management Plan. The purpose of this report is to discuss the existing drainage pattern and proposed drainage strategy for the project and size the on-site Biofiltration Storage BMP based on the calculated Design Capture Volume (DCV) per City of Escondido NPDES standards and County of San Diego BMPDM.

The proposed project is located on the northwest corner of W. Mission Avenue and Rock Springs Road in the City of Escondido. The improvements include demolition of existing buildings and adjoining parking lot paving covering 100% of the 1.11 acre lot, as well as construction of a 7-Eleven convenience store and covered gasoline fueling station.

II. DESIGN METHODOLOGY AND CALCULATIONS

The 1.11 acre project site is developed in its current condition. Under the existing condition, storm runoff surface flows across the site from the north toward the south and directly off-site onto W. Mission Avenue. Under the proposed condition storm runoff will continue to surface flow. However, site grading will be such that 30% of the project site will be converted to pervious, non-paved planter areas. A large planter area extending the full width of the property will be constructed along the northerly property line and will retain its own rainfall tributary to the planter and act as a self-mitigating Drainage Management Area (DMA). The remainder of the site will follow existing grading and drainage patterns flowing in a north to south direction. However, all runoff will be directed to planter areas toward the southerly end of the project site where structural control BMP Infiltration basins will be located.

The two proposed biofiltration basins will be shallow (1ft deep minimum) and provide on-site storm water storage in an amount defined as the Design Capture Volume (DCV) the 85th percentile, 24 hour storm event as required by City of Escondido WQMP and County of San Diego BMPDM standards. When storm volumes exceed the DCV, storm runoff will overflow the biofiltration basins, leaving the site onto W. Mission Avenue and flowing east across Rock Springs Road where it will be captured by a curb inlet entering the City's public storm drain system and conveyed underground south outletting into Escondido Creek. Escondido Creek meanders flowing in a westerly direction toward its terminus at San Elijo Lagoon adjacent to the Pacific Ocean.

The proposed development also includes a gasoline fueling station. The surface of the fueling station pad is a self-mitigating DMA in that the site will be graded so that no storm runoff will be allowed to enter the fueling station surface areas. Also, improvements will be designed so that no gasoline spills on the filling station pad will be allowed to leave the area where they could potentially co-mingle with storm flows. All surface drainage from the filling station pad will be collected in an underground treatment system where flows will ultimately be directed to the public sewer system. Storm water that lands on the canopy and roof of these facilities will remain separate and be included in storage calculations for on-site storm runoff.

This project is subject to MS-4 requirements and therefore must implement a project specific Storm Water Quality Control Plan (SWQMP). In order to satisfy the requirements of the SWQMP, the design will implement site BMPs for storm flow capture with landscaping and bio-detention basin treatment (BF-1) with underground release system to the existing drainage facility. A significant amount of the 100 year, 6 hour event will be stored within the Bio-detention basin and treated per State standards of storm water management practices, while the peak flows will drain via surface flow to the existing storm drain curb inlet that is part of an underground storm drain system that conveys collected storm run-off to Escondido Creek. The site design does not accept any off-site tributary flows and is kept separate.

DESIGN CRITERIA (DCV)

The following parameters were used in the preparation of the calculations provided in this report:

- Percent Impervious (Existing) 98%
- Percent Impervious (Proposed) 70%
- Design Capture Storm Depth (d) 0.54” Figure B 1.1 Escondido SWD Manual
- Tributary area to BMPs 0.83 acres
- Area Weighted Runoff Factor (C) 0.90 (Impervious) and 0.14 (Type B Soil)
- Project Site Area 1.11 acres

Section V of this report provides calculations and data quantifying the DCV.

DESIGN CRITERIA (100 Year)

The following parameters were used in the preparation of the calculations provided in this report:

- 100 year – 6 hour Precipitation 3.5” San Diego County Isopluvial Maps
- 100 year – 24 hour Precipitation 6.0” San Diego County Isopluvial Maps
- Hydrologic Soil Type “B” Geotechnical Report

A summary of the San Diego County Rational Method Hydrograph of each development area is presented below:

Summary (Developed Condition) for the runoff (Q=CIA)

Hydraulic Summary

The overall Escondido 7-Eleven is divided into 2 hydraulic drainage-areas (Area-1 and Area-2). The remaining drainage areas (Area-3) is self-mitigating, and are shown only for total influence area (total 1.11 acre). Below is a summary of calculations and findings for each sub-area.

	Area (acre)	Length (ft.)	Δ ELEVATION (ft.)	Slope (%)	Q (c.f./s)
Area-1	0.28	215	650.1-647.0 = 3.1	1.44%	1.44
Area-2	0.62	240	650.0-646.7 = 3.3	1.38%	3.04
Area-3	0.21	---	---	---	---
Total	1.11	---	---	---	4.48

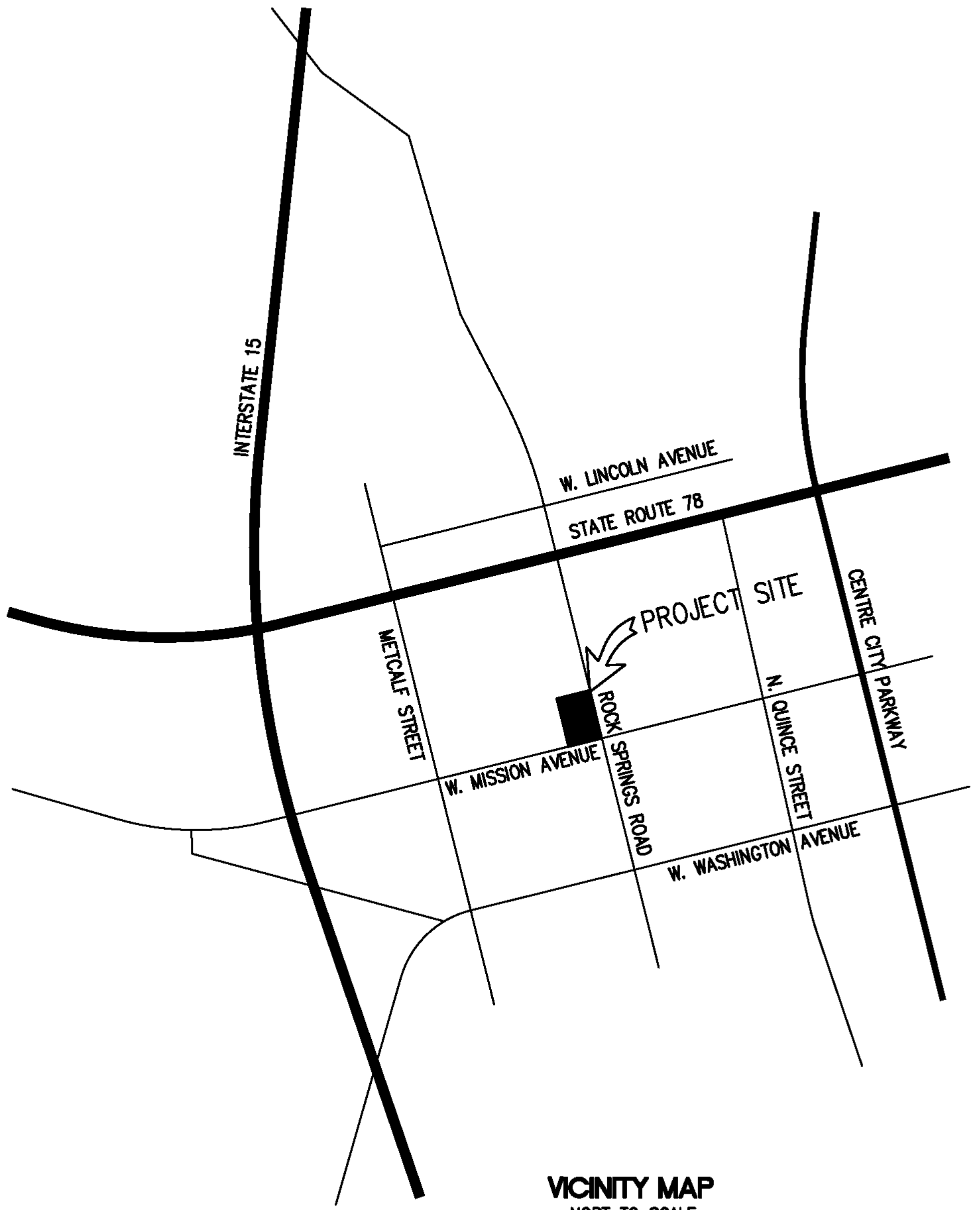
Hydrology Conclusion

The volume provide within the lower portion of the biofiltration basins is provided for treatment via a modified County BF-1 Bio-filtration BMP, which meets or exceeds the State requirements calculated in the SWQMP. The additional detention volume above the treatment elevation is discharged accordingly, through the basins outlet pipe. Any peak flows that overfill the basins will drain via surface flow directly onto W Mission Avenue, then in an easterly direction where storm flows are captured by an existing storm drain curb inlet. The existing storm drain curb inlet is part of an underground storm drain system that conveys collected storm run-off to Escondido Creek.

The entire basin will be emptied within the 48 hour prescribed by State required vector control. The proposed site and basin is not designed to accept off-site flows.

III. VACINITY MAP

Project Name: Escondido 7-Eleven
Permit Application Number:



VICINITY MAP
NORT TO SCALE

IV. HYDROLOGY SITE MAP

IN THE CITY OF ESCONDIDO, STATE OF CALIFORNIA

ESCONDIDO 7-ELEVEN
SWQMP AND HYDROLOGY SITE PLAN

PERVIOUS AREA RATIO

TOTAL SITE AREA = 1.11 AC.

PROPOSED SITE:

LANDSCAPE AREA (PERVIOUS) = 0.30 AC.

PERVIOUS AREA RATIO = 0.30 AC./1.11 AC. = 27%

EXISTING SITE:

LANDSCAPE AREA (PERVIOUS) = 0.02

PERVIOUS AREA RATIO = 0.02 AC./1.11 AC. = 2%

DESIGN CAPTURE VOLUME (DCV) = 1,383 CU. FT.
BIOFILTRATION BMP VOLUME PROVIDED = 1,518 CU. FT

HYDRAULIC SOIL GROUP

UNDERLYING SOIL GROUP 'TYPE B'

EXISTING NATURAL HYDRAULIC FEATURES

N/A (NONE EXISTING)

CRITICAL COURSE SEDIMENT YIELD AREAS

N/A (NONE EXISTING)

