DRAINAGE/HYDROLOGY CALCULATIONS

TPM 20930
ER 05-14-011; 05-0039801

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Job No. 04-105L

SKANES TENTATIVE PARCEL MAP
HYDROLOGY

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REGISTERED PROFESSIONAL ENGINEER
VERNON J. LEMING
RCE19816
Exp. 09-30-07
11/22/06
CIVIL
STATE OF CALIFORNIA

CULVERT HYDROLOGY

AREA=	3.3 AC		
HEIGHT=	23'	$Q_{100}=CI_{100}A$	$Q_{10}=CI_{10}A$
LENGTH=	400'		
Ti=(10%)=	10 MIN		
Tt=	3 MIN		
TC=	13 MIN	(0.36)(5.1)(3.3)	(0.36)(3.6)(3.3)
C=	0.36		
I_{100}=	5.1	Q_{100}= 6.1 CFS	Q_{10}= 4.3 CFS
I_{10}=	3.6		

RECOMMENDED STRUCTURE

24" CMP CULVERT 52' LONG
n= 0.024
SLOPE = 12.5%
VELOCITY = 8.8 FT/SEC

RIP-RAP:
ROCK CLASS "FACING"
WIDTH = 6
LENGTH = 10'
THICKNESS = 1.4
FILTER BLANKET: 3/8" ROCK 1.0' THICK

HEADWATER

INLET FL= 1710.5
OUTLET FL=1704.0
10 YR HEADWATER=1411.7
100 YR HEADWATER=1412.0
CENTERLINE EL=1413.5

Culvert Calculator Report
ROAD CULVERT

10 YR

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	0.00 ft	Headwater Depth/ Height	0.62
Computed Headwater Elevation	11.74 ft	Discharge	4.30 cfs
Inlet Control HW Elev	11.44 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev	11.74 ft	Control Type	Outlet Control

Grades			
Upstream Invert	10.50 ft	Downstream Invert	4.00 ft
Length	52.00 ft	Constructed Slope	0.125000 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.43 ft
Slope Type	Steep	Normal Depth	0.43 ft
Flow Regime	Supercritical	Critical Depth	0.73 ft
Velocity Downstream	8.80 ft/s	Critical Slope	0.015348 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	11.74 ft	Upstream Velocity Head	0.27 ft
Ke	0.90	Entrance Loss	0.24 ft

Inlet Control Properties			
Inlet Control HW Elev	11.44 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	3.1 ft^2
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Calculator Report
ROAD CULVERT
100 YR

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	0.00 ft	Headwater Depth/ Height	0.75
Computed Headwater Elevation	12.01 ft	Discharge	6.10 cfs
Inlet Control HW Elev	11.69 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev	12.01 ft	Control Type	Outlet Control

