CEQA Preliminary Drainage Report for
Woodland & Watson Subdivision
San Diego County, CA

Preparation/Revision Date: October 1, 2014

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REGISTERED PROFESSIONAL ENGINEER
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STATE OF CALIFORNIA

October 1, 2014
Date

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CEQA PRELIMINARY DRAINAGE REPORT FOR
Woodland & Watson Subdivision
San Diego County, CA

PROJECT INFORMATION

Project Name:	Woodland and Watson Subdivision
Project Location/Address:	SE corner Woodland Drive and Watson Way
Permit Number (Land Development Projects):	
Work Authorization Number (**CIP only**):	
Applicant:	Paul D. Colucci
Applicant's Address:	2734 Loker Avenue, Suite E Carlsbad, CA 92101
Plan Prepared By:	Larry R. Taylor, RCE, GE
Preparer's Address:	Taylor Group, Inc. 301 Mission Avenue, Suite 201 Oceanside, CA 72054
Date:	October 1, 2014

PROJECT DESCRIPTION

The proposed project consists of a village/suburban infill project that will entail subdividing an existing 3.5 acre site to create a new residential subdivision consisting of 18 lots for single-family residences, a new private street and a remainder parcel (approx.. 3,750 s.f.) that will be used for a common bioretention BMP.

The site is comprised of four contiguous parcels under common ownership. The land is currently undeveloped and has been used in the past (circa 1940s-1960s) for agricultural purposes.

The project will include offsite improvements including street widening and construction of curb, gutter and sidewalk along the Woodland Drive and Watson Way frontages and construction of new public sewer main in Woodland Drive.

The proposed residential lots will range from 6,000 sf to 10,650 s.f. (net), with an average lot size of 6,830 s.f. and a median lot size of 6,038 s.f. (net). Level building pads on the lots will be approximately 4,000 s.f.. Conceptual future improvements to the residential lots will consist of small 1- and 2-story single family residences with rooftop areas in the range of 1,800 to 2,000 square feet.

The existing site topography consists of mildly to moderately sloping terrain that slopes down to the northeast at about 10 to 25 percent, with an average slope of approximately 14 percent. The high point of the site is El. 570' at the SW corner and the low point is El. 502' at the SE corner.

The project proposes to create level building pads on most of the proposed parcels by performing cut and fill grading that will create cut and fill slopes with maximum slope ratios of 2:1 (26.6%). The maximum slope height will be approximately 20 feet, with most slopes less than 10 feet high. The average slope of the project site will remain at approximately 14%.

The site is underlain by Cretaceous-age batholitic rock (Green Valley Tonalite). The rock is weathered to a shallow soil cover of decomposed granite that is expected to be thicker at the lower elevations Soil is classified as soil group "D". The shallow bedrock is expected to haw low permeability and low erodibility. The shallow weathered soil cover is expected to have low to moderate permeability and is moderately erodible. Depth to groundwater is more than 50 feet. Infiltration-based BMPs are not proposed.

DESCRIPTION OF WATERSHED

The project is located at the southeast corner of Woodland Drive and Watson Way in the North Metro area in the County of San Diego, State of California. The project site location is illustrated on Figure 1.

The project site is situated within a roughly 300 acre urban watershed that drains to a tributary of Buena Creek as illustrated in Figure 1. The site is part of a roughly 10 acre sub-basin within the watershed as illustrated on Figure 2. The entire site is within a single drainage system, with the high point of the site at roughly the high point of the sub-area. There are no significant hydrologic features at the site. Existing site drainage is by overland sheet flow to the north and northeast to the Woodland Drive ROW and then via flow in an earthen swale and street flow along the south side to Woodland towards the southeast.

Flow in Woodland Drive enters a curb inlet at the southeast intersection of Woodland and Yettford Road at a point located approximately 640 feet southeast of the project boundary. Drainage flows approximately 670 feet to the east in a RCP pipe and discharges to a natural drainage that crosses Woodland Drive approximately 100 feet east of Manzanita Court (east).

METHODOLOGY

Hydrology was evaluated using the Rational Method (RM). The RM is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage, where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and small drainage structures. The RM is recommended for analyzing the runoff response from drainage areas up to approximately 1 square mile in size.

The RM can be applied using any design storm frequency (e.g., 100-year, 50-year, 10-year, etc.). The local agency determines the design storm frequency that must be used based on the type of project and specific

local requirements. A procedure has been developed that converts the 6-hour and 24-hour precipitation isopluvial map data to an Intensity-Duration curve that can be used for the rainfall intensity in the RM formula as shown in Figure 3-1 in the Attachments. The RM is applicable to a 6-hour storm duration because the procedure uses Intensity-Duration Design Charts that are based on a 6-hour storm duration.

Rational Method Formula

The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (Tc), which is the time required for water to flow from the most remote point of the basin to the location being analyzed. The RM formula is expressed as follows:

$$Q = C\ I\ A$$

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 Tc for the area, in inches per hour (Note: If the computed Tc is less than 5 minutes, use 5 minutes for computing the peak discharge, Q)
A = drainage area contributing to the design location, in acres

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. 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 Tc.
- The fraction of rainfall that becomes runoff (or the runoff coefficient, C) is independent of I or precipitation zone number (PZN) condition.
- The peak rate of runoff is the only information produced by using the RM.

Runoff Coefficient

Table 3-1 in the Attachments lists the estimated runoff coefficients for urban areas. The concepts related to the runoff coefficient were evaluated in a report entitled *Evaluation, Rational Method "C" Values* (Hill, 2002) that was reviewed by the Hydrology Manual Committee. The Report is available at San Diego County Department of Public Works, Flood Control Section and on the San Diego County Department of Public Works web page.

The runoff coefficients are based on land use and soil type. Soil type can be determined from the soil type map provided in Appendix A. An appropriate runoff coefficient (C) for each type of land use in the subarea should be selected from this table and multiplied by the percentage of the total area (A) included in that class. The sum of the products for all land uses is the weighted runoff coefficient (Σ[CA]). Good engineering judgment should be used when applying the values

presented in Table 3-1, as adjustments to these values may be appropriate based on site-specific characteristics. In any event, the impervious percentage (% Impervious) as given in the table, for any area, shall govern the selected value for C. The runoff coefficient can also be calculated for an area based on soil type and impervious percentage using the following formula:

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

Where: Cp = 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.

Rainfall Intensity

The rainfall intensity (I) is the rainfall in inches per hour (in/hr) for a duration equal to the Tc for a selected storm frequency. Once a particular storm frequency has been selected for design and a Tc calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration Design Chart (Figure 3-1). The 6-hour storm rainfall amount (P6) and the 24-hour storm rainfall amount (P24) for the selected storm frequency are also needed for calculation of I. P6 and P24 can be read from the isopluvial maps provided in Appendix B.

An Intensity-Duration Design Chart applicable to all areas within San Diego County is provided as Figure 3-1 in the Attachments to this report. Intensity can also be calculated as:

$$I = 7.44\ P6\ D^{-0.645}$$

Where: P6 = adjusted 6-hour storm rainfall amount (see discussion below)
D = duration in minutes (use Tc)

Note: This equation applies only to the 6-hour storm rainfall amount (i.e., P6 cannot be changed to P24 to calculate a 24-hour intensity using this equation).