DEPTH TO GROUNDWATER

ESTIMATED GROUNDWATER DEPTH= > 20 FT

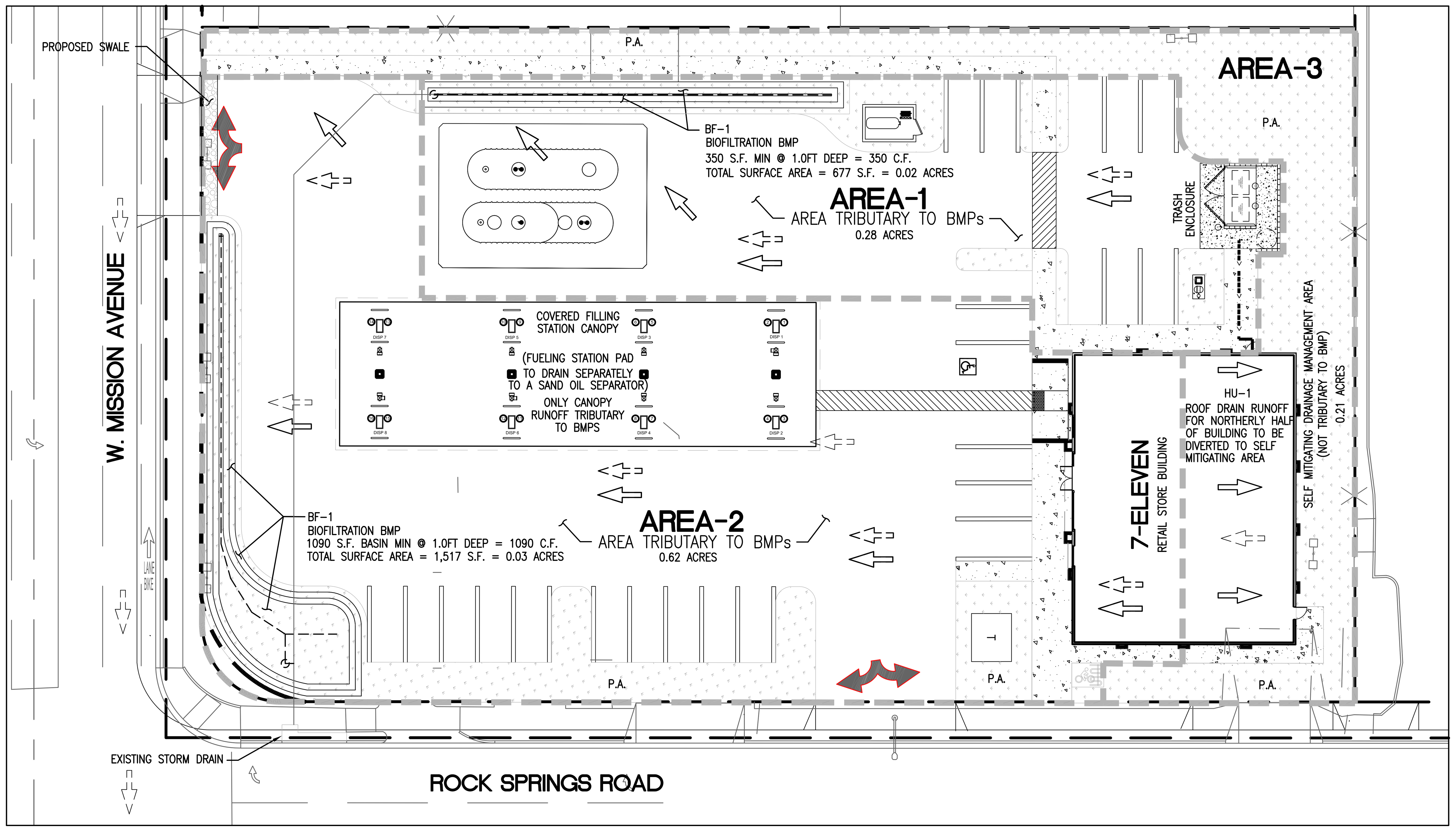
SITE ADDRESS

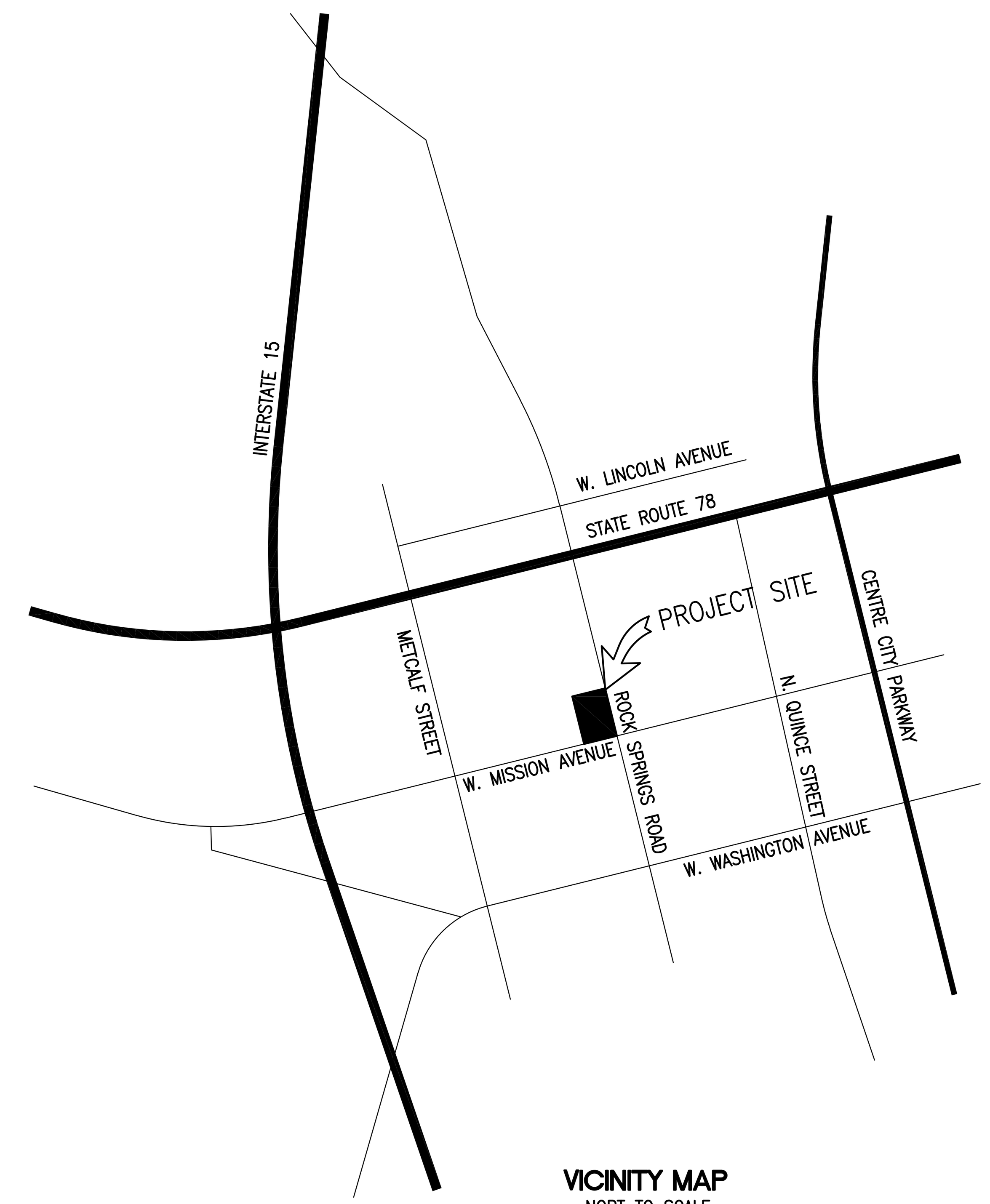
900 W MISSION AVENUE
ESCONDIDO, CA 92025

APN: 228-220-043

LEGEND

TRIBUTARY AREA	
HISTORIC DRAINAGE PATH	
PROPOSED DRAINAGE PATH	
PLANTER AREA	P.A.





VICINITY MAP
NORT TO SCALE

GRAPHIC SCALE
SCALE 1"=20'
0 10 20 40 60 80

DRAINAGE MANAGEMENT AREA TABLE					
DMA ID	AREA (AC)	SURFACE TYPE	BMP	DCV	Q100
AREA-1	0.28	0.23 AC (IMPERVIOUS) 0.05 AC (TYPE B SOIL)	BF-1	424 CF	1.44 CFS
AREA-2	0.62	0.53 AC (IMPERVIOUS) 0.09 AC (TYPE B SOIL)	BF-1	959 CF	3.04 CFS
AREA-3	0.21		(SELF MITIGATING)		
TOTAL	1.11			1383 CF	4.48 CFS

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ENGINEERING | PLANNING | SURVEY | ENVIRONMENTAL

CITY OF ESCONDIDO
SWQMP AND HYDROLOGY SITE PLAN
ESCONDIDO 7-ELEVEN
PROPOSED CONDITION

FOR:

SHEET 1 OF 1

V. DESIGN CAPTURE AND WATER QUALITY CALCULATIONS

The infiltration BMPs will be sized to store the Design Capture Volume (DCV) defined as the 85th percentile, 24 hour storm event. The DCV is calculated as follows:

Automated Worksheet B.1: Calculation of Design Capture Volume (V2.0)

Category	#	Description	i	ii	iii	iv	v	Units
Standard Drainage Basin Inputs	1	Drainage Basin ID or Name	Area-1	Area-2				unitless
	2	85th Percentile 24-hr Storm Depth	0.54	0.54				inches
	3	Impervious Surfaces Not Directed to Dispersion Area (C=0.90)	10,102	23,026				sq-ft
	4	Semi-Pervious Surfaces Not Serving as Dispersion Area (C=0.30)						sq-ft
	5	Engineered Pervious Surfaces Not Serving as Dispersion Area (C=0.10)						sq-ft
	6	Natural Type A Soil Not Serving as Dispersion Area (C=0.10)						sq-ft
	7	Natural Type B Soil Not Serving as Dispersion Area (C=0.14)	1,966	3,938				sq-ft
	8	Natural Type C Soil Not Serving as Dispersion Area (C=0.23)						sq-ft
	9	Natural Type D Soil Not Serving as Dispersion Area (C=0.30)						sq-ft
Dispersion Area, Tree Well & Rain Barrel Inputs (Optional)	10	Does Tributary Incorporate Dispersion, Tree Wells, and/or Rain Barrels?	No	No				yes/no
	11	Impervious Surfaces **Directed to Dispersion Area** per SD-B (Ci=0.90)						sq-ft
	12	Semi-Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.30)						sq-ft
	13	Engineered Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.10)						sq-ft
	14	Natural Type A Soil **Serving as Dispersion Area** per SD-B (Ci=0.10)						sq-ft
	15	Natural Type B Soil **Serving as Dispersion Area** per SD-B (Ci=0.14)						sq-ft
	16	Natural Type C Soil **Serving as Dispersion Area** per SD-B (Ci=0.23)						sq-ft
	17	Natural Type D Soil **Serving as Dispersion Area** per SD-B (Ci=0.30)						sq-ft
	18	Number of Tree Wells Proposed per SD-A						#
	19	Average Mature Tree Canopy Diameter						ft
	20	Number of Rain Barrels Proposed per SD-E						#
	21	Average Rain Barrel Size						gal
Initial Runoff Factor Calculation	22	Total Tributary Area	12,068	26,964	0	0	0	sq-ft
	23	Initial Runoff Factor for Standard Drainage Areas	0.78	0.79	0.00	0.00	0.00	unitless
	24	Initial Runoff Factor for Dispersed & Dispersion Areas	0.00	0.00	0.00	0.00	0.00	unitless
	25	Initial Weighted Runoff Factor	0.78	0.79	0.00	0.00	0.00	unitless
	26	Initial Design Capture Volume	424	959	0	0	0	cubic-feet
Dispersion Area Adjustments	27	Total Impervious Area Dispersed to Pervious Surface	0	0	0	0	0	sq-ft
	28	Total Pervious Dispersion Area	0	0	0	0	0	sq-ft
	29	Ratio of Dispersed Impervious Area to Pervious Dispersion Area	n/a	n/a	n/a	n/a	n/a	ratio
	30	Adjustment Factor for Dispersed & Dispersion Areas	1.00	1.00	1.00	1.00	1.00	ratio
	31	Runoff Factor After Dispersion Techniques	0.78	0.79	n/a	n/a	n/a	unitless
	32	Design Capture Volume After Dispersion Techniques	424	959	0	0	0	cubic-feet
Tree & Barrel Adjustments	33	Total Tree Well Volume Reduction	0	0	0	0	0	cubic-feet
	34	Total Rain Barrel Volume Reduction	0	0	0	0	0	cubic-feet
Results	35	Final Adjusted Runoff Factor	0.78	0.79	0.00	0.00	0.00	unitless
	36	Final Effective Tributary Area	9,413	21,302	0	0	0	sq-ft
	37	Initial Design Capture Volume Retained by Site Design Elements	0	0	0	0	0	cubic-feet
	38	Final Design Capture Volume Tributary to BMP	424	959	0	0	0	cubic-feet

No Warning Messages

Automated Worksheet B.2: Retention Requirements (V2.0)

Category	#	Description	*i*	*ii*	*iii*	*iv*	*v*	Units
Basic Analysis	1	Drainage Basin ID or Name	Area-1	Area-2	-	-	-	unitless
	2	85th Percentile Rainfall Depth	0.54	0.54	-	-	-	inches
	3	Predominant NRCS Soil Type Within BMP Location	B	B				unitless
	4	Is proposed BMP location Restricted or Unrestricted for Infiltration Activities?	Restricted	Restricted				unitless
	5	Nature of Restriction	n/a	n/a				unitless
	6	Do Minimum Retention Requirements Apply to this Project?	Yes	Yes				yes/no
	7	Are Habitable Structures Greater than 9 Stories Proposed?	No	No				yes/no
Advanced Analysis	8	Has Geotechnical Engineer Performed an Infiltration Analysis?	Yes	Yes				yes/no
	9	Design Infiltration Rate Recommended by Geotechnical Engineer	0.261	0.261				in/hr
Result	10	Design Infiltration Rate Used To Determine Retention Requirements	0.000	0.000	-	-	-	in/hr
	11	Percent of Average Annual Runoff that Must be Retained within DMA	4.5%	4.5%	-	-	-	percentage
	12	Fraction of DCV Requiring Retention	0.02	0.02	-	-	-	ratio
	13	Required Retention Volume	8	19	-	-	-	cubic-feet

No Warning Messages

Automated Worksheet B.3: BMP Performance (V2.0)

Category	#	Description	i	ii	iii	iv	v	Units
BMP Inputs	1	Drainage Basin ID or Name	Area-1	Area-2	-	-	-	sq-ft
	2	Design Infiltration Rate Recommended	0.000	0.000	-	-	-	in/hr
	3	Design Capture Volume Tributary to BMP	424	959	-	-	-	cubic-feet
	4	Is BMP Vegetated or Unvegetated?	Vegetated	Vegetated				unitless
	5	Is BMP Impermeably Lined or Unlined?	Lined	Lined				unitless
	6	Does BMP Have an Underdrain?	Underdrain	Underdrain				unitless
	7	Does BMP Utilize Standard or Specialized Media?	Standard	Standard				unitless
	8	Provided Surface Area	926	1,090				sq-ft
	9	Provided Surface Ponding Depth	6	6				inches
	10	Provided Soil Media Thickness	18	18				inches
	11	Provided Gravel Thickness (Total Thickness)	6	6				inches
	12	Underdrain Offset	3	3				inches
	13	Diameter of Underdrain or Hydromod Orifice (Select Smallest)	0.50	0.50				inches
	14	Specialized Soil Media Filtration Rate						in/hr
	15	Specialized Soil Media Pore Space for Retention						unitless
	16	Specialized Soil Media Pore Space for Biofiltration						unitless
	17	Specialized Gravel Media Pore Space						unitless
Retention Calculations	18	Volume Infiltrated Over 6 Hour Storm	0	0	0	0	0	cubic-feet
	19	Ponding Pore Space Available for Retention	0.00	0.00	1.00	1.00	1.00	unitless
	20	Soil Media Pore Space Available for Retention	0.05	0.05	0.05	0.05	0.05	unitless
	21	Gravel Pore Space Available for Retention (Above Underdrain)	0.00	0.00	0.40	0.40	0.40	unitless
	22	Gravel Pore Space Available for Retention (Below Underdrain)	0.40	0.40	0.40	0.40	0.40	unitless
	23	Effective Retention Depth	2.10	2.10	0.00	0.00	0.00	inches
	24	Fraction of DCV Retained (Independent of Drawdown Time)	0.38	0.20	0.00	0.00	0.00	ratio
	25	Calculated Retention Storage Drawdown Time	120	120	0	0	0	hours
	26	Efficacy of Retention Processes	0.37	0.22	0.00	0.00	0.00	ratio
	27	Volume Retained by BMP (Considering Drawdown Time)	159	212	0	0	0	cubic-feet
	28	Design Capture Volume Remaining for Biofiltration	265	747	0	0	0	cubic-feet
Biofiltration Calculations	29	Max Hydromod Flow Rate through Underdrain	0.0098	0.0098	0.0000	0.0000	0.0000	cfs
	30	Max Soil Filtration Rate Allowed by Underdrain Orifice	0.46	0.39	0.00	0.00	0.00	in/hr
	31	Soil Media Filtration Rate per Specifications	5.00	5.00	5.00	5.00	5.00	in/hr
	32	Soil Media Filtration Rate to be used for Sizing	0.46	0.39	0.00	0.00	0.00	in/hr
	33	Depth Biofiltered Over 6 Hour Storm	2.74	2.33	0.00	0.00	0.00	inches
	34	Ponding Pore Space Available for Biofiltration	1.00	1.00	0.00	0.00	0.00	unitless
	35	Soil Media Pore Space Available for Biofiltration	0.20	0.20	0.20	0.20	0.20	unitless
	36	Gravel Pore Space Available for Biofiltration (Above Underdrain)	0.40	0.40	0.40	0.40	0.40	unitless
	37	Effective Depth of Biofiltration Storage	10.80	10.80	0.00	0.00	0.00	inches
	38	Drawdown Time for Surface Ponding	13	15	0	0	0	hours
	39	Drawdown Time for Effective Biofiltration Depth	24	28	0	0	0	hours
	40	Total Depth Biofiltered	13.54	13.13	0.00	0.00	0.00	inches
	41	Option 1 - Biofilter 1.50 DCV: Target Volume	398	1,120	0	0	0	cubic-feet
	42	Option 1 - Provided Biofiltration Volume	398	1,120	0	0	0	cubic-feet
	43	Option 2 - Store 0.75 DCV: Target Volume	199	560	0	0	0	cubic-feet
	44	Option 2 - Provided Storage Volume	199	560	0	0	0	cubic-feet
	45	Portion of Biofiltration Performance Standard Satisfied	1.00	1.00	0.00	0.00	0.00	ratio
Result	46	Do Site Design Elements and BMPs Satisfy Annual Retention Requirements?	Yes	Yes	-	-	-	yes/no
	47	Overall Portion of Performance Standard Satisfied (BMP Efficacy Factor)	1.00	1.00	0.00	0.00	0.00	ratio
	48	**Deficit of Effectively Treated Stormwater**	**0**	**0**	**n/a**	**n/a**	**n/a**	cubic-feet

No Warning Messages

VI. WATERSHED INFORMATION AND STORM FLOW CALCULATIONS

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

INTERPOLATE

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

70%

Cp=0.70

*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

$C = 0.90(0.71/1.11) + 0.70(1 - (0.71/1.11)) = 0.828$

$$C = 0.90 \times (\%\ \text{Impervious}) + C_p \times (1 - \%\ \text{Impervious})$$

Where: C_p = Pervious Coefficient Runoff Value for the soil type (shown in Table 3-1 as Undisturbed Natural Terrain/Permanent Open Space, 0% Impervious). Soil type can be determined from the soil type map provided in Appendix A.

The values in Table 3-1 are typical for most urban areas. However, if the basin contains rural or agricultural land use, parks, golf courses, or other types of nonurban land use that are expected to be permanent, the appropriate value should be selected based upon the soil and cover and approved by the local agency.

3.1.4 Time of Concentration

The Time of Concentration (T_c) is the time required for runoff to flow from the most remote part of the drainage area to the point of interest. The T_c is composed of two components: initial time of concentration (T_i) and travel time (T_t). Methods of computation for T_i and T_t are discussed below. The T_i is the time required for runoff to travel across the surface of the most remote subarea in the study, or "initial subarea." Guidelines for designating the initial subarea are provided within the discussion of computation of T_i. The T_t is the time required for the runoff to flow in a watercourse (e.g., swale, channel, gutter, pipe) or series of watercourses from the initial subarea to the point of interest. For the RM, the T_c at any point within the drainage area is given by:

Area-1 Tc=Ti at 5.79+(Tt not used) = 9.3 min.
Area-2 Tc = 10.0 min.