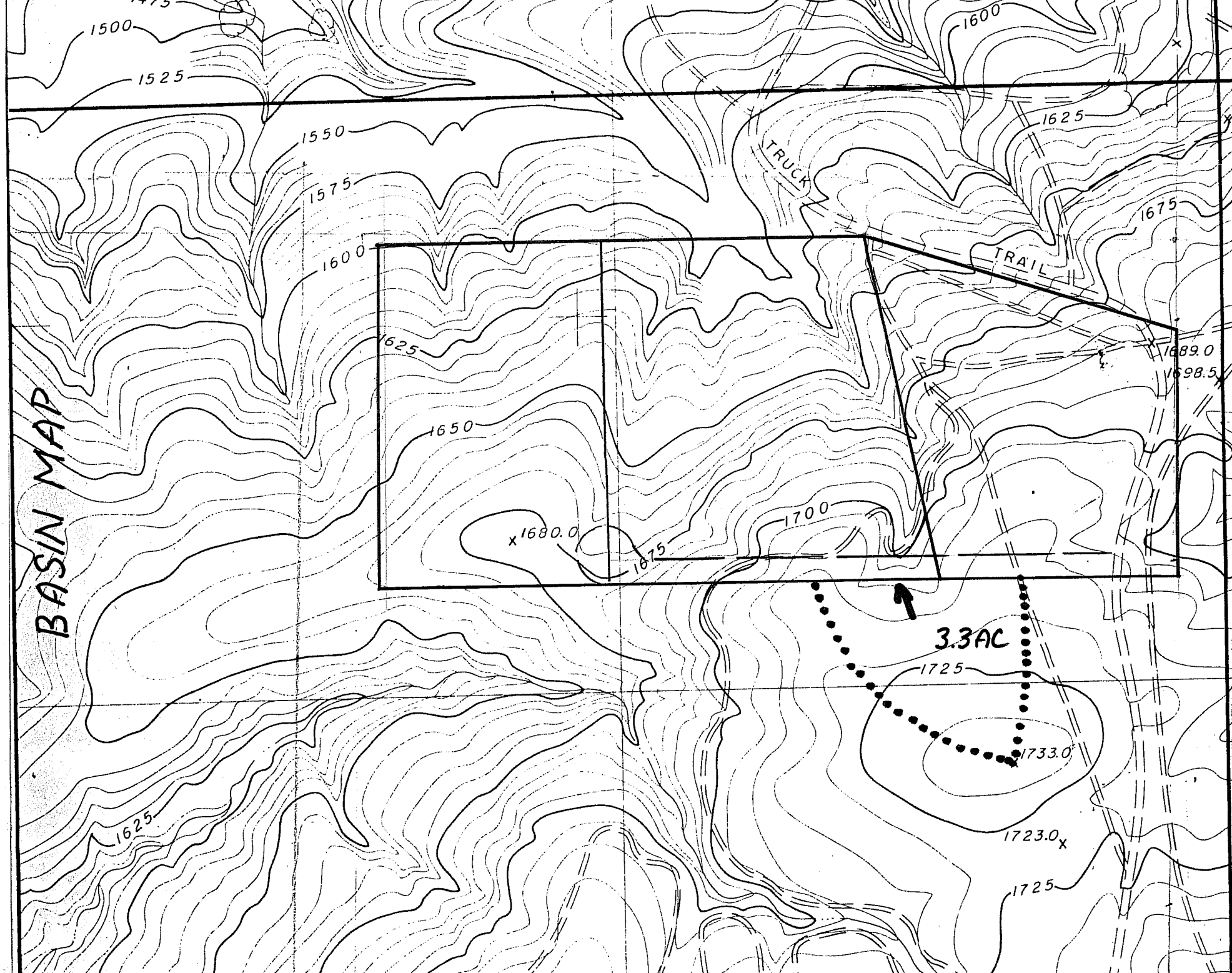
Grades			
Upstream Invert	10.50 ft	Downstream Invert	4.00 ft
Length	52.00 ft	Constructed Slope	0.125000 ft/ft