The Intensity-Duration Design Chart and the equation are for the 6-hour storm rainfall amount. In general, P6 for the selected frequency should be between 45% and 65% of P24 for the selected frequency. If P6 is not within 45% to 65% of P24, P6 should be increased or decreased as necessary to meet this criteria. The isopluvial lines are based on precipitation gauge data. At the time that the isopluvial lines were created, the majority of precipitation gauges in San Diego County were read daily, and these readings yielded 24-hour precipitation data. Some 6-hour data were available from the few recording gauges distributed throughout the County at that time; however, some 6-hour data were extrapolated. Therefore, the 24-hour precipitation data for San Diego County are considered to be more reliable.

Time of Concentration

The Time of Concentration (Tc) is the time required for runoff to flow from the most remote part of the drainage area to the point of interest. The Tc is composed of two components: initial time of concentration (Ti) and travel time (Tt).

The Ti 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 Ti. The Tt 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 Tc at any point within the drainage area is given by:

$$Tc = Ti + Tt$$

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 Tc and runoff calculations, and can be determined from the local Community General Plan.

RATIONAL METHOD HYDROGRAPH PROCEDURE

Hydrographs for the pre-and post-development conditions were developed based on the RM study results and the procedures in Section 6 of the County's Hydrology Manual.

The concept of this hydrograph procedure is based on the RM formula. An assumption of the RM is that discharge increases linearly over the Tc for the drainage area until reaching the peak discharge as defined by the RM formula, and then decreases linearly. A linear hydrograph can be developed for the peak flow occurring over the Tc. However, for designs that are dependent on the total storm volume, it is not sufficient to consider a single hydrograph for peak flow occurring over the Tc at the beginning of a 6-hour storm event because the hydrograph does not account for the entire volume of runoff from the storm event. The volume under the linear hydrograph is equal to the rainfall intensity multiplied by the duration for which that intensity occurs (Tc), the drainage area (A) contributing to the design location, and the runoff coefficient (C) for the drainage area. For designs that are dependent on the total storm volume, a hydrograph must be generated to account for the entire volume of runoff from the 6-hour storm event. The hydrograph for the entire 6-hour storm event is generated by creating a rainfall distribution consisting of blocks of rain, creating an incremental hydrograph for each block of rain, and adding the hydrographs from each block of rain. This process creates a hydrograph that contains runoff from all the blocks of rain and accounts for the entire volume of runoff from the 6-hour storm event. The total volume under the resulting hydrograph is equal to the following equation:

$$VOL = CP_6A$$

Where: VOL = volume of runoff (acre-inches)
P_6 = 6-hour rainfall (inches)

C = runoff coefficient
A = area of the watershed (acres)

SUMMARY OF RESULTS

Pre- and post development hydrology maps, RM hydrology calculations and RM hydrograph calculations for the site are attached to this report as Attachment 1.

Results of the RM analysis are summarized in the following table.

SUMMARY OF PRE- AND POST DEVELOPMENT DISCHARGE AT NODE 110						
C	Tc (min)	I (in/hr)	A (acre)	Q (cfs)	V (ft/sec)	NOTES
PRE-DEVELOPMENT CONDITIONS						
0.41	11.76	5.01	4.32	8.82		
POST-DEVELOPMENT CONDITIONS (UNMITIGATED)						
0.62	11.92	4.95	3.93	11.75		0.39 acres in right-of-way and onsite slopes adjacent to the parkway is contained and self-treating in parkway.

Runoff volumes for the pre- and post-development conditions from the hydrograph analysis are summarized in the table below.

SUMMARY OF PRE- AND POST DEVELOPMENT RUNOFF VOLUME AT NODE 110		
Pre-Development	5.90 acre-inch	0.49 acre-ft
Post-Development	8.01 acre-inch	0.67 acre-ft
Required Detention/Retention	2.11 acre-inch	0.18 acre-ft

If unmitigated, development of the site would result in a roughly 33% increase in peak discharge for the 100-year storm event. The project is required to implement flow control measures to comply with hydromodification requirements. Bioretention BMPs as shown on the site plan and documented in the project's Storm Water Mitigation Plan (SWMP) will provide retention/detention and will have orifice outlets that will reduce post-development peak discharge to less than the pre-development peak discharge.

DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the civil Engineer of Work for this project, that I have exercised responsible charge over the design of this project as defined in Section 6703 of the Business and Professions code, and that the design is consistent with current design.

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

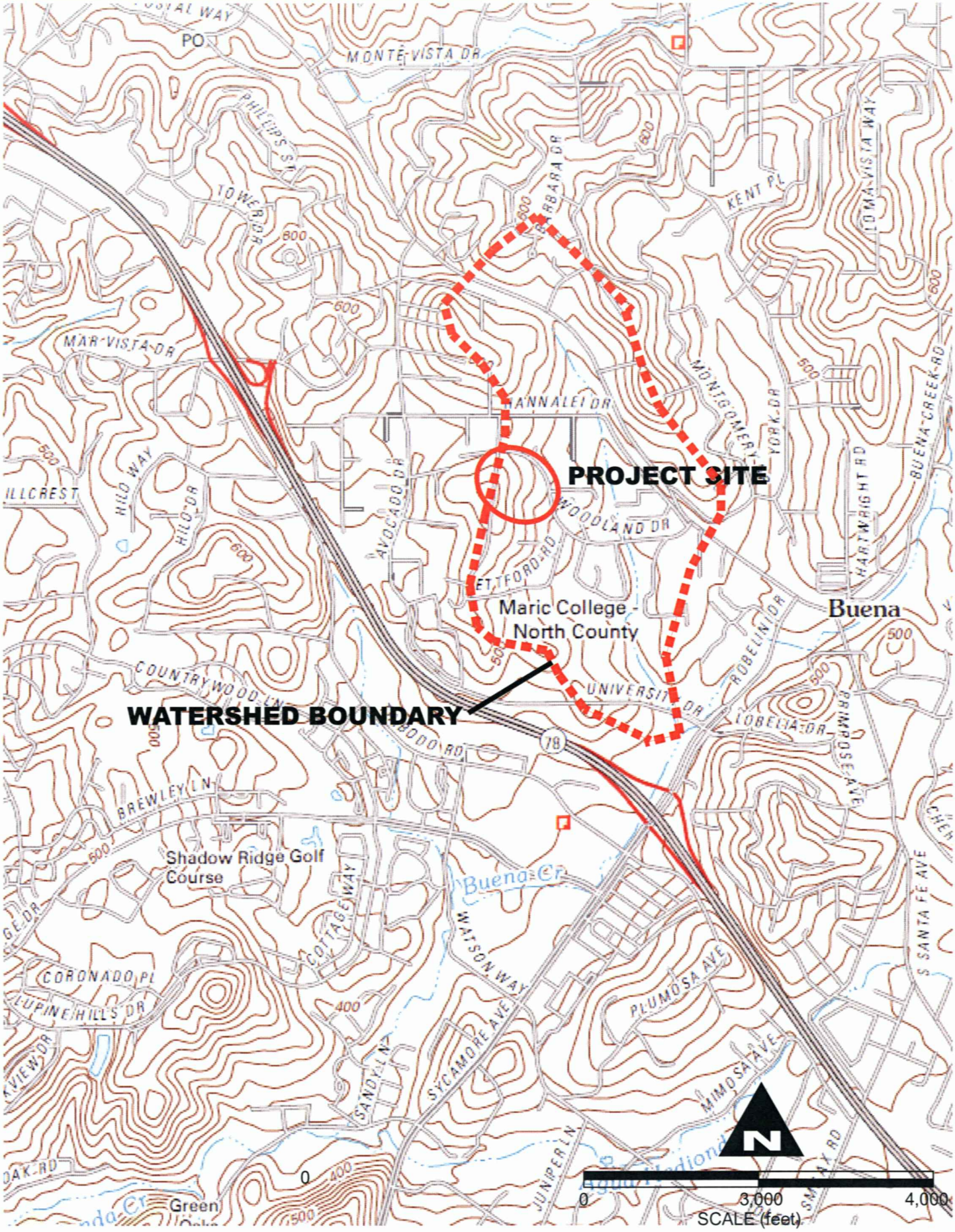
REGISTERED PROFESSIONAL ENGINEER
LARRY R. TAYLOR
C 58274
CIVIL
STATE OF CALIFORNIA