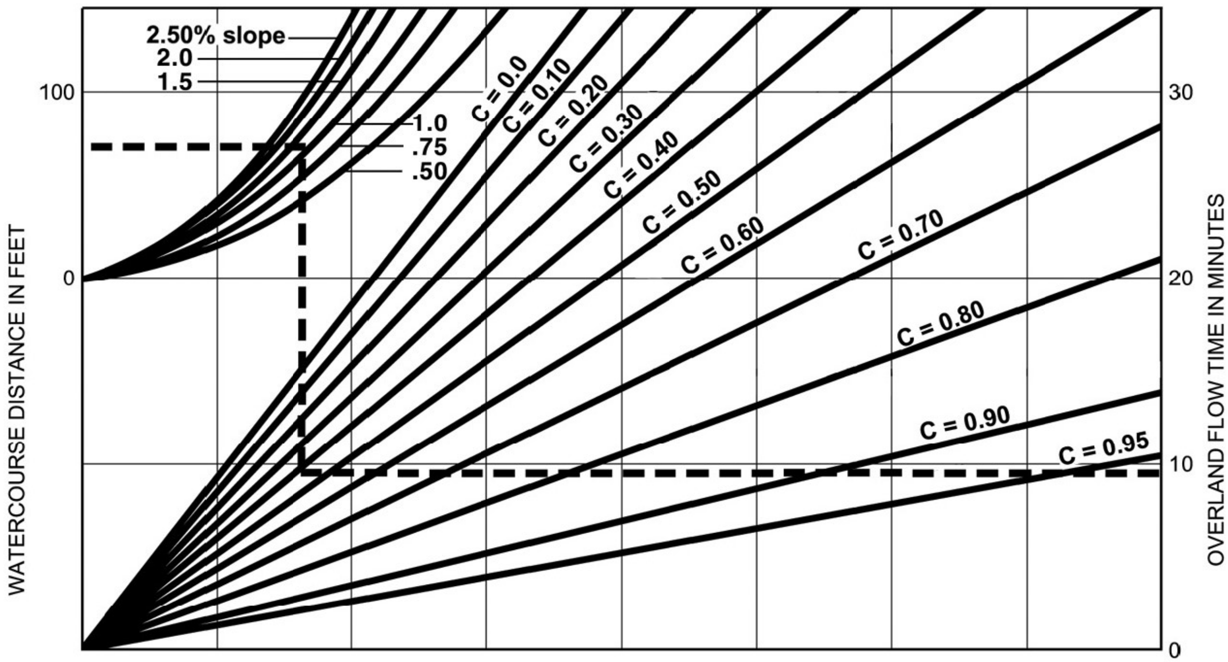
$$T_c = T_i + T_t$$

Methods of calculation differ for natural watersheds (nonurbanized) and for urban drainage systems. When analyzing storm drain systems, the designer must consider the possibility that an existing natural watershed may become urbanized during the useful life of the storm drain system. Future land uses must be used for T_c and runoff calculations, and can be determined from the local Community General Plan.

3.1.4.1 Initial Time of Concentration

The initial time of concentration is typically based on sheet flow at the upstream end of a drainage basin. The Overland Time of Flow (Figure 3-3) is approximated by an equation developed by the Federal Aviation Agency (FAA) for analyzing flow on runaways (FAA, 1970). The usual runway configuration consists of a crown, like most freeways, with sloping pavement that directs flow to either side of the runway. This type of flow is uniform in the direction perpendicular to the velocity and is very shallow. Since these depths are ¼ of an inch (more or less) in magnitude, the relative roughness is high. Some higher relative roughness values for overland flow are presented in Table 3.5 of the *HEC-1 Flood Hydrograph Package User's Manual* (USACE, 1990).

AREA-1



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet

Slope (s) = 1.3%

Runoff Coefficient (C) = 0.41

Overland Flow Time (**T**) = 9.5 Minutes

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

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

3-3

Rational Formula - Overland Time of Flow Nomograph

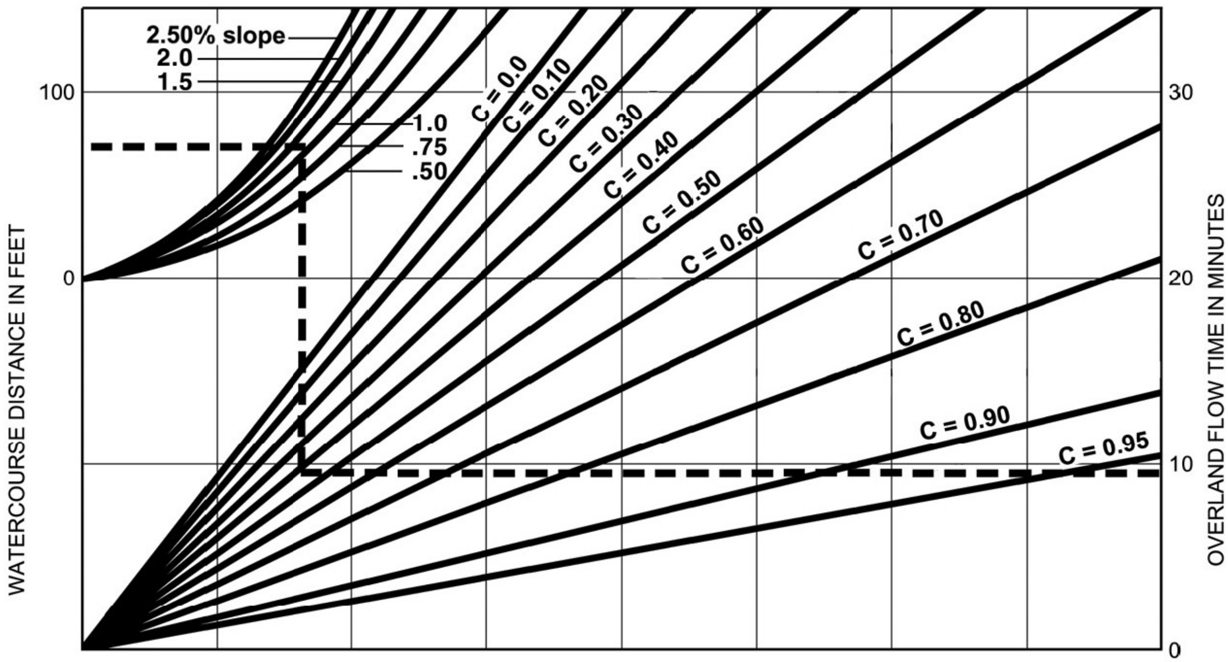
EQ: Tt = (1.8(1.1-C)(D^.5)) / (s^.333) = 9.3 Min.

D= 215

C= 0.70

S= 1.44

AREA-2



EXAMPLE:

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

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

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE **3-3**

Rational Formula - Overland Time of Flow Nomograph

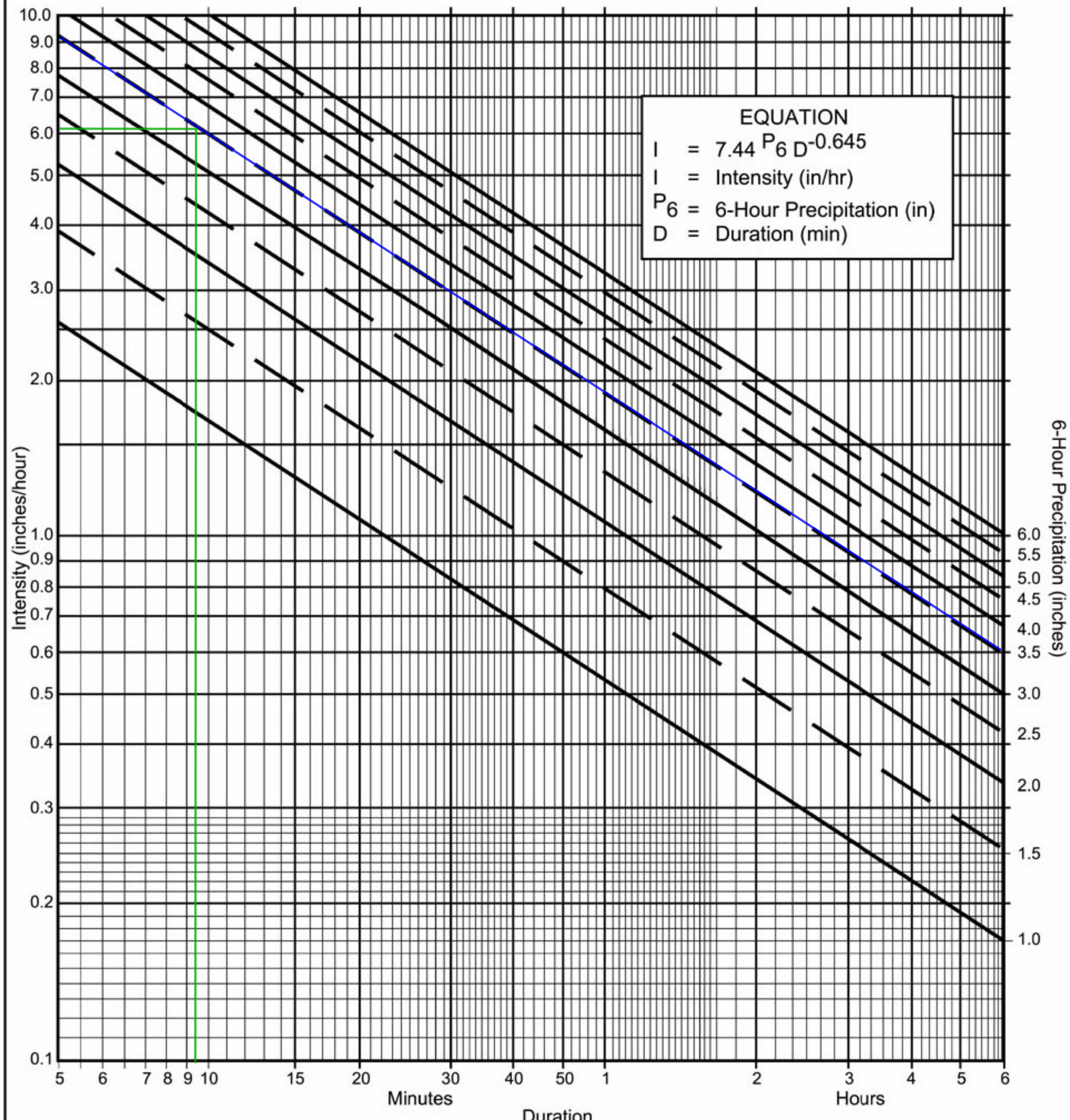
EQ: Tt = (1.8(1.1-C)(D^.5)) / (s^.333) = 10.0 Min.

D= 240

C= 0.70

s=1.38

AREA-1



Directions for Application:

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

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not 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 100 year

(b) P_6 = 3.5 in., P_{24} = 6, $\frac{P_6}{P_{24}}$ = 58.3 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 9.3 min.

(e) I = 6.18 in./hr.

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

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

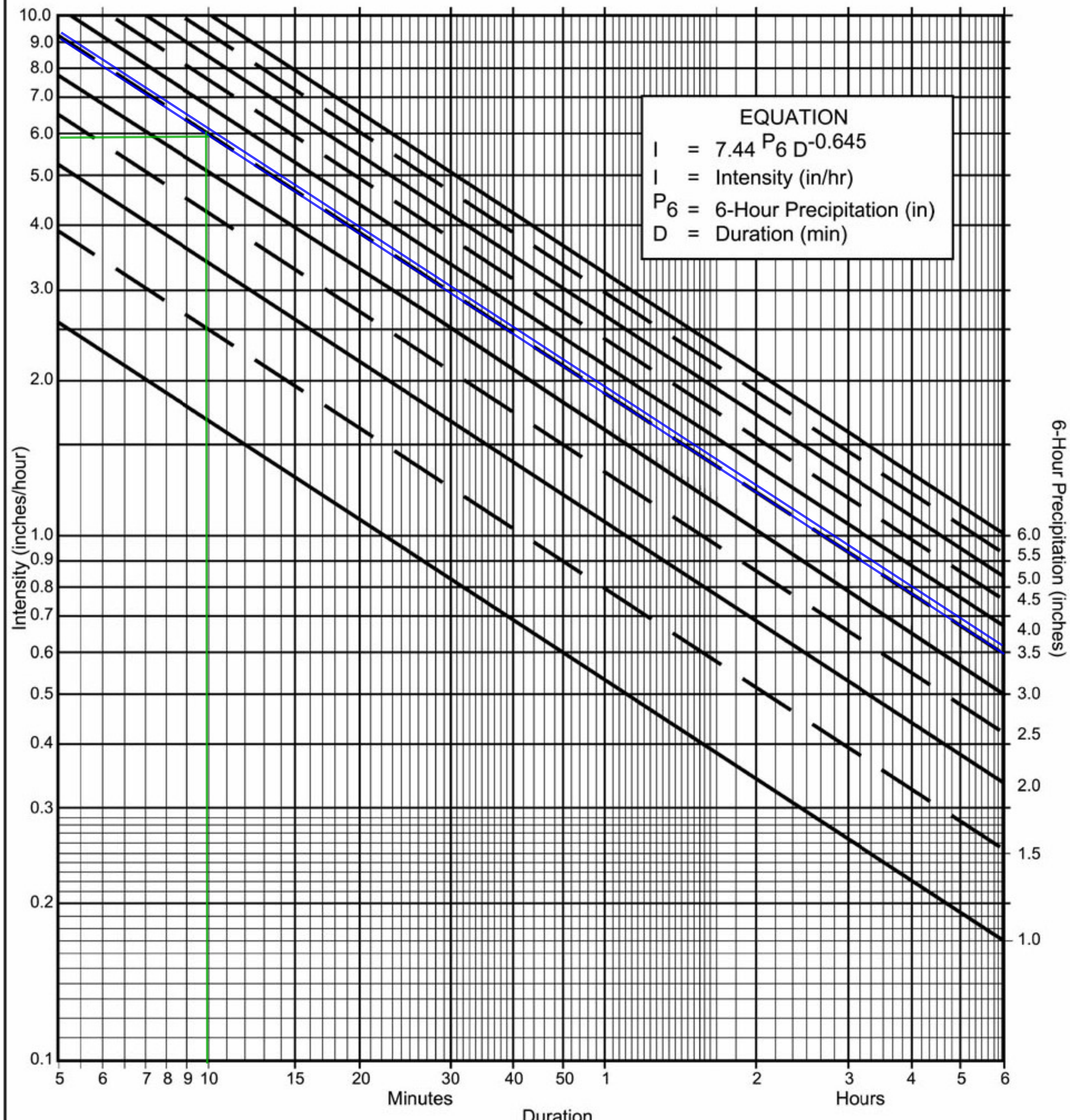
EQ: I = (7.44)(3.5)(9.3^-0.645) = 6.18 IN/HR

Intensity-Duration Design Chart - Template

FIGURE

3-1

AREA-2



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 100 year

(b) P_6 = 3.5 in., P_{24} = 6, $\frac{P_6}{P_{24}}$ = 58.3 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 10.0 min.

(e) I = 5.90 in./hr.