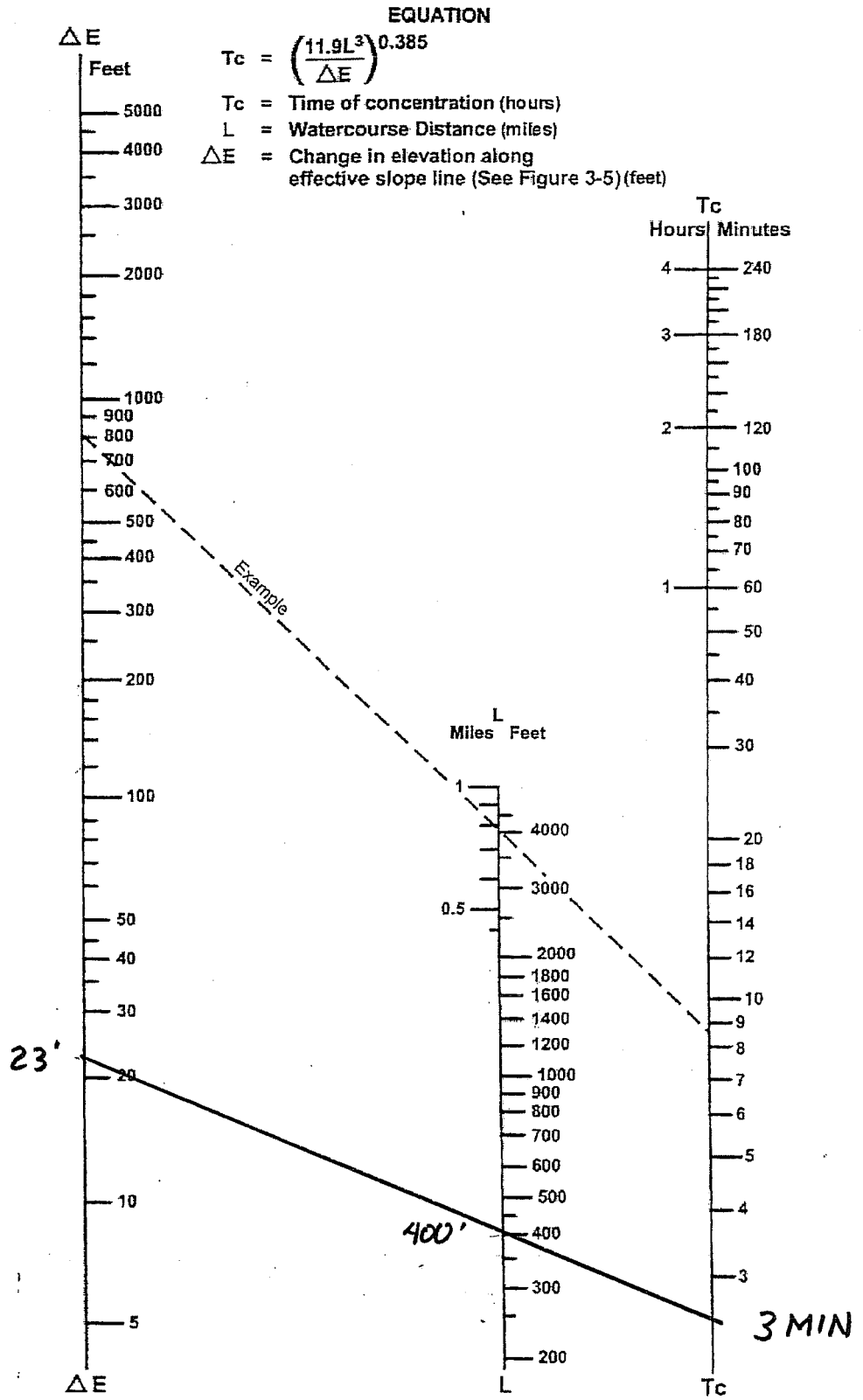
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.51 ft
Slope Type	Steep	Normal Depth	0.51 ft
Flow Regime	Supercritical	Critical Depth	0.87 ft
Velocity Downstream	9.74 ft/s	Critical Slope	0.015867 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	12.01 ft	Upstream Velocity Head	0.33 ft
Ke	0.90	Entrance Loss	0.30 ft

Inlet Control Properties			
Inlet Control HW Elev	11.69 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	3.1 ft^2
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		


BASIN MAP
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1600
1625
1675
TRUCK
TRAIL
1689.0
1698.5
1680.0
3.3AC
1733.0
1723.0
1625
1725



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

FIGURE

3-4

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

SITE
USE "C"
CANADA DE SAN VICENTE
Y MESA DEL
PADRE BARONA
SAN VICENTE
SWARTZ
CANYON
San Vicente Creek
RESERVATION
BOUNDARY
Indian Head
NATIONAL
FOREST
Four Corners

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)