Larry R. Taylor, RCE, GE
RCE 58274, Expires 06.30.2016

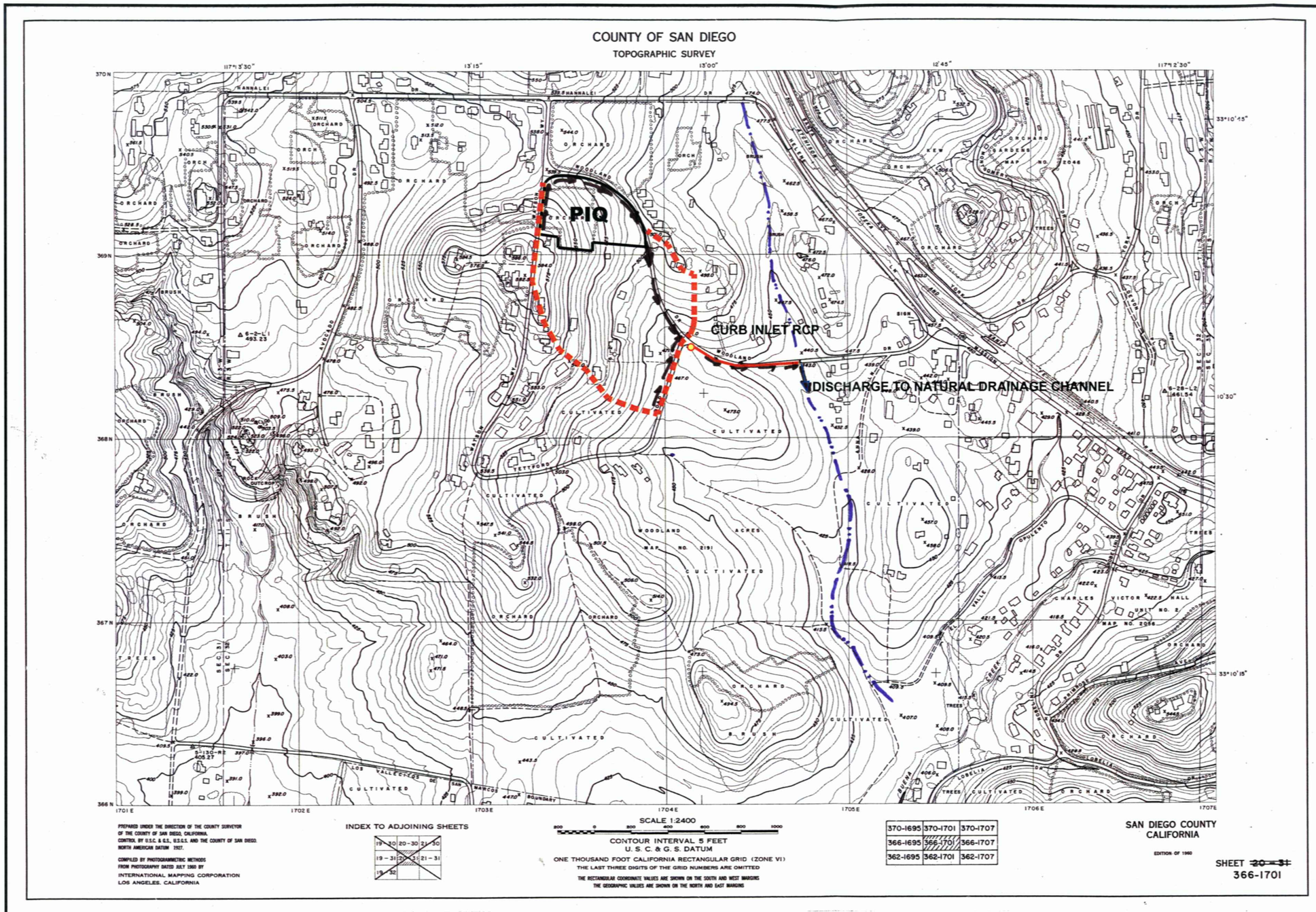
FIGURES

Figure 1. Site Location and Watershed Area Map

Figure 2. Site Drainage Subarea Map



TAYLOR GROUP, INC. GEOSCIENCE & ENGINEERING CONSULTANTS	TGI Project No. 14.00681	FIGURE 1. SITE LOCATION AND WATERSHED MAP
	Drawn by: LT / Checked by:	
	Date: October 2014	Woodland and Watson Subdivision



LEGEND

- SITE BOUNDARY
- DRAINAGE SUB-AREA BOUNDARY
- FLOW LINE

FIGURE 2. SITE LOCATION & DRAINAGE SUBAREA BOUNDARIES

Woodland & Watson Subdivision, San Diego County, CA

TGI Project No.:	14.00681
Drawn by:	LT
Date:	October 2014

TAYLOR GROUP, INC.
GEOSCIENCE & ENGINEERING CONSULTANTS

ATTACHMENTS

100-Year Hydrology Calculations – Pre-Development Conditions
100-Year Hydrology Calculations – Post-Development Conditions
100-Year Hydrograph Calculations – Pre-Development Conditions
100-Year Hydrograph Calculations – Post-Development Conditions
Pre-Development Hydrology Map
Post-Development Hydrology Map

RATIONAL METHOD HYDROLOGY CALCULATIONS

EXISTING PRE-DEVELOPMENT CONDITIONS
WOODLAND & WATSON SUBDIVISION
TGI PROJECT NO. 14.00681
DATE: 08/10/2014
BY: L. TAYLOR

P6 = 3.29 inches

AREA1 - UNDEVELOPED SITE ARES

AREA	FROM	TO	Area (ac.)	Description	C	Tc	I (in/hr)	Q (cfs)
1	000	101	0.03	INITIAL SUBAREA	0.35	6.9	7.04	0.074
	101	102		OVERLAND FLOW		1.6		
	102	110		OVERLAND FLOW		3.2		
	000	110	3.87	AREA1 TOTAL	0.35	11.7	5.01	6.785