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

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

EQ: $I = (7.44)(3.5)(10.0^{-0.645}) = 5.90$ IN/HR

FIGURE **3-1**

Intensity-Duration Design Chart - Template

flow from the most remote point of the basin to the location being analyzed. The RM formula is expressed as follows:

$$\boxed{Q = C\,I\,A}$$

Q-1 = (0.83)(6.18)(0.28) = 1.44 cfs
Q-2= (0.83)(5.90)(0.62) = 3.04 cfs

Where: Q = peak discharge, in cubic feet per second (cfs)

C = runoff coefficient, proportion of the rainfall that runs off the surface (no units)

I = average rainfall intensity for a duration equal to the T_c for the area, in inches per hour (Note: If the computed T_c is less than 5 minutes, use 5 minutes for computing the peak discharge, Q)

A = drainage area contributing to the design location, in acres

Combining the units for the expression CIA yields:

$$\left(\frac{1\,\text{acre}\times\text{inch}}{\text{hour}}\right)\left(\frac{43{,}560\,\text{ft}^2}{\text{acre}}\right)\left(\frac{1\,\text{foot}}{12\,\text{inches}}\right)\left(\frac{1\,\text{hour}}{3{,}600\,\text{seconds}}\right) \Rightarrow 1.008\,\text{cfs}$$

For practical purposes the unit conversion coefficient difference of 0.8% can be ignored.

The RM formula is based on the assumption that for constant rainfall intensity, the peak discharge rate at a point will occur when the raindrop that falls at the most upstream point in the tributary drainage basin arrives at the point of interest.

Unlike the MRM (discussed in Section 3.4) or the NRCS hydrologic method (discussed in Section 4), the RM does not create hydrographs and therefore does not add separate subarea hydrographs at collection points. Instead, the RM develops peak discharges in the main line by increasing the T_c as flow travels downstream.

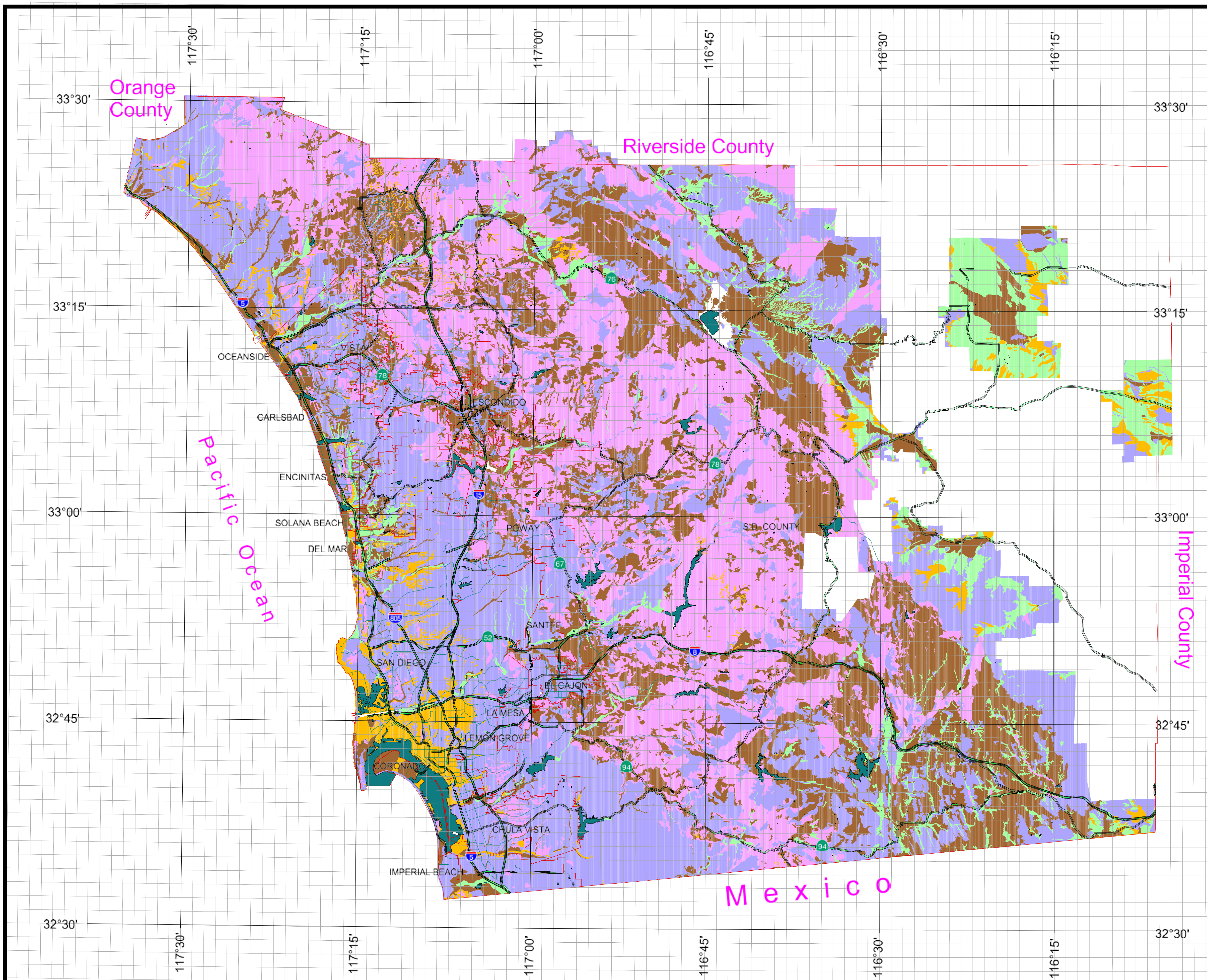
Characteristics of, or assumptions inherent to, the RM are listed below:

- The discharge flow rate resulting from any I is maximum when the I lasts as long as or longer than the T_c.

VII. WATERSHED GEOMETIRC INFORMATION MAP

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

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

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N S E W

3 0 3 Miles

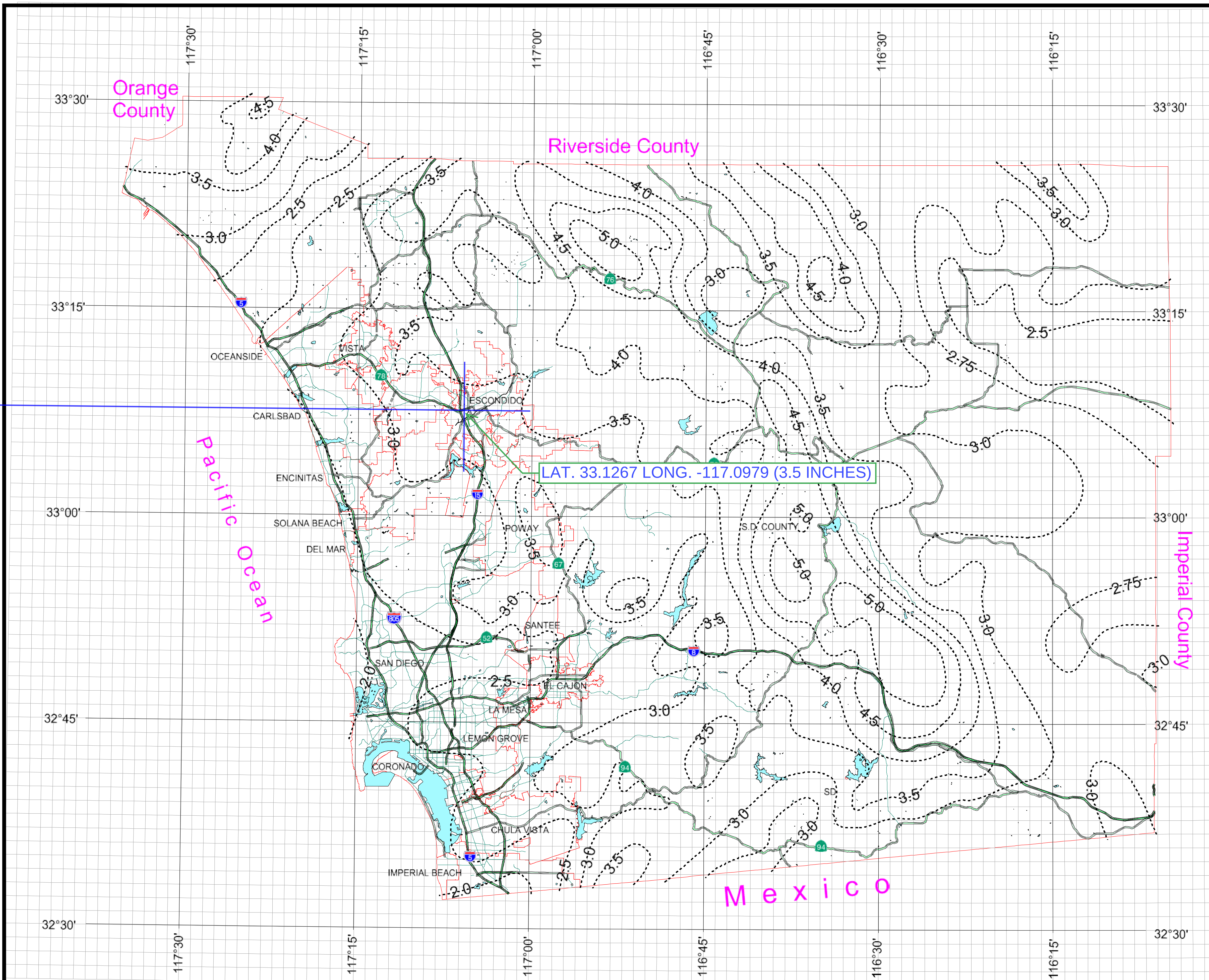
VIII. WATERSHED POINT RAINFALL ISOHYETAL MAPS

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

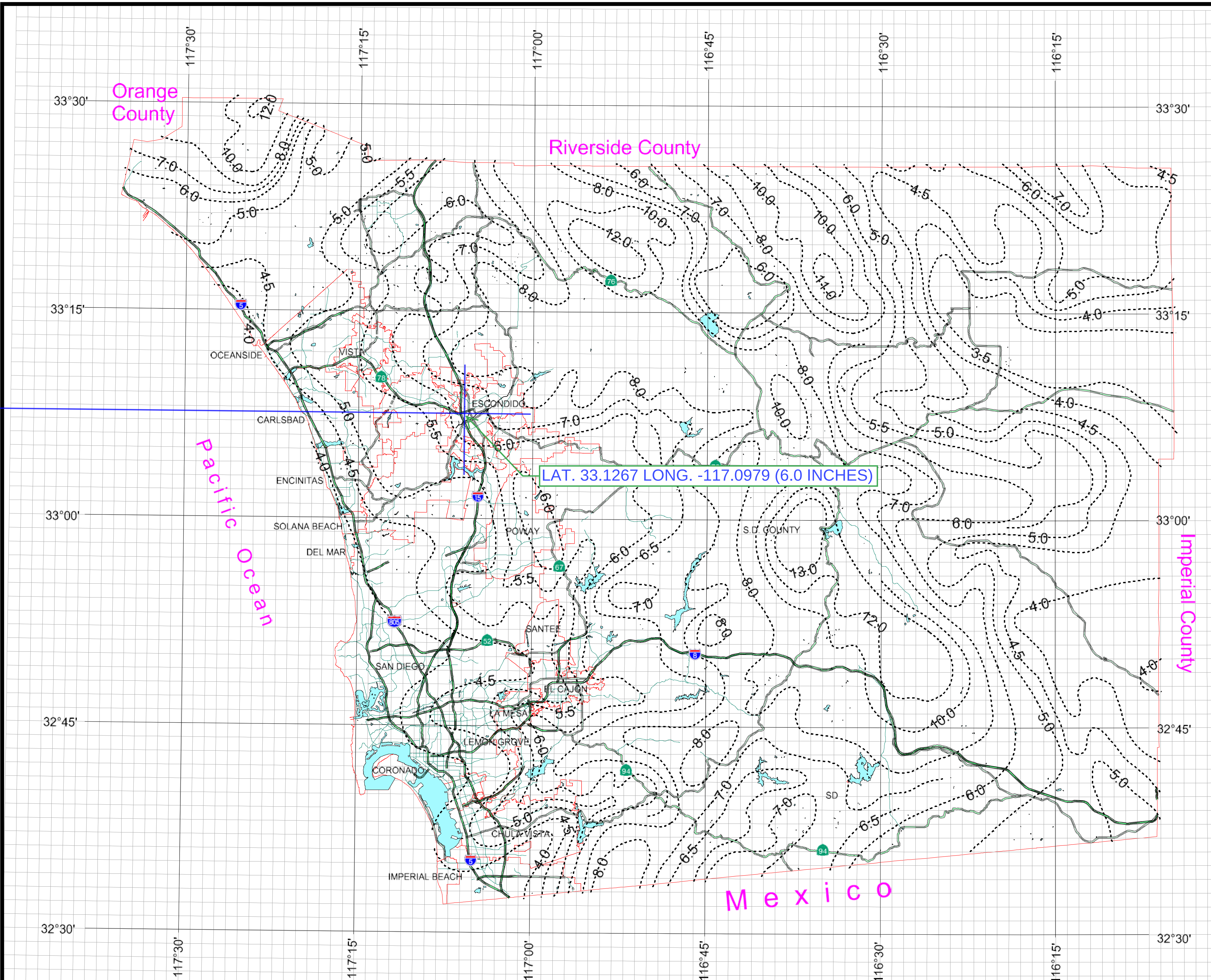


N
W
E
S

3 0 3 Miles

Department of Public Works
Geographic Information Services

We Have San Diego Covered!



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
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N
W E
S