AREA2- PAVED ROWS IN WATSON WAY AND WOODLAND DRIVE

AREA	FROM	TO	Area (ac.)	Description	C	Tc	I (in/hr)	Q (cfs)
2	200	201	0.005	INITIAL SUBAREA	0.90	2.3	14.30	0.064
	201	110		CHANNEL FLOW		5.0		
	200	110	0.45	AREA2 TOTAL	0.90	7.3	6.79	2.750

JUNCTION ANALYSIS FOR NODE 110

AREA	Area (ac.)	C	CA	Tc	I (in/hr)	Q (cfs)
1	3.87	0.35	1.35	11.70	5.01	6.79
2	0.45	0.90	0.41	7.30	6.79	2.75
	4.32		1.76			

QT1 = 6.99 TC1 = 16.76 I1 = 3.97
QT2 = 8.82 **TC2 = 11.68** **I2 = 5.01**

RATIONAL METHOD HYDROLOGY CALCULATIONS

PROPOSED POST-DEVELOPMENT CONDITIONS
WOODLAND & WATSON SUBDIVISION
TGI PROJECT NO. 14.00681
DATE: 08/10/2014
BY: L. TAYLOR

P6 = 3.29 inches

AREA1 - SOUTHERLY PORTION OF SITE INCLUDING PROPOSED PRIVATE STREET AND LOTS 13-14

AREA	FROM	TO	Area (ac.)	Description	C	Tc	I (in/hr)	Q (cfs)
1	101	102	0.16	INITIAL SUBAREA	0.54	5.3	8.35	0.721
	102	103		GUTTER FLOW		0.3		
	100	107	0.69	AREA1 TOTAL	0.69	5.6	8.06	3.836

AREA2 - CENTRAL PORTION OF SITE INCLUDING LOTS 10-12 AND 15-18.

AREA	FROM	TO	Area (ac.)	Description	C	Tc	I (in/hr)	Q (cfs)
2	104	105	0.09	INITIAL SUBAREA	0.68	8.4	6.20	0.380
	105	106		CHANNEL FLOW		3.5		
	104	107	1.42	AREA2 TOTAL	0.51	11.9	4.95	3.588

JUNCTION ANALYSIS FOR NODE 107

AREA	Area (ac.)	C	CA	Tc	I (in/hr)	Q (cfs)
1	0.69	0.69	0.48	5.60	8.06	3.84
2	1.42	0.51	0.72	11.90	4.95	3.58
	2.11		1.20			

QT1 = 5.52 Tc1= 13.33
QT2 = 5.94 Tc2= 11.92

AREA3 - NORTHERN PORTION OF SITE INCLUDING LOTS 1-9 ALONG WOODLAND DRIVE

AREA	FROM	TO	Area (ac.)	Description	C	Tc	I (in/hr)	Q (cfs)
3	108	109	0.09	INITIAL SUBAREA	0.68	8.4	6.20	0.380
	109	110		GUTTER FLOW		2.8		
	108	110	1.09	AREA3 TOTAL	0.57	11.2	5.15	3.201

AREA4 - STREETS IN WATSON WAY AND WOODLAND DRIVE ROWS. STREET HALF WIDTH IS 30; AND PAVED WIDTH IS 20'

AREA	FROM	TO	Area (ac.)	Description	C	Tc	I (in/hr)	Q (cfs)
4	001	002	0.04	INITIAL SUBAREA	0.90	2.2	14.72	0.530
	002	110		GUTTER FLOW		4.1		
	001	110	0.63	AREA4 TOTAL	0.88	6.3	7.47	4.126

RATIONAL METHOD HYDROLOGY CALCULATIONS

PROPOSED POST-DEVELOPMENT CONDITIONS
WOODLAND & WATSON SUBDIVISION
TGI PROJECT NO. 14.00681
DATE: 08/10/2014
BY: L. TAYLOR

P6 = 3.29 inches

JUNCTION ANALYSIS FOR NODE 110

AREA	Area (ac.)	C	CA	Tc	I (in/hr)	Q (cfs)
1 and 2	2.11	0.57	1.20	11.92	4.95	5.94
3	1.09	0.57	0.62	11.20	5.15	3.20
4	0.63	0.88	0.55	6.30	7.47	4.13
	3.83		2.38			

QT1 =	9.07	TC1 = 17.82	I1 = 3.82
QT2 =	11.63	TC2 = 12.12	I2 = 4.89
QT3 =	**11.75**	**TC3 = 11.92**	I3 = 4.95

AREA5 - PARKWAY IN WATSON WAY AND WOODLAND DRIVE ROWS. PARKWAY IS 10' WIDE WITH 5' SIDEWALK
ALSO INCLUDES MINOW SLOPES ALONG NORTHEASTERLY PORTIONS OF LOTS 1-9 THAT DRAIN TO SIDEWALK
RUNOFF CONTAINED IN LANDSCAPED PORTION OF PARKWAY

AREA	FROM	TO	Area (ac.)	Description	C	Tc	I (in/hr)	Q (cfs)
5			0.02	INITIAL SUBAREA	0.57	6.0	7.71	0.088
			0.39	AREA5 TOTAL	0.57	100.0	1.26	0.279