3 0 3 Miles

NOAA Atlas 14, Volume 6, Version 2
Location name: Escondido, California, USA*
Latitude: 33.1267°, Longitude: -117.0979°
Elevation: 648.14 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.119 (0.100-0.142)	0.150 (0.126-0.180)	0.192 (0.161-0.231)	0.226 (0.188-0.275)	0.274 (0.220-0.345)	0.311 (0.244-0.400)	0.349 (0.267-0.461)	0.389 (0.288-0.529)	0.443 (0.314-0.631)	0.486 (0.332-0.718)
10-min	0.170 (0.143-0.204)	0.215 (0.181-0.258)	0.275 (0.231-0.331)	0.324 (0.270-0.394)	0.392 (0.315-0.494)	0.446 (0.349-0.574)	0.500 (0.382-0.661)	0.557 (0.413-0.759)	0.635 (0.450-0.904)	0.696 (0.476-1.03)
15-min	0.206 (0.173-0.247)	0.260 (0.219-0.312)	0.333 (0.279-0.400)	0.392 (0.326-0.477)	0.475 (0.381-0.598)	0.539 (0.423-0.694)	0.605 (0.462-0.800)	0.673 (0.499-0.918)	0.768 (0.545-1.09)	0.842 (0.576-1.24)
30-min	0.286 (0.241-0.342)	0.361 (0.304-0.434)	0.462 (0.388-0.556)	0.545 (0.453-0.662)	0.659 (0.529-0.830)	0.748 (0.587-0.963)	0.840 (0.642-1.11)	0.935 (0.693-1.27)	1.07 (0.756-1.52)	1.17 (0.799-1.73)
60-min	0.449 (0.378-0.538)	0.568 (0.478-0.682)	0.726 (0.609-0.874)	0.856 (0.712-1.04)	1.04 (0.831-1.30)	1.18 (0.922-1.52)	1.32 (1.01-1.75)	1.47 (1.09-2.00)	1.68 (1.19-2.39)	1.84 (1.26-2.72)
2-hr	0.651 (0.548-0.780)	0.814 (0.685-0.977)	1.04 (0.871-1.25)	1.23 (1.02-1.49)	1.50 (1.21-1.89)	1.72 (1.35-2.22)	1.96 (1.49-2.58)	2.21 (1.64-3.00)	2.56 (1.82-3.65)	2.85 (1.95-4.22)
3-hr	0.793 (0.668-0.951)	0.988 (0.831-1.19)	1.26 (1.06-1.52)	1.49 (1.24-1.81)	1.83 (1.47-2.31)	2.11 (1.66-2.72)	2.41 (1.84-3.19)	2.74 (2.03-3.73)	3.21 (2.28-4.57)	3.60 (2.46-5.32)
6-hr	1.10 (0.925-1.32)	1.37 (1.15-1.64)	1.74 (1.46-2.10)	2.07 (1.72-2.51)	2.55 (2.04-3.21)	2.94 (2.31-3.79)	3.37 (2.57-4.45)	3.83 (2.84-5.22)	4.51 (3.20-6.42)	5.07 (3.47-7.49)
12-hr	1.51 (1.27-1.81)	1.89 (1.59-2.27)	2.42 (2.03-2.91)	2.87 (2.38-3.48)	3.51 (2.82-4.42)	4.03 (3.16-5.19)	4.58 (3.50-6.05)	5.17 (3.83-7.04)	6.01 (4.26-8.56)	6.70 (4.58-9.90)
24-hr	1.85 (1.64-2.14)	2.35 (2.07-2.72)	3.02 (2.65-3.50)	3.58 (3.12-4.18)	4.36 (3.69-5.26)	4.99 (4.14-6.14)	5.64 (4.57-7.10)	6.33 (4.99-8.18)	7.29 (5.53-9.80)	8.06 (5.92-11.2)
2-day	2.28 (2.01-2.63)	2.92 (2.57-3.37)	3.79 (3.33-4.39)	4.52 (3.94-5.28)	5.55 (4.70-6.70)	6.38 (5.29-7.85)	7.24 (5.87-9.12)	8.16 (6.44-10.6)	9.46 (7.18-12.7)	10.5 (7.71-14.6)
3-day	2.56 (2.26-2.96)	3.31 (2.92-3.83)	4.34 (3.82-5.03)	5.21 (4.55-6.09)	6.45 (5.45-7.78)	7.44 (6.17-9.16)	8.49 (6.88-10.7)	9.61 (7.59-12.4)	11.2 (8.50-15.1)	12.5 (9.17-17.4)
4-day	2.80 (2.47-3.23)	3.64 (3.21-4.21)	4.79 (4.21-5.55)	5.77 (5.03-6.74)	7.16 (6.05-8.64)	8.28 (6.87-10.2)	9.47 (7.67-11.9)	10.7 (8.47-13.9)	12.5 (9.52-16.9)	14.0 (10.3-19.5)
7-day	3.26 (2.88-3.77)	4.26 (3.75-4.93)	5.62 (4.94-6.52)	6.78 (5.92-7.93)	8.42 (7.12-10.2)	9.74 (8.07-12.0)	11.1 (9.02-14.0)	12.6 (9.95-16.3)	14.7 (11.2-19.8)	16.4 (12.1-22.8)
10-day	3.59 (3.17-4.15)	4.71 (4.15-5.45)	6.23 (5.48-7.23)	7.52 (6.56-8.80)	9.35 (7.91-11.3)	10.8 (8.97-13.3)	12.4 (10.0-15.6)	14.0 (11.0-18.1)	16.3 (12.4-21.9)	18.2 (13.4-25.3)
20-day	4.42 (3.90-5.11)	5.85 (5.16-6.77)	7.82 (6.87-9.07)	9.48 (8.28-11.1)	11.8 (10.0-14.3)	13.7 (11.4-16.9)	15.7 (12.8-19.8)	17.9 (14.1-23.1)	20.9 (15.9-28.1)	23.4 (17.2-32.5)
30-day	5.25 (4.63-6.07)	6.99 (6.17-8.10)	9.39 (8.26-10.9)	11.4 (9.98-13.4)	14.3 (12.1-17.3)	16.7 (13.8-20.5)	19.2 (15.5-24.1)	21.8 (17.2-28.2)	25.6 (19.5-34.5)	28.8 (21.1-39.9)
45-day	6.18 (5.46-7.15)	8.25 (7.28-9.55)	11.1 (9.78-12.9)	13.6 (11.9-15.9)	17.1 (14.5-20.7)	20.0 (16.6-24.6)	23.1 (18.7-29.0)	26.4 (20.8-34.1)	31.1 (23.6-41.9)	35.1 (25.8-48.7)
60-day	7.17 (6.33-8.29)	9.55 (8.42-11.1)	12.9 (11.3-14.9)	15.8 (13.8-18.4)	19.9 (16.9-24.1)	23.4 (19.4-28.8)	27.0 (21.9-34.1)	31.0 (24.5-40.1)	36.8 (28.0-49.5)	41.7 (30.6-57.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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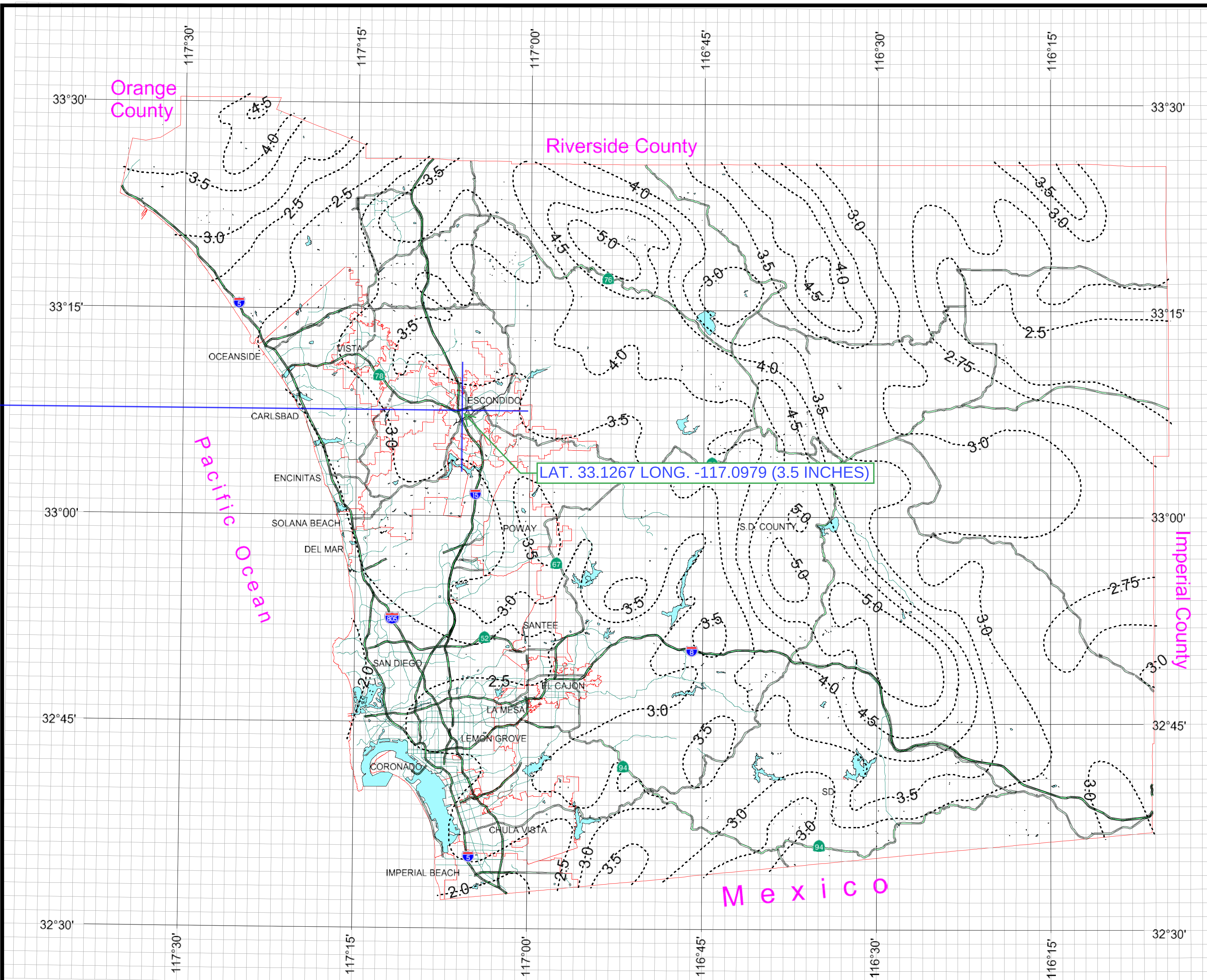
PF graphical

IX. APPENDIX A – REFERENCE MATERIAL



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
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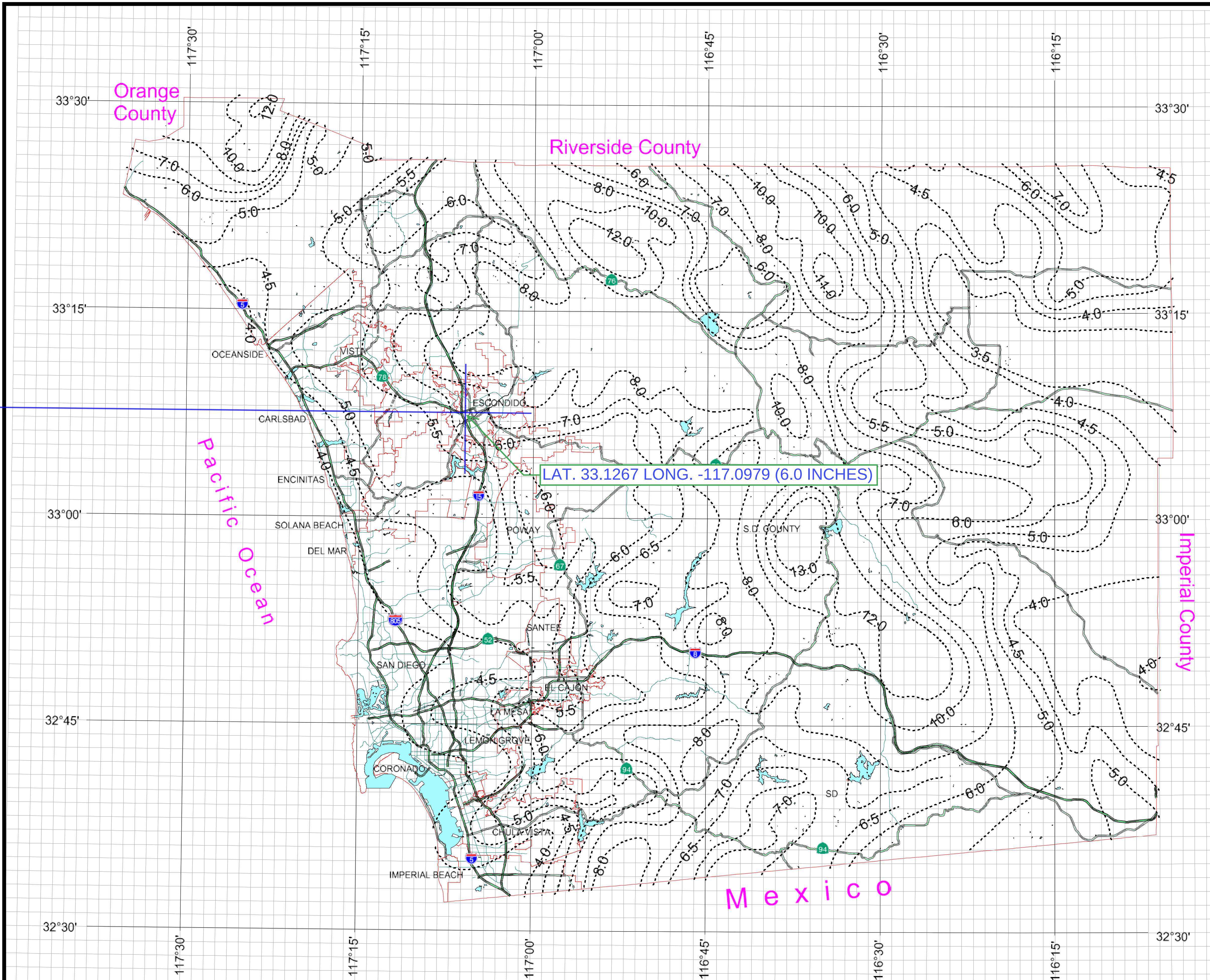
N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