6-HOUR RATIONAL METHOD HYDROGRAPH

PROJECT: WOODLAND & WATSON SUBDIVISION
TGI PROJECT NO. 14.00681

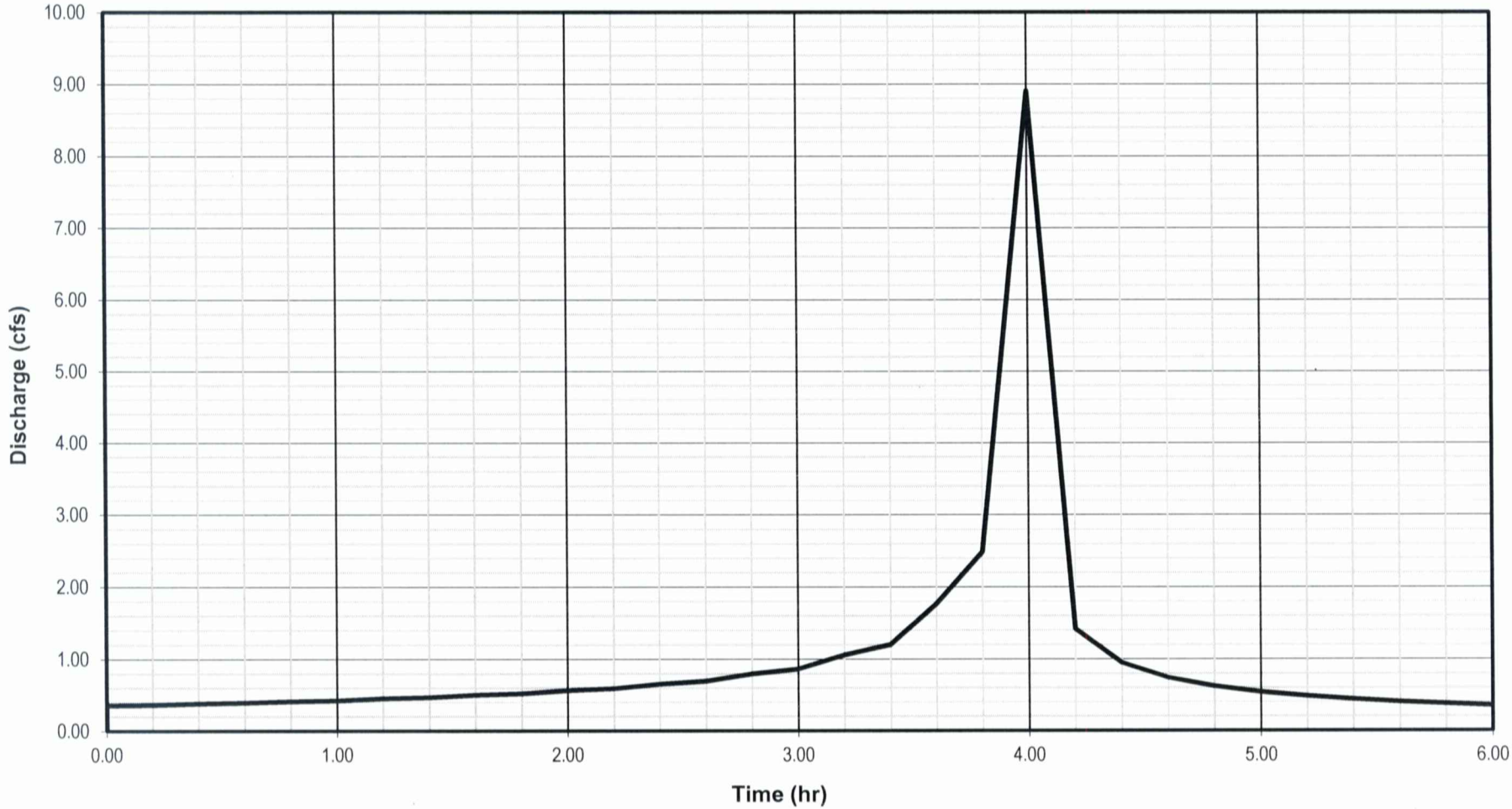
POST-DEVELOPMENT CONDITIONS
DATE: AUGUST 2014

N	TT(N) (MIN)	TT(N)/60 (HR)	IT(N) (IN/HR)	PT(N)	P(N)	IN	QN	TIME (HR)	QN (CFS)	VOLUME (CF) INC	VOLUME (CF) CUM
		0	0	0	0	0	0	0.00	0.00		
1	12	0.2	4.9282977	0.9856595	0.9856595	4.9613735	11.893845	0.00	0.48	348.3	348
2	24	0.4	3.1516108	1.2606443	0.2749848	1.3841517	3.3182113	0.20	0.49	356.1	704
3	36	0.6	2.4263515	1.4558109	0.1951666	0.9823821	2.3550537	0.40	0.52	373.2	1,078
4	48	0.8	2.0154324	1.6123459	0.156535	0.7879279	1.8888907	0.60	0.53	382.6	1,460
5	60	1	1.7452646	1.7452646	0.1329187	0.6690537	1.603915	0.80	0.56	403.3	1,864
6	72	1.2	1.5516343	1.8619612	0.1166966	0.5873989	1.4081648	1.00	0.58	414.8	2,278
7	84	1.4	1.4047812	1.9666937	0.1047325	0.5271772	1.2637961	1.20	0.61	440.5	2,719
8	96	1.6	1.2888545	2.0621672	0.0954735	0.4805711	1.1520678	1.40	0.63	454.9	3,174
9	108	1.8	1.194567	2.1502206	0.0880534	0.4432219	1.0625308	1.60	0.68	487.8	3,662
10	120	2	1.1160841	2.2321682	0.0819477	0.4124882	0.9888533	1.80	0.70	506.7	4,168
11	132	2.2	1.0495392	2.3089862	0.0768179	0.3866673	0.9269533	2.00	0.76	550.7	4,719
12	144	2.4	0.992259	2.3814215	0.0724353	0.3646074	0.8740692	2.20	0.80	576.7	5,296
13	156	2.6	0.942331	2.4500605	0.0686391	0.3454986	0.8282599	2.40	0.89	639.6	5,935
14	168	2.8	0.8983475	2.5153729	0.0653124	0.3287535	0.7881171	2.60	0.94	678.3	6,614
15	180	3	0.8592471	2.5777413	0.0623684	0.3139347	0.7525921	2.80	1.08	777.6	7,391
16	192	3.2	0.8242132	2.6374821	0.0597408	0.3007089	0.7208861	3.00	1.17	843.1	8,234
17	204	3.4	0.792606	2.6948605	0.0573784	0.2888176	0.6923792	3.20	1.43	1030.5	9,265
18	216	3.6	0.763917	2.7501011	0.0552406	0.2780568	0.6665823	3.40	1.63	1173.8	10,439
19	228	3.8	0.7377358	2.803396	0.0532949	0.2682629	0.6431037	3.60	2.39	1723.4	12,162
20	240	4	0.7137277	2.854911	0.051515	0.2593035	0.6216255	3.80	3.37	2428.3	14,590
21	252	4.2	0.6916167	2.9047902	0.0498792	0.2510699	0.6018872	4.00	12.09	8704.0	23,294
22	264	4.4	0.6711727	2.95316	0.0483698	0.243472	0.5836727	4.20	1.92	1382.3	24,677
23	276	4.6	0.6522025	3.0001316	0.0469716	0.2364343	0.5668013	4.40	1.28	924.9	25,601
24	288	4.8	0.6345424	3.0458037	0.0456721	0.2298933	0.5511206	4.60	1.01	723.6	26,325
25	300	5	0.6180529	3.0902643	0.0444606	0.2237949	0.536501	4.80	0.84	606.1	26,931
26	312	5.2	0.6026139	3.1335921	0.0433278	0.2180928	0.5228315	5.00	0.73	527.5	27,459
27	324	5.4	0.5881218	3.1758579	0.0422658	0.2127473	0.5100167	5.20	0.65	470.6	27,929
28	336	5.6	0.5744867	3.2171257	0.0412678	0.2077237	0.4979737	5.40	0.59	427.1	28,356
29	348	5.8	0.5616299	3.2574534	0.0403277	0.202992	0.4866305	5.60	0.55	392.6	28,749
30	360	6	0.5494823	3.2968939	0.0394405	0.1985259	0.4759239	5.80	0.51	364.4	29,114
								6.00	0.47		