3 0 3 Miles

NOAA Atlas 14, Volume 6, Version 2
Location name: Escondido, California, USA*
Latitude: 33.1267°, Longitude: -117.0979°
Elevation: 648.14 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.119 (0.100-0.142)	0.150 (0.126-0.180)	0.192 (0.161-0.231)	0.226 (0.188-0.275)	0.274 (0.220-0.345)	0.311 (0.244-0.400)	0.349 (0.267-0.461)	0.389 (0.288-0.529)	0.443 (0.314-0.631)	0.486 (0.332-0.718)
10-min	0.170 (0.143-0.204)	0.215 (0.181-0.258)	0.275 (0.231-0.331)	0.324 (0.270-0.394)	0.392 (0.315-0.494)	0.446 (0.349-0.574)	0.500 (0.382-0.661)	0.557 (0.413-0.759)	0.635 (0.450-0.904)	0.696 (0.476-1.03)
15-min	0.206 (0.173-0.247)	0.260 (0.219-0.312)	0.333 (0.279-0.400)	0.392 (0.326-0.477)	0.475 (0.381-0.598)	0.539 (0.423-0.694)	0.605 (0.462-0.800)	0.673 (0.499-0.918)	0.768 (0.545-1.09)	0.842 (0.576-1.24)
30-min	0.286 (0.241-0.342)	0.361 (0.304-0.434)	0.462 (0.388-0.556)	0.545 (0.453-0.662)	0.659 (0.529-0.830)	0.748 (0.587-0.963)	0.840 (0.642-1.11)	0.935 (0.693-1.27)	1.07 (0.756-1.52)	1.17 (0.799-1.73)
60-min	0.449 (0.378-0.538)	0.568 (0.478-0.682)	0.726 (0.609-0.874)	0.856 (0.712-1.04)	1.04 (0.831-1.30)	1.18 (0.922-1.52)	1.32 (1.01-1.75)	1.47 (1.09-2.00)	1.68 (1.19-2.39)	1.84 (1.26-2.72)
2-hr	0.651 (0.548-0.780)	0.814 (0.685-0.977)	1.04 (0.871-1.25)	1.23 (1.02-1.49)	1.50 (1.21-1.89)	1.72 (1.35-2.22)	1.96 (1.49-2.58)	2.21 (1.64-3.00)	2.56 (1.82-3.65)	2.85 (1.95-4.22)
3-hr	0.793 (0.668-0.951)	0.988 (0.831-1.19)	1.26 (1.06-1.52)	1.49 (1.24-1.81)	1.83 (1.47-2.31)	2.11 (1.66-2.72)	2.41 (1.84-3.19)	2.74 (2.03-3.73)	3.21 (2.28-4.57)	3.60 (2.46-5.32)
6-hr	1.10 (0.925-1.32)	1.37 (1.15-1.64)	1.74 (1.46-2.10)	2.07 (1.72-2.51)	2.55 (2.04-3.21)	2.94 (2.31-3.79)	3.37 (2.57-4.45)	3.83 (2.84-5.22)	4.51 (3.20-6.42)	5.07 (3.47-7.49)
12-hr	1.51 (1.27-1.81)	1.89 (1.59-2.27)	2.42 (2.03-2.91)	2.87 (2.38-3.48)	3.51 (2.82-4.42)	4.03 (3.16-5.19)	4.58 (3.50-6.05)	5.17 (3.83-7.04)	6.01 (4.26-8.56)	6.70 (4.58-9.90)
24-hr	1.85 (1.64-2.14)	2.35 (2.07-2.72)	3.02 (2.65-3.50)	3.58 (3.12-4.18)	4.36 (3.69-5.26)	4.99 (4.14-6.14)	5.64 (4.57-7.10)	6.33 (4.99-8.18)	7.29 (5.53-9.80)	8.06 (5.92-11.2)
2-day	2.28 (2.01-2.63)	2.92 (2.57-3.37)	3.79 (3.33-4.39)	4.52 (3.94-5.28)	5.55 (4.70-6.70)	6.38 (5.29-7.85)	7.24 (5.87-9.12)	8.16 (6.44-10.6)	9.46 (7.18-12.7)	10.5 (7.71-14.6)
3-day	2.56 (2.26-2.96)	3.31 (2.92-3.83)	4.34 (3.82-5.03)	5.21 (4.55-6.09)	6.45 (5.45-7.78)	7.44 (6.17-9.16)	8.49 (6.88-10.7)	9.61 (7.59-12.4)	11.2 (8.50-15.1)	12.5 (9.17-17.4)
4-day	2.80 (2.47-3.23)	3.64 (3.21-4.21)	4.79 (4.21-5.55)	5.77 (5.03-6.74)	7.16 (6.05-8.64)	8.28 (6.87-10.2)	9.47 (7.67-11.9)	10.7 (8.47-13.9)	12.5 (9.52-16.9)	14.0 (10.3-19.5)
7-day	3.26 (2.88-3.77)	4.26 (3.75-4.93)	5.62 (4.94-6.52)	6.78 (5.92-7.93)	8.42 (7.12-10.2)	9.74 (8.07-12.0)	11.1 (9.02-14.0)	12.6 (9.95-16.3)	14.7 (11.2-19.8)	16.4 (12.1-22.8)
10-day	3.59 (3.17-4.15)	4.71 (4.15-5.45)	6.23 (5.48-7.23)	7.52 (6.56-8.80)	9.35 (7.91-11.3)	10.8 (8.97-13.3)	12.4 (10.0-15.6)	14.0 (11.0-18.1)	16.3 (12.4-21.9)	18.2 (13.4-25.3)
20-day	4.42 (3.90-5.11)	5.85 (5.16-6.77)	7.82 (6.87-9.07)	9.48 (8.28-11.1)	11.8 (10.0-14.3)	13.7 (11.4-16.9)	15.7 (12.8-19.8)	17.9 (14.1-23.1)	20.9 (15.9-28.1)	23.4 (17.2-32.5)
30-day	5.25 (4.63-6.07)	6.99 (6.17-8.10)	9.39 (8.26-10.9)	11.4 (9.98-13.4)	14.3 (12.1-17.3)	16.7 (13.8-20.5)	19.2 (15.5-24.1)	21.8 (17.2-28.2)	25.6 (19.5-34.5)	28.8 (21.1-39.9)
45-day	6.18 (5.46-7.15)	8.25 (7.28-9.55)	11.1 (9.78-12.9)	13.6 (11.9-15.9)	17.1 (14.5-20.7)	20.0 (16.6-24.6)	23.1 (18.7-29.0)	26.4 (20.8-34.1)	31.1 (23.6-41.9)	35.1 (25.8-48.7)
60-day	7.17 (6.33-8.29)	9.55 (8.42-11.1)	12.9 (11.3-14.9)	15.8 (13.8-18.4)	19.9 (16.9-24.1)	23.4 (19.4-28.8)	27.0 (21.9-34.1)	31.0 (24.5-40.1)	36.8 (28.0-49.5)	41.7 (30.6-57.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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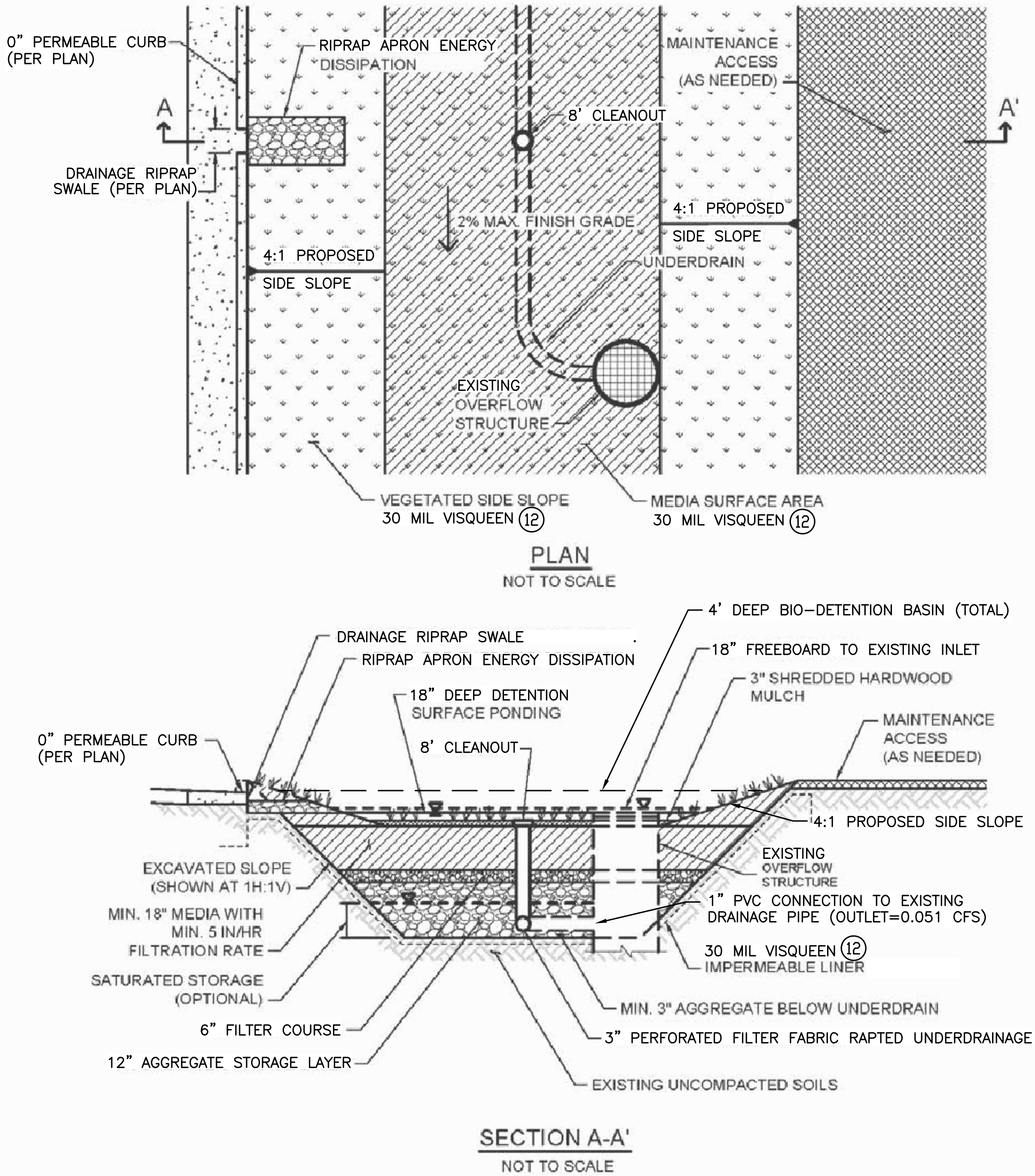
PF graphical

IX. WATERSHED RUNOFF HYDROGRAPH (24-HOUR STORM)

X. APPENDIX A – REFERENCE MATERIAL



Typical plan and Section view of a Biofiltration BMP

Design Adaptations for Project Goals

Biofiltration Treatment BMP for storm water pollutant control. The system is lined or un-lined to provide incidental infiltration, and an underdrain is provided at the bottom to carry away filtered

13 MODIFIED BIO-DETENTION BASIN

NOT TO SCALE

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RATIONAL METHOD DESIGN STORM HYDROGRAPH METHOD

The Rational Method can be used to develop a hydrograph. The design storm pattern is based on the County of San Diego Intensity-Duration Design Chart (Revised 1/85). The chart uses the following equation to relate the intensity(I) of the storm to time of concentration(Tc):

$$I = 7.44 \; P_6 \; D^{-.645}$$

I = Intensity (inches / hour)

P_6 = 6 Hour Precipitation (inches)

D = Duration (minutes)

Next

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RATIONAL METHOD DESIGN STORM HYDROGRAPH METHOD

The Intensity at any given multiple of the time of concentration can be calculated by the following equation:

$$In=((ITcn)(Tcn)-(ITc(n-1))(Tc(n-1)))/Tc$$

n = Number of Hydrograph Ordinates

Tcn = Time of Concentration at Ordinate n (minutes)

In = Rainfall Intensity at Hydrograph Ordinate n (inches/hour)

ITcn = Rainfall Intensity at Time of Concentration Tcn (inches/hour)

Next

RATIONAL METHOD DESIGN STORM HYDROGRAPH METHOD

Rainfall is computed at multiples of time of concentration. The rainfall at block N = 1,(1Tc), is centered at 4 hours, the rainfall at block N = 2, (2Tc), is centered at 4 hours - 1Tc, the rainfall at block N = 3, (3Tc), is centered at 4 hours - 2Tc, and the rainfall at block N = 4, (4Tc), is centered at 4 hours + 1Tc. The sequence continues alternating two blocks to the left and one block to the right. (See Figure 6-2 of the Hydrology Manual)

In order to determine peak discharge of the hydrograph at any given multiple of the time of concentration the following equation is used:

$$Qn = CIA$$

$$Qn=((ITcn)(Tcn)-(ITc(n-1))(Tc(n-1)))CA/Tc$$

Qn = Peak Discharge at Tcn (cubic feet per second)

n = Number of Hydrograph Ordinates

Tcn = Time of Concentration at Ordinate n (minutes)

ITcn = Rainfall Intensity at Time of Concentration Tcn (inches/hour)

C = Rational Method Runoff Coefficient

A = Area of the watershed (acres)

Next

August 28, 2019
Project No. 9135001

Mr. Max Antono
The Altum Group
73-710 Fred Waring Drive
Suite 219
Palm Desert, California 92260

Subject: Geotechnical and Geologic Hazard Evaluation
7-Eleven Convenience Store
West Mission Avenue and Rock Springs Road
Escondido, California

Dear Mr. Antono,

We are pleased to submit our Geotechnical and Geologic Hazard Evaluation in support of the Initial Study/Mitigated Negative Declaration for construction of the 7-Eleven Convenience store at the corner of West Mission Avenue and Rock Springs Road in Escondido, California. This report identifies geotechnical and geologic hazards that have the potential to affect the Project.

Respectfully submitted,

THE BODHI GROUP, INC.

Lee Vanderhurst, P.G.
Senior Geologist

Sree Gopinath
Principal Engineer

Distribution: 1) Addressee

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EXECUTIVE SUMMARY

This Geotechnical and Geologic Hazard Evaluation (Study) identifies geotechnical and geologic hazards that could have potentially adverse effects on the proposed 7-Eleven Convenience Store to be located on the northwest corner of West Mission Avenue and Rock Springs Road, Escondido, California (Study Area). For this study, we reviewed relevant geologic maps and planning documents published by the City of Escondido. In-house resources were researched, and a brief site reconnaissance was performed. Please note that this evaluation is not intended for design or construction and is being performed to support the Initial Study/Mitigated Negative Declaration document for construction of the 7-Eleven Store.

A summary of the geology and geologic hazards is provided below.

- The geologic units in the Study Area consists of fill and Older Alluvial Plain Deposits. The alluvial deposits are underlain at depth by granitic rock. Documentation of the fill compaction was not found in our Study and may need removal and recompaction beneath settlement sensitive improvements. The Older Alluvial Plain Deposits are moderately consolidated however, near the existing ground surface they can be soft and may need remedial earthwork to support structures.
- The Study Area is not underlain by an Alquist Priolo Special Studies Zone or known potentially active faults. The closest known active faults are the Rose Canyon fault zone (located 15 miles west of the Study Area) and the Elsinore fault zone (located 15 miles east of the Study Area. The Study Area, like the rest of San Diego County, is in a region of local and regional active faults and will be subject to strong ground motion in the event of an earthquake on these faults.
- Liquefaction occurs in soft, saturated soil during moderate to severe ground shaking during earthquakes. According to City of Escondido maps, the Study Area is not in an area with a potential for liquefaction. However, the County of San Diego considers the area to have a low potential for liquefaction. Previous geotechnical investigations for other projects in the immediate vicinity of the Study Area have estimated post liquefaction differential settlement to be less than ½ inch.
- Tsunami events caused by large offshore earthquakes or submarine landslides or seiches (waves within enclosed bodies of water) will not affect the Study area due to the elevation above sea level and absence of large enclosed bodies of water nearby.
- Landslide hazards have not been mapped in or in the immediate vicinity of the Study Area. The absence of steep or high slopes precludes landslides.
- Most of the Study Area is blanketed with soils that range from low to non-expansive in nature.
- Potentially corrosive soils may be present in some localized areas, which may be exacerbated by the presence of brackish groundwater.
- Infiltration rates for at grade soil may be affected by shallow groundwater (anticipated depth to groundwater is 10 feet below ground surface).

The geologic hazards identified above can be mitigated through engineering design in accordance with established State of California and City of Escondido requirements and codes. Storm water infiltration into soils may be limited and alternative systems like bioswales or bioretention basins may be needed. Geotechnical investigations are recommended to support the design and construction of the convenience store.

1. INTRODUCTION

The Bodhi Group has completed a Geotechnical and Geologic Hazards Study (Study) of the northwest corner of West Mission Avenue and Rock Springs Road in Escondido California. This report presents the results of our "desktop" evaluation of the geotechnical and geologic hazards potentially affecting the Study Area. The purpose of our evaluation was to identify geotechnical and geologic conditions or hazards that might affect development of the planned 7-Eleven Convenience Store on the Study Area. No mapping, subsurface exploration or laboratory testing was performed for this Study. The following services were provided.

- Reviewed relevant published geologic information including State of California-issued geologic and hazard maps, and the City of Escondido (City) General Plan, Downtown Specific Plan and Action Plan.
- Reviewed the Conceptual Site Plan for 7-11 #1045089, by Tait and Associates, dated 2018.
- Reviewed and summarized regional and local geology from publicly available resources and identified potential geotechnical and geologic hazards.
- Researched other City and County of San Diego resources, and our in-house library of historical aerial photographs, geotechnical and geological hazards such as faulting, seismicity, and liquefiable soils.
- Prepared this technical report that identifies geotechnical and geologic hazards. Included in this report is a location map (Figure 1), a map of the regional and Study Area geology showing distribution of surficial deposits and geologic units (Figure 2); and a map of the active regional faults in southern California (Figure 3).

1.1. Significant Assumptions

Documentation and data provided by the client or from the public domain, and referred to in the preparation of this study, are assumed to be complete and correct and have been used and referenced with the understanding that the Bodhi Group assumes no responsibility or liability for their accuracy. The conclusions contained herein are based upon such information and documentation. Because Study Area conditions may change and additional data may become available, data reported and conclusions drawn in this report are limited to current conditions and may not be relied upon on a significantly later date or if changes have occurred at the Study Area.

Reasonable CEQA-level efforts were made during the Study to identify geologic hazards. "Reasonable efforts" are limited to information gained from information readily-accessible to the public. Such methods may not identify Study Area geologic or geotechnical issues that are not listed in these sources. In the preparation of this report, the Bodhi Group has used the degree of care and skill ordinarily exercised by a reasonably prudent environmental professional in the same community and in the same time frame given the same or similar facts and circumstances. No other warranties are made to any third party, either expressed or implied.

This evaluation is not intended to replace or supplement geotechnical investigations that are required for design or construction of structures. Separate geotechnical investigations should be performed for the design and construction of the 7-Eleven convenience store project.

2. PROJECT LOCATION AND DESCRIPTION

The Study Area is approximately 1.14 acres and is located at the northeast corner of West Mission Avenue and Rock Springs Road in Escondido California. (Latitude 33.126892 degrees, Longitude -117.098107 degrees). The Study Area is currently occupied by a 5,300 square feet single story building and paved parking. Topographically, the Study Area level with elevations ranging from 653 feet to 647 feet from north to south relative to the North American Vertical Datum of 1988. Figure 1 depicts the location of the Study Area.