6-HOUR RATIONAL METHOD HYDROGRAPH

PROJECT: WOODLAND & WATSON SUBDIVISION
TGI PROJECT NO. 14.00681

PRE-DEVELOPMENT CONDITIONS
DATE: AUGUST 2014



PEAK DISCHARGE	8.91	CFS

VOLUME:	AT PEAK	TOTAL	
	17163	21451	CF
	128383	160455	GAL
	4.72	5.90	ACRE-IN

6-HOUR RATIONAL METHOD HYDROGRAPH

PROJECT: WOODLAND & WATSON SUBDIVISION
TGI PROJECT NO. 14.00681

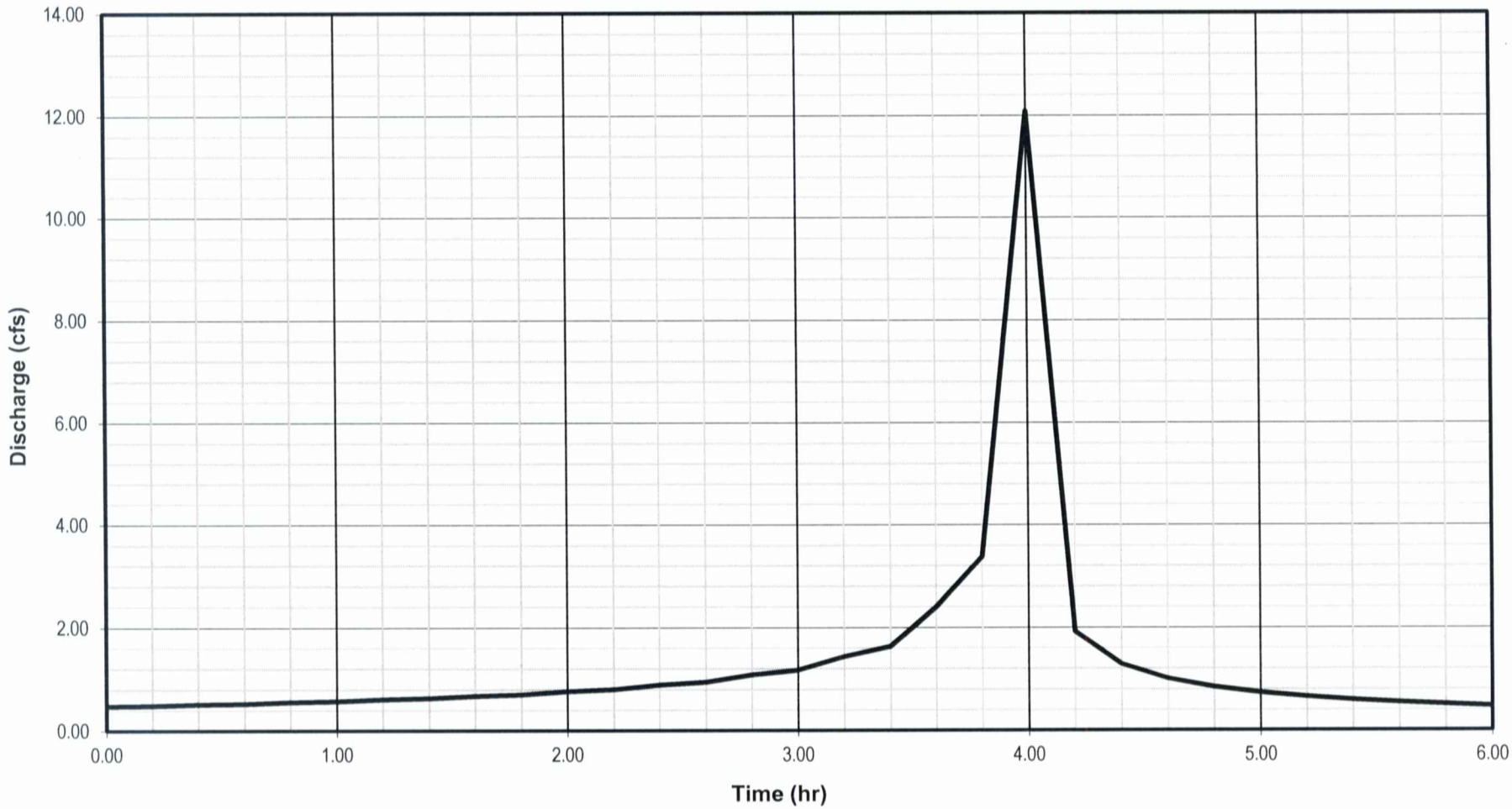
PRE-DEVELOPMENT CONDITIONS
DATE: AUGUST 2014

N	TT(N) (MIN)	TT(N)/60 (HR)	IT(N) (IN/HR)	PT(N)	P(N)	IN	QN	TIME (HR)	QN (CFS)	VOLUME (CF) INC	VOLUME (CF) CUM
		0	0	0	0	0	0	0.00	0.00		
1	12	0.2	4.9282977	0.9856595	0.9856595	5.0288752	8.9071815	0.00	0.36	0.0	
2	24	0.4	3.1516108	1.2606443	0.2749848	1.4029837	2.4849752	0.20	0.36	256.6	257
3	36	0.6	2.4263515	1.4558109	0.1951666	0.9957479	1.7636762	0.40	0.38	262.4	519
4	48	0.8	2.0154324	1.6123459	0.156535	0.798648	1.4145713	0.60	0.39	275.0	794
5	60	1	1.7452646	1.7452646	0.1329187	0.6781565	1.2011559	0.80	0.41	281.9	1,076
6	72	1.2	1.5516343	1.8619612	0.1166966	0.5953907	1.0545605	1.00	0.42	297.2	1,373
7	84	1.4	1.4047812	1.9666937	0.1047325	0.5343497	0.9464443	1.20	0.45	305.6	1,679
8	96	1.6	1.2888545	2.0621672	0.0954735	0.4871095	0.8627721	1.40	0.47	324.5	2,003
9	108	1.8	1.194567	2.1502206	0.0880534	0.4492521	0.7957187	1.60	0.50	335.2	2,338
10	120	2	1.1160841	2.2321682	0.0819477	0.4181003	0.7405424	1.80	0.52	359.4	2,698
11	132	2.2	1.0495392	2.3089862	0.0768179	0.3919281	0.694186	2.00	0.56	373.3	3,071
12	144	2.4	0.992259	2.3814215	0.0724353	0.369568	0.6545817	2.20	0.59	405.8	3,477
13	156	2.6	0.942331	2.4500605	0.0686391	0.3501992	0.6202755	2.40	0.65	425.0	3,902
14	168	2.8	0.8983475	2.5153729	0.0653124	0.3332263	0.590213	2.60	0.69	471.3	4,373
15	180	3	0.8592471	2.5777413	0.0623684	0.3182059	0.5636087	2.80	0.80	499.8	4,873
16	192	3.2	0.8242132	2.6374821	0.0597408	0.3048002	0.5398644	3.00	0.86	572.9	5,446
17	204	3.4	0.792606	2.6948605	0.0573784	0.2927471	0.5185159	3.20	1.05	621.2	6,067
18	216	3.6	0.763917	2.7501011	0.0552406	0.2818398	0.4991968	3.40	1.20	759.3	6,826
19	228	3.8	0.7377358	2.803396	0.0532949	0.2719127	0.4816139	3.60	1.76	864.8	7,691
20	240	4	0.7137277	2.854911	0.051515	0.2628315	0.4655291	3.80	2.48	1269.8	8,961
21	252	4.2	0.6916167	2.9047902	0.0498792	0.2544859	0.4507473	4.00	8.91	1789.2	10,750
22	264	4.4	0.6711727	2.95316	0.0483698	0.2467845	0.4371066	4.20	1.41	6413.2	17,163
23	276	4.6	0.6522025	3.0001316	0.0469716	0.2396511	0.4244718	4.40	0.95	1018.5	18,182
24	288	4.8	0.6345424	3.0458037	0.0456721	0.2330211	0.4127287	4.60	0.74	681.4	18,863
25	300	5	0.6180529	3.0902643	0.0444606	0.2268397	0.4017802	4.80	0.62	533.2	19,397
26	312	5.2	0.6026139	3.1335921	0.0433278	0.2210601	0.3915433	5.00	0.54	446.6	19,843
27	324	5.4	0.5881218	3.1758579	0.0422658	0.2156418	0.3819464	5.20	0.48	388.7	20,232
28	336	5.6	0.5744867	3.2171257	0.0412678	0.2105499	0.3729275	5.40	0.44	346.8	20,579
29	348	5.8	0.5616299	3.2574534	0.0403277	0.2057538	0.3644327	5.60	0.40	314.7	20,893
30	360	6	0.5494823	3.2968939	0.0394405	0.2012269	0.3564146	5.80	0.37	289.3	21,183
								6.00	0.00	268.5	21,451

6-HOUR RATIONAL METHOD HYDROGRAPH

PROJECT: WOODLAND & WATSON SUBDIVISION
TGI PROJECT NO. 14.00681

POST-DEVELOPMENT CONDITIONS
DATE: AUGUST 2014

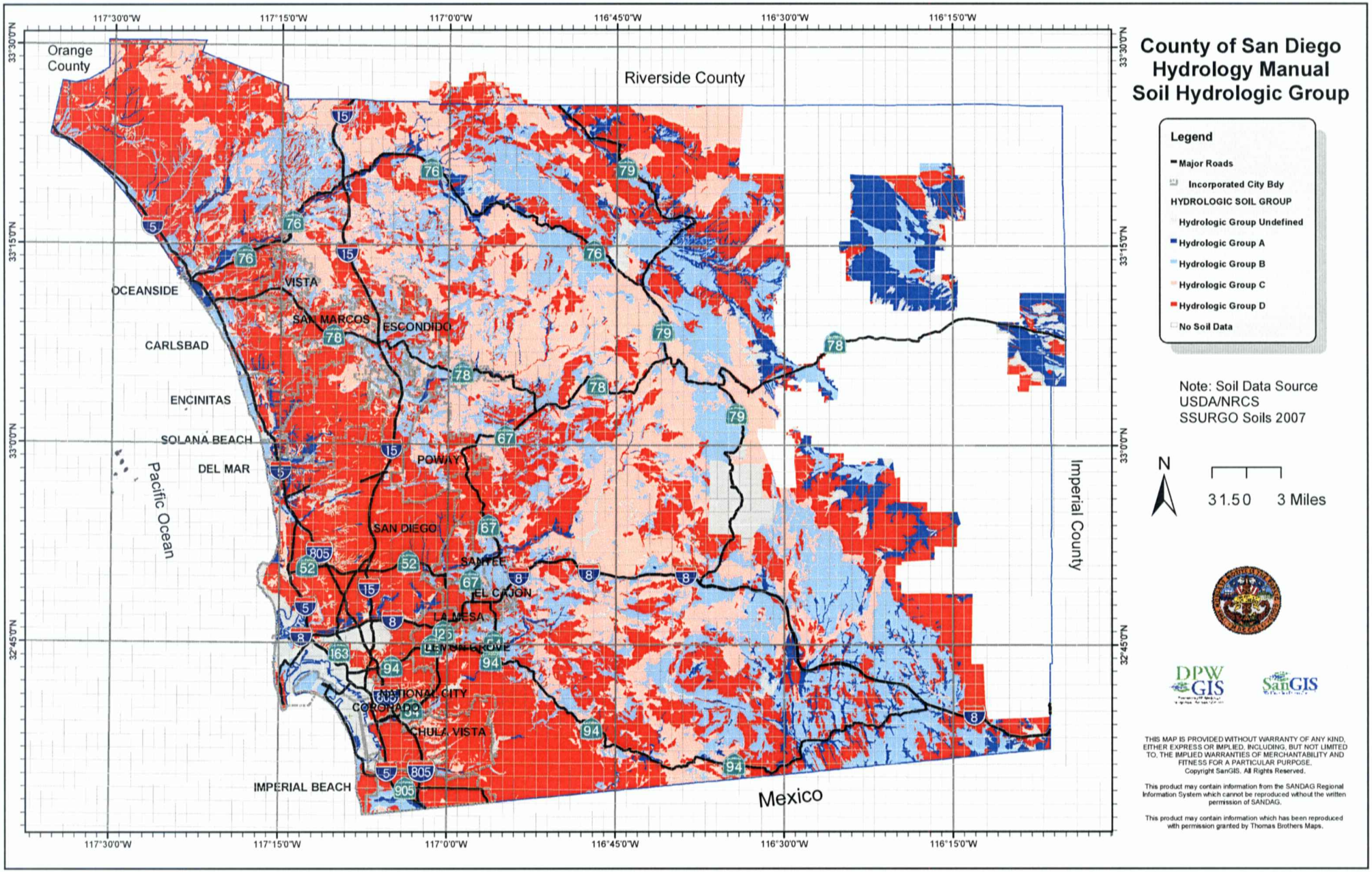


PEAK DISCHARGE	11.89	CFS

VOLUME:	AT PEAK	TOTAL	
	23294	29114	CF
	174241	217769	GAL
	6.41	8.01	ACRE-IN

APPENDIX

Hydrologic Soils Group Map
Runoff Coefficient Table
100-Year, 6-Hour Precipitation Isopleth Maps