The planned project will include demolition of the existing 5300 square foot building and construction of a 4,088 square foot 7-Eleven Convenience Store and refueling station with a 4,284 square foot canopy. Underground tanks and utilities will also be constructed.

3. HISTORY

Review of in-house aerial photographs indicate that between 1953 and 1967, the Study Area was used for agriculture. Sometime before 1967 a structure was built in the Study Area that appears to be a single-family residence. Between 1967 and 1980, the Study Area was developed into its current configuration.

4. GEOLOGY

Escondido is located at the margin between the western (coastal) portion and central portion of the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges encompass an area that roughly extends from the Transverse Ranges and the Los Angeles Basin, south to the Mexican border, and beyond another approximately 800 miles to the tip of Baja California (Harden, 1998). The geomorphic province varies in width from approximately 30 to 100 miles, most of which is characterized by northwest-trending mountain ranges separated by subparallel fault zones. In general, the Peninsular Ranges are underlain by Jurassic-age metavolcanic and metasedimentary rocks and by Cretaceous-age igneous rocks of the southern California batholith. Geologic cover over the basement rocks in the westernmost portion of the province in San Diego County generally consists of Upper Cretaceous-, Tertiary-, and Quaternary-age sedimentary rocks. Figure 2, Regional Geologic Map, modified from Kennedy and Tan (2008), shows the regional geology.

Structurally, the Peninsular Ranges are traversed by several major active faults. The Elsinore, San Jacinto, and the San Andreas faults are major active fault systems located northeast of Escondido and the Rose Canyon, San Diego Trough, Coronado Bank and San Clemente faults are major active faults located west of Escondido. Major tectonic activity associated with these and other faults within this regional tectonic framework is generally right-lateral strike-slip movement. These faults, as well as other faults in the region, have the potential for generating strong ground motions in the Study Area. Figure 3, Regional Fault map shows the proximity of the Study Area to nearby mapped Quaternary faults.

4.1. Local Geology

The geologic units in the Study Area consists of fill and Older Alluvial Plain Deposits. Descriptions of the general characteristics of these units are presented below.

- Artificial fill – Fill associated with the existing development should be anticipated in the Study Area. The fills are likely relatively shallow and scattered. They were probably used to create drainage to street gutters, backfill of underground utility trenches and as pavement base. The fill is probably composed of reused underlying natural soil and sediments (silty and clayey fine sand) and import construction materials (gravel and pavement base course). Since no records of compaction were found during this Study, the fills should be considered compressible under new foundation or structural fill loads.
- Older Alluvial Plain Deposits – The Older Alluvial Plain Deposits typically consist of moderately consolidated, clayey and silty fine sand. These deposits typically range from 20 to 40 feet thick and overlie weathered crystalline rock. Readily available geotechnical reports in the nearby vicinity (Salem, 2015; Terracon, 2016) indicate that the upper portion of the deposits may be compressible and have recommended remedial grading to create a compacted fill mat beneath buildings and structural loads. Heavier structures may require deepened foundations. The Older Alluvial Plain deposits usually exhibit low to non-expansive potential but may be corrosive to steel and concrete. Where disturbed by demolition, the Older Alluvial Plain Deposits may require recompaction.

4.2. Local Structural Geology

The Older Alluvial Plain Deposits are relatively flat lying. There are no known active or potentially active faults within or projecting into the Study Area or nearby vicinity.

5. TECTONICS AND SEISMICITY

San Diego is affected by the boundary between the North American and Pacific tectonic plates. The boundary, in southern California is characterized by a wide zone of predominantly northwest-striking, right-slip faults that span the Imperial Valley and Peninsular Range to the offshore California Continental Borderland Province (from the California continental slope to the coast). The most active faults based on geodetic and seismic data are the San Andreas, San Jacinto, and Imperial faults. These faults take up most of the plate motion. Smaller faults, however, are active enough to create damaging earthquakes and these include the Elsinore, Newport-Inglewood-Rose Canyon, and the offshore Coronado Banks, San Diego Trough, and San Clemente fault zones (Figure 3).

5.1. Local and Regional Faults

Table 1 summarizes the local and regional fault characteristics for the active faults that will affect the Study area. A Quaternary fault is defined by the State of California (2007) as a fault that shows evidence of movement in the last 1.6 million years. Quaternary (Holocene and Pleistocene) faults can be classified as either active or potentially active faults. Active faults are those Quaternary Holocene faults which have been shown to have ruptured in the last 11,000 years. Potentially active faults are those Quaternary Pleistocene faults which have been shown to have ruptured during the 1.6 million years but not within the last 11,000 years. Potentially active faults have a much lower probability for future activity than active faults. Earthquakes on the faults summarized in Table 1 below will create ground shaking that can affect the study area.

Table 1 - Fault Characteristics for Active Faults in the Region

Fault Name	Approximate Distance to Study Area	Slip Rate (mm/yr)	Fault Length (miles)	Estimated Magnitude (Maximum Moment Magnitude (Mw))
Newport-Inglewood-Rose Canyon Fault Zone	15	1.5	130	7.2
Coronado Bank Fault Zone (offshore)	30	3.0	115	7.6
Elsinore Fault Zone	15	5.0	190	7.0
San Jacinto Fault Zone	40	4.0	152	6.8
Southern San Andreas Fault Zone	59	25	140	7.2

Table References USGS, 2009.

5.2. Historical Earthquakes

A majority of the historical earthquakes in excess of magnitude 5.0 closest to the Study Area have occurred on the San Jacinto fault east of Escondido. None of these earthquakes have caused any reported structural damage in the City of Escondido. There have been many smaller earthquakes on closer faults such as the Rose Canyon and Elsinore but have not resulted in any reported structural damage in the City of Escondido. An earthquake having a magnitude 6 or larger is possible on the active faults within 50 miles of the Study Area.

6. LANDSLIDES AND SLOPE STABILITY

The Study Area is relatively flat. Landslides and slope stability will not affect the Study Area.

7. SOILS AND INFILTRATION

The soils at the site are a mix of silty fine sand, sandy silt and sandy clay (City of Escondido, 2012) which suggest a moderate to slow infiltration rate. Shallow groundwater may affect storm water recharge systems. Other factors should be considered in evaluating storm water infiltration feasibility including lateral migration of water and groundwater mounding.

8. HYDROGEOLOGY

Groundwater data for the Study Area is based on nearby geotechnical reports (Salem, 2015; Terracon, 2016, and Atkins, 2012) which indicate the groundwater table is fairly consistent below the Escondido Valley at about 10 to 15 feet below existing ground. Groundwater elevations will vary with seasonal rainfall.

9. DRAINAGE AND FLOODING

The site is not within a flood plain (SANDAG, 2019).

10. GEOLOGIC HAZARDS AND IMPACTS

This section identifies geologic hazards that may affect proposed development of the Study Area. These hazards include earthquake shaking ground motion; liquefaction; seismically induced settlement; and subsidence. These hazards can be mitigated through engineering improvements (e.g., ground improvement, ground restraints, or appropriate structure foundation). Site-specific geotechnical investigations should be performed to evaluate the appropriate mitigation measure or combination of measures.

10.1. Seismicity and Ground Motion

An active fault is defined by the State Mining and Geology Board as one that has experienced surface displacement within the Holocene epoch, i.e., during the last 11,000 years (California Geological Survey, 2007). The Study Area is subject to potential ground shaking caused by activity along faults located near the Study Area.

Ground shaking during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and the type of geologic material underlying the area. The composition of underlying soils, even those relatively distant from faults, can intensify ground shaking. Areas that are underlain by bedrock tend to experience less ground shaking than those underlain by unconsolidated sediments such as fill or unconsolidated alluvium.

As noted, the Study Area is subject to ground shaking hazards caused by earthquakes on regional active faults. Based on a Probabilistic Seismic Hazards Ground Motion Interpolator provided by the American Society of Civil Engineers (2018), the Study Area (Longitude -117.098107 Latitude 33.126892) is located in a zone where the horizontal peak ground acceleration having a 10 percent probability of exceedance in 50 years is about 0.5 g (where g represents the acceleration of gravity).

10.2. Ground Rupture

There are no known active or potentially active faults beneath or projecting into the Study Area. There are no Alquist-Priolo Special Studies Zones on or projecting toward the Study Area.

10.3. Liquefaction, Seismically Induced Settlement

Liquefaction is a phenomenon where the strength and stiffness of a soil is reduced by earthquake or other rapid loading. The relatively rapid loss of soil shear strength during strong earthquake shaking results in temporary, fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, underground cables, and buildings with shallow foundations. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by a relatively shallow groundwater table are susceptible to liquefaction. For these reasons, there is a low potential for liquefaction at the Study Area.

Among the potential hazards related to liquefaction are seismically induced settlement. Seismically induced settlement is caused by the reduction of shear strength due to loss of grain-to-grain contact during liquefaction and may result in dynamic settlement on the order of several inches to several feet. Other factors such as earthquake magnitude, distance from the earthquake epicenter, thickness of the liquefiable layers, and the fines content and particle sizes of the liquefiable layers will also affect the amount of settlement. Geotechnical investigations in the nearby vicinity (Salem, 2015, Terracon, 2016) have found that seismically induced differential settlement of ½ inch can be expected in soils similar to the materials underlying the Study Area.

10.4. Tsunamis, Seiches, and Dam Failure

A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic action. The Study Area’s elevation is too high to be affected by a tsunami. A seiche is a seismic wave in an enclosed body of water such as a lake or bay. There are no enclosed bodies of water near the Study Area that produce a seiche that could affect the Study Area.

An earthquake-induced dam failure can result in a severe flood event. Based on review of the 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan Dam Failure map, the Study Area is outside dam inundation zones.

10.5. Subsidence

Subsidence typically occurs when extraction of fluids (water or oil) cause the reservoir rock to consolidate. Water extraction is minimal in the Study Area and the geologic materials area well consolidated. Subsidence is not a hazard in the Study Area.

Settlement of unconsolidated soil (fill or alluvial/estuarine sediments) may occur locally where new loads are imposed on previously uncompacted fill or unconsolidated alluvium.

10.6. Infiltration

The soil under the Study Area will likely exhibit moderate to low infiltration rates. Onsite storm water infiltration facilities will need to account for shallow groundwater during design (approximately 10 feet below the existing ground surface).

10.7. Expansive or Corrosive Soils

The soil in the Study Area is expected to have a low expansion potential. Low to moderate corrosion potential was experienced on nearby sites with similar soil conditions (Salem, 2015, Terracon, 2016).

11. IMPACT MITIGATION

The impacts summarized above may be mitigated through engineering improvements (e.g., ground improvement, ground restraints, remedial grading or foundation design). Site specific geotechnical investigations are required to recommend the appropriate mitigation measure(s).

11.1. Seismicity and Ground Motion

The entire Study Area will be affected by seismicity and ground motion. Mitigation can be accomplished by geotechnical and structural engineering design. Geotechnical investigations should be conducted in accordance with local guidelines and State of California requirements. Most mitigation measures will involve foundation design and/or ground improvement.

11.2. Liquefaction, Seismically Induced Settlement

The Study Area may be susceptible to seismically induced settlement or post liquefaction settlement and should be considered during design of structures. Mitigation can be accomplished by ground improvement and or foundation design. Geotechnical investigations should be conducted in accordance with local guidelines and State of California requirements.

11.3. Subsidence

Construction of improvements in areas underlain by alluvium or fill should be designed to withstand settlement of unconsolidated soil. Geotechnical investigations for design of settlement resistant structures should be conducted in accordance with local guidelines and State of California requirements. Mitigation measures typically include ground improvement and/or foundation design.

11.4. Corrosive Soil

Corrosive soil should be evaluated by a Corrosion Engineer for recommendations for soil replacement or cathodic protection.

11.5. Infiltration

Infiltration potential should be evaluated in accordance with County of San Diego Best Management Manual, (County of San Diego, 2019).

12. THRESHOLDS OF SIGNIFICANCE

In accordance with Appendix G of the CEQA Guidelines, the project will have significant effect on the environment if:

G-1: Expose people to potential substantial adverse effects, including the risk of loss, injury or death involving: a) fault rupture, b) seismic shaking, c) seismic ground failure, d) landsliding.

G-2: Result in substantial soil erosion or loss of top soil.

G-3: Be located in a geologic unit or soil that is unstable (landsliding, settlement, lateral spreading) or that would become unstable as a result of the project.

G-4: Be located on expansive soil causing substantial risk to life or property.

G-5: Having soils incapable of supporting the use of septic tanks where sewers are not available.

12.1. Threshold G-1 a) Fault Rupture

No significant effect. There are no known active or potentially active faults beneath or projecting into the Study Area.

12.2. Threshold G-1 b) Strong Seismic Ground Shaking

Less than significant effect. Construction of the structures, parking lots and underground utilities will be required to use seismic resistant designs in accordance with California and City standards and codes.

12.3. Threshold G-1 c) Seismic Ground Failure

Less than significant effect. Construction of structures, parking lots and underground utilities will be required to use seismic resistant designs in accordance with California and City standards and codes.

12.4. Threshold G-1 d) Seismic Induced Landsliding

Less than significant effect. The Study Area is flat and no slopes are planned.

12.5. Threshold G-2 Substantial Soil Erosion and Loss of Topsoil

Less than significant effect. The Study Area is covered in hardscape (pavement and buildings). The proposed development will not alter the hardscape coverage. No soil will be exposed to erosion. Since construction will be required to follow City and County standards and code that stipulate protection against temporary and permanent erosion, the impact of erosion and loss of topsoil is less than significant.

12.6. Threshold G-3 Unstable Soil (Landslide, Settlement, Lateral Spreading)

<u>Landslide:</u> Less than Significant. Landslide prone geologic formations and tall, steep slopes are not present in the Study Area.

<u>Settlement:</u> Less than Significant. Construction of structures and other settlement prone improvements will need to use designs resistant to passive and post liquefaction differential settlements in accordance with City of Escondido and County of San Diego as well as State of California standards and codes.

12.7. Threshold G-4 Expansive Soil

Less than Significant. Expansive soils are generally not present in the Study Area.

12.8. Threshold G-5 Soil Unsuitable for Onsite Sewage Disposal Systems

Less than Significant. Shallow groundwater and poor infiltration characteristics may preclude the use of onsite storm water systems in the Study Area. Alternatives include bioretention systems for storm water disposal. Underground sewer systems are available for sewage disposal.

13. CONCLUSIONS

The conclusions from this Study are listed below.

- There are no geologic hazards that cannot be avoided or addressed.
- The proposed land uses are compatible with the known geologic hazards.

14. LIMITATIONS

This report was prepared in general accordance with current guidelines and the standard-of-care exercised by professionals preparing similar documents near the Study Area. No warranty, expressed or implied, is made regarding the professional opinions presented in this document. As this report represents a review of existing documentation on geotechnical conditions of the planning areas rather than in-depth on-site investigation, it cannot account for variations in individual site conditions or changes to existing conditions. Please also note that this document did not include an evaluation of environmental hazards.

The conclusions, opinions, and recommendations as presented in this document, are based on a desktop analysis of data, some of which were obtained by others. It is our opinion that the data, as a whole, support the conclusions and recommendations presented in the report.

The purpose of this study was to evaluate geologic and geotechnical conditions within the planning areas to assist in the preparation of environmental impact documents for the project. Comprehensive geotechnical evaluations, including subsurface exploration and laboratory testing, should be performed prior to design and construction of structural improvements. Any future projects on individual sites in the planning areas will require site-specific geotechnical studies as required by State and City regulations.