County of San Diego
Hydrology Manual
Soil Hydrologic Group
Legend
Major Roads
Incorporated City Bdy
HYDROLOGIC SOIL GROUP
Hydrologic Group Undefined
Hydrologic Group A
Hydrologic Group B
Hydrologic Group C
Hydrologic Group D
No Soil Data
Note: Soil Data Source
USDA/NRCS
SSURGO Soils 2007
N
3 1.5 0 3 Miles
Orange County
Riverside County
Imperial County
Mexico
Pacific Ocean
OCEANSIDE
VISTA
SAN MARCOS
ESCONDIDO
CARLSBAD
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
SAN DIEGO
SANTEE
EL CAJON
LA MESA
LEMON GROVE
NATIONAL CITY
CORONADO
CHULA VISTA
IMPERIAL BEACH
117°30'0"W
117°15'0"W
117°0'0"W
116°45'0"W
116°30'0"W
116°15'0"W
33°30'0"N
33°15'0"N
33°0'0"N
32°45'0"N
DPW GIS
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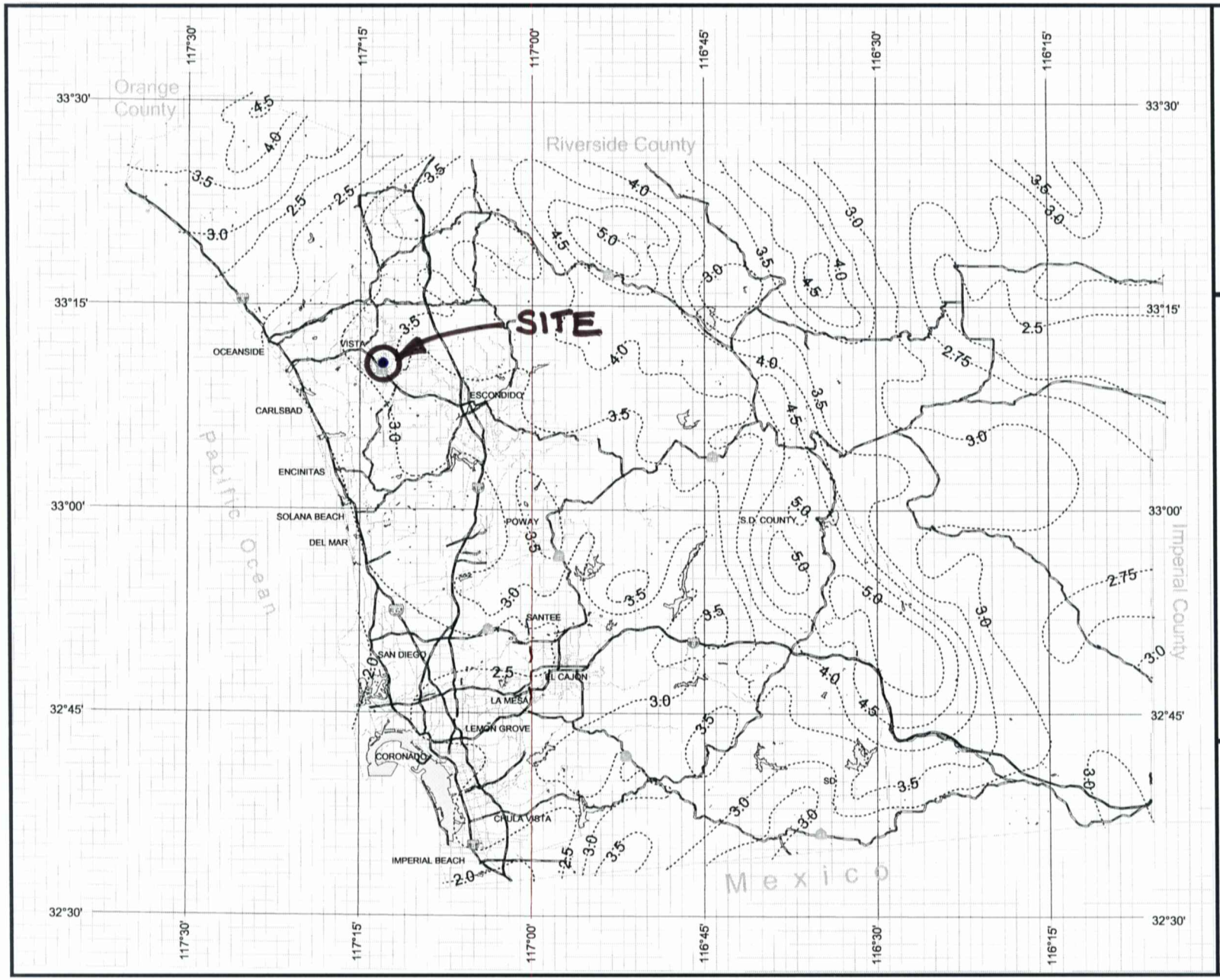
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



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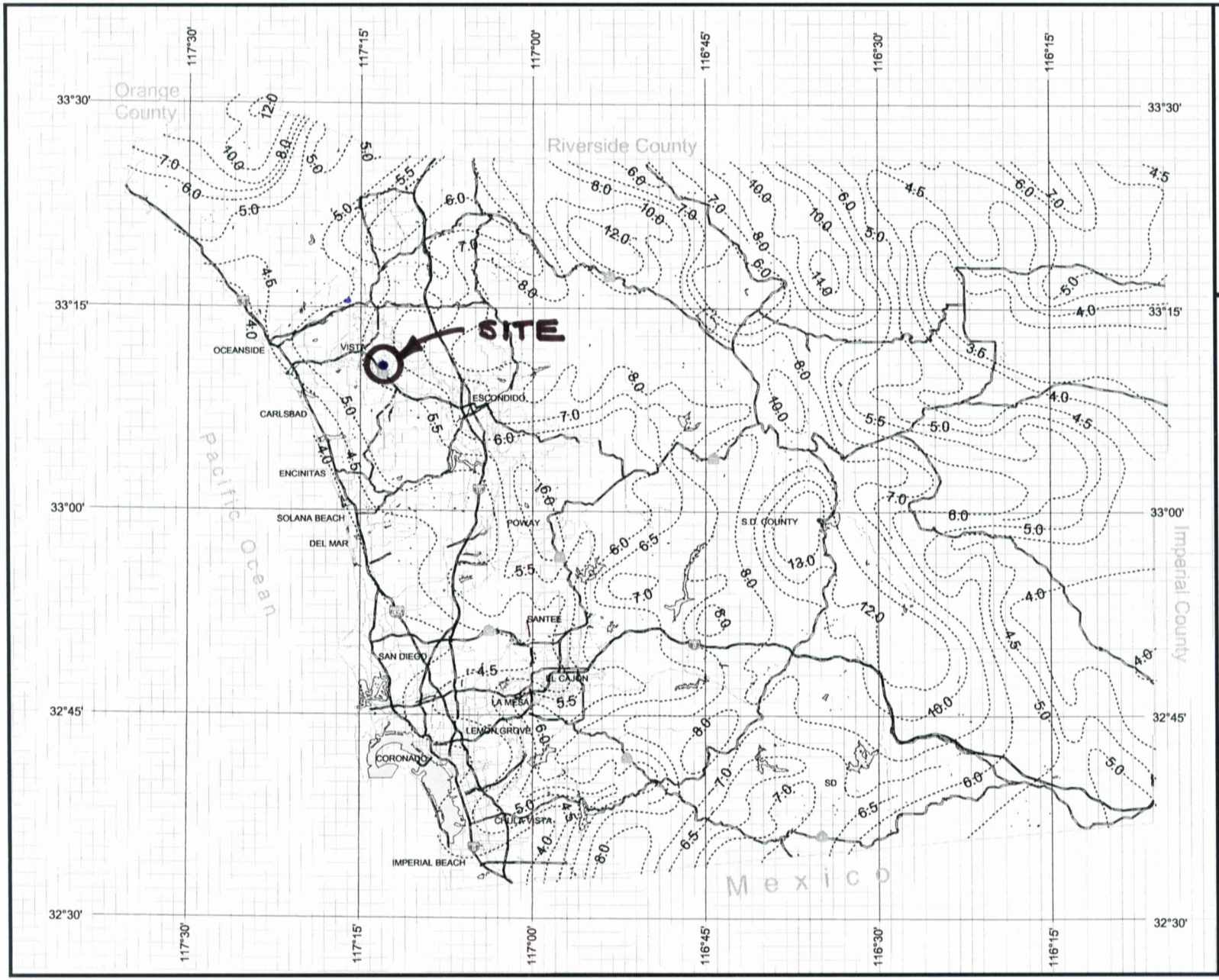
N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

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N W E S

3 0 3 Miles

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

*See Table 3-1 for more detailed description