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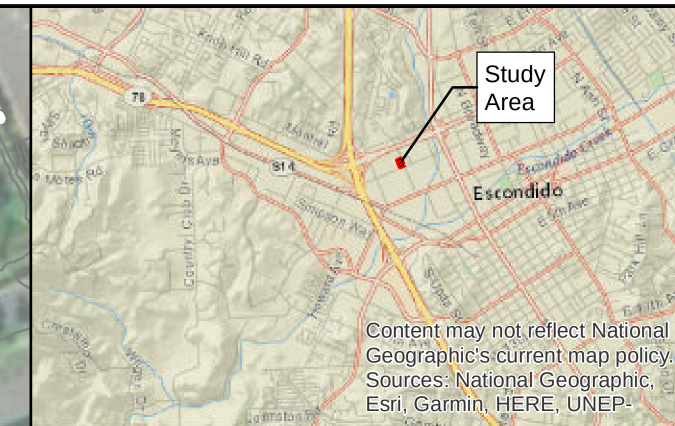
FIGURES



Legend

Topographical Elevation Contours in NAVD88 feet

Study Area

N

0 50 100 Feet

1 inch = 100 feet

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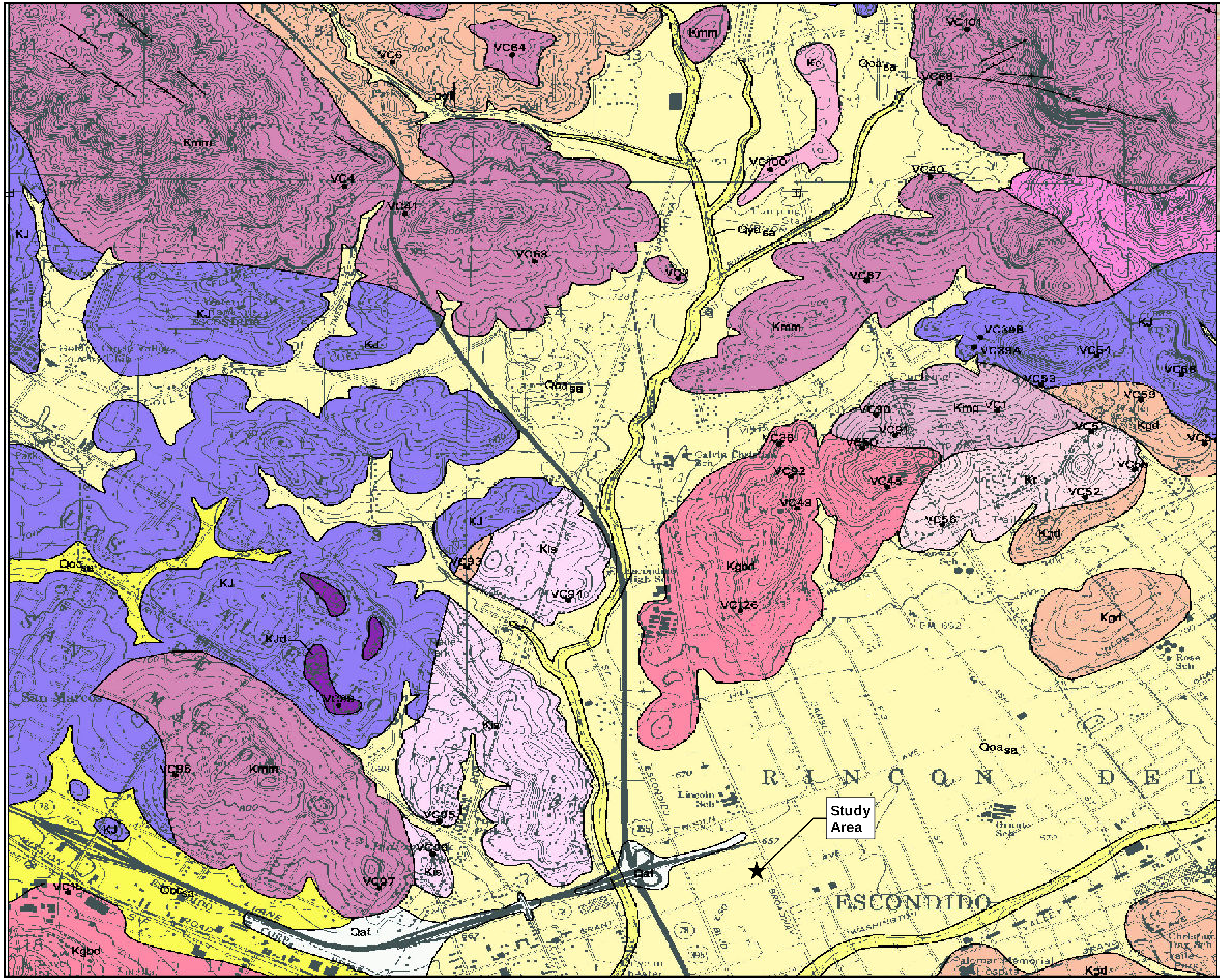
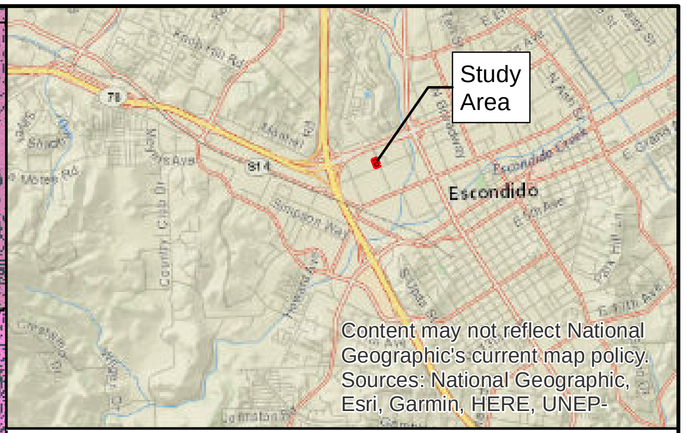
Site Location and Vicinity Map
7-Eleven Convenience Store
West Mission Avenue and
Rock Springs Road
Escondido, California

FIGURE 1

DATE: 09/2019





DESCRIPTION OF MAP UNITS

MODERN SURFICIAL DEPOSITS -- Sediment recently deposited in washes and artificial fills.

Qaf	Artificial fill (late Holocene) - Sand, gravel, and boulders used for "man made" fills.

YOUNG SURFICIAL DEPOSITS -- Sedimentary units that are slightly consolidated to cemented and slightly to moderately dissected.

Qya	Young alluvial flood plain deposits (Holocene and late Pleistocene) - Mostly unconsolidated, poorly sorted, permeable flood plain sediment.
Qyc	Young colluvial deposits (Holocene and late Pleistocene) - Mostly poorly consolidated and poorly sorted slope wash and stream deposits.
Qls	Landslide deposits (Holocene to Pleistocene).

OLD SURFICIAL DEPOSITS -- Sedimentary units that are moderately consolidated and slightly to moderately well dissected. Older surficial deposits have upper surfaces that are capped by moderately to well-developed soils.

Qoa	Older alluvial flood plain deposits (Pleistocene, younger than 500,000 years) - Mostly moderately well consolidated, poorly sorted, permeable flood plain deposits.
Qoc	Older colluvial deposits (Pleistocene, younger than 500,000 years) - Mostly moderately well consolidated, poorly sorted slope wash and stream deposits.
Qof	Older fan deposits (Pleistocene, younger than 500,000 years) - Mostly poorly consolidated fan, debris flow, and talus deposits.

BEDROCK UNITS

Kbm	Granodiorite of Burnt Mountain (Cretaceous) - Leucocratic biotite granodiorite; very fine grained, massive.
Kmm	Monzogranite of Merriam Mountain (Cretaceous) - Leucocratic hornblende-biotite monzogranite; medium to course grained, massive.
Km	Quartzdiorite of Mountain Meadows (Cretaceous) - Hornblende quartzdiorite; medium grained, dark gray.
Kdl	Granite of Dixon Lake (Cretaceous) - Leucocratic biotite granite, very fine grained, sub-porphyritic.
Kr	Granodiorite of Rimrock (Cretaceous) - Biotite granodiorite; fine grained, sub-porphyritic.
Kbp	Granite of Bottle Peak (Cretaceous) - Leucocratic, hornblende-biotite granite, coarse grained.
Krm	Quartz bearing diorite of Red Mountain (Cretaceous) - Biotite-hornblende diorite; course grained, dary gray, massive.
Kvc	Monzogranite of Valley Center (Cretaceous) - Leucocratic biotite monzogranite; coarse grained, massive.
Kis	Granite of Indian Springs (Cretaceous) - Biotite granite: fine grained granite similar in appearance to Kdl.
Kcg	Tonalite of Cole Grade (Cretaceous) - Hornblende-biotite-tonalite, coarse grained, massive.
Kg	Granite undivided (Cretaceous) - Mostly biotite granite, coarse to medium grained, massive.
Kgd	Granodiorite undivided (Cretaceous) - Mostly hornblende-biotite granodiorite, coarse to medium grained.
Kmg	Monzogranite undivided (Cretaceous) - Mostly biotite-hornblende monzogranite, coarse grained.
Kqbd	Quartz bearing diorite undivided (Cretaceous) - Mostly biotite-hornblende, quartz bearing diorite; medium grained, dark gray, massive.
Kd	Diorite undivided (Cretaceous) - Mostly hornblende diorite; medium to coarse grained, dark gray, massive.
Kt	Tonalite undivided (Cretaceous) - Mostly hornblende-biotite tonalite; coarse grained, light gray.
Kgb	Gabbro undivided (Cretaceous) - Mostly biotite-hornblende-hypersthene gabbro; coarse grained, dark gray, massive.
KJ	Metavolcanic and metasedimentary rocks undivided (Cretaceous and Jurassic) - low grade (greenschist facies) rocks that are in part coeval with and in part older than the Cretaceous plutonic rocks they lie in contact with.
KJg	Metagranitic rocks (Cretaceous and Jurassic) - mostly gneiss; very light gray to white, massive.
KJd	Metavolcanic dikes undivided (Cretaceous and Jurassic) - dikes that cut KJ; very fine grained, dark gray, massive.

0 1,000 2,000 Feet

N

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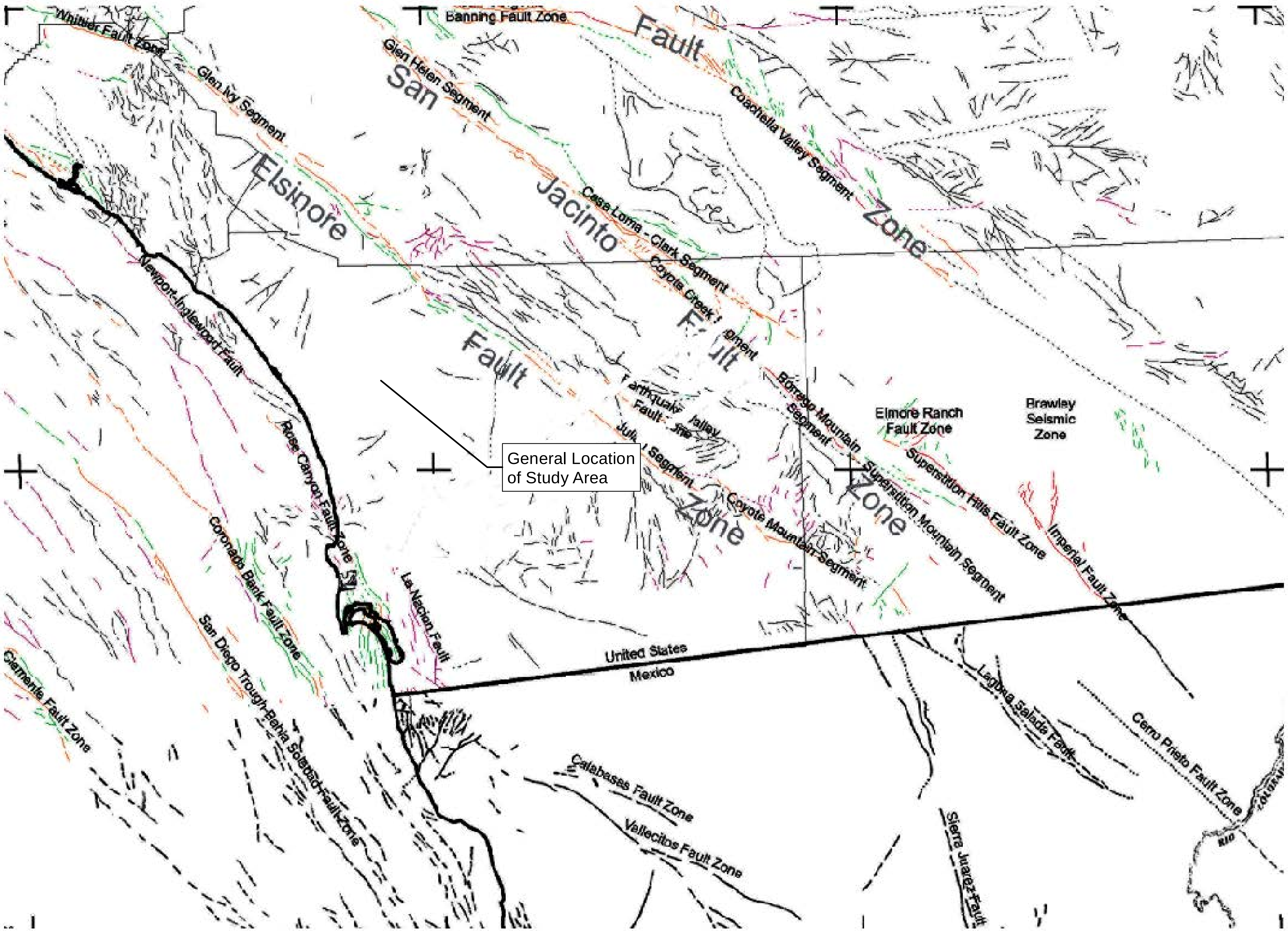
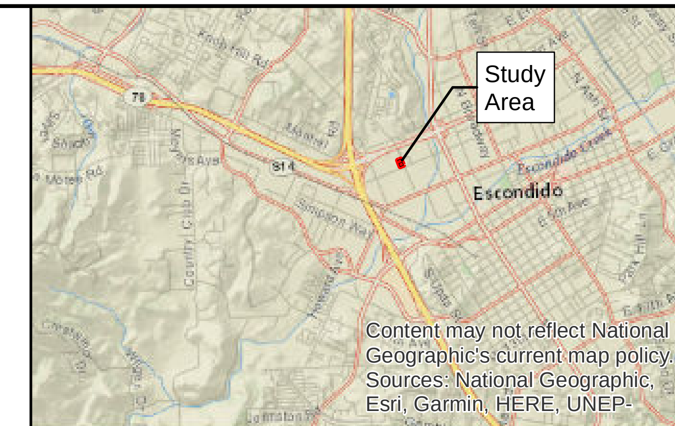
Regional Geology
7-Eleven Convenience Store
West Mission Avenue and
Rock Springs Road
Escondido, California

FIGURE 2

DATE: 09/2019





NOTATIONS

Holocene fault displacement (during past 10,000 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults that displace rocks of undifferentiated Plio-Pleistocene age. See Bulletin 201, Appendix D for source data.

Late Cenozoic faults within the Sierra Nevada including, but not restricted to, the Foothills fault system. Faults show stratigraphic and/or geomorphic evidence for displacement of late Miocene and Pliocene deposits. By analogy, late Cenozoic faults in this system that have been investigated in detail may have been active in Quaternary time (Data from PG&.E, l993.)

Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissance nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

N

Not To Scale

Regional Fault Map
7-Eleven Convenience Store
West Mission Avenue and
Rock Springs Road
Escondido, California

FIGURE 3

DATE: 09/2019