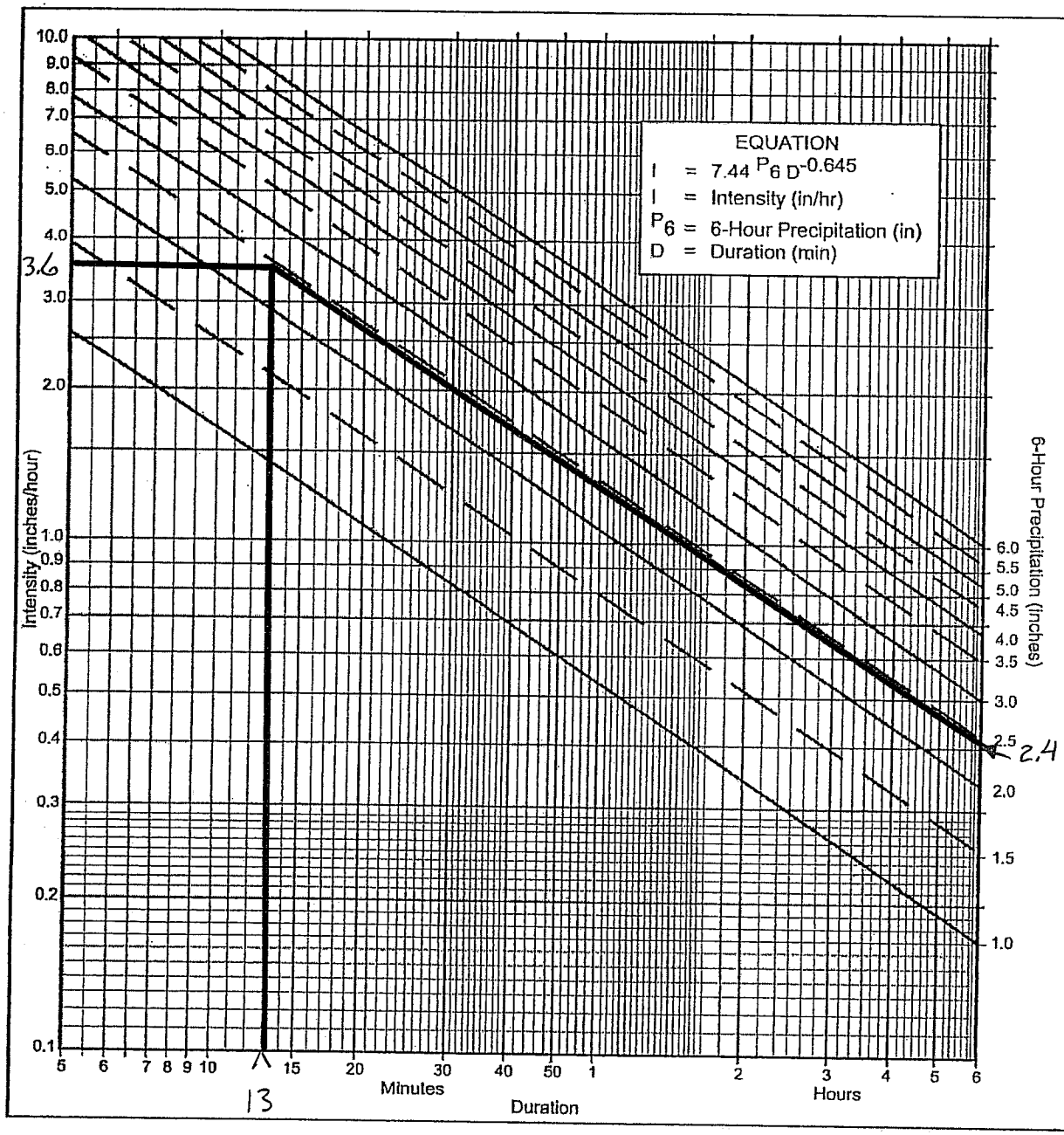
Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	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

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

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

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



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 10 year

(b) P_6 = 2.4 in., P_{24} = 4.5, $\frac{P_6}{P_{24}}$ = 53 %(2)

(c) Adjusted P_6(2) = 2.4 in.

(d) t_x = 13 min.

(e) I = 3.6 in./hr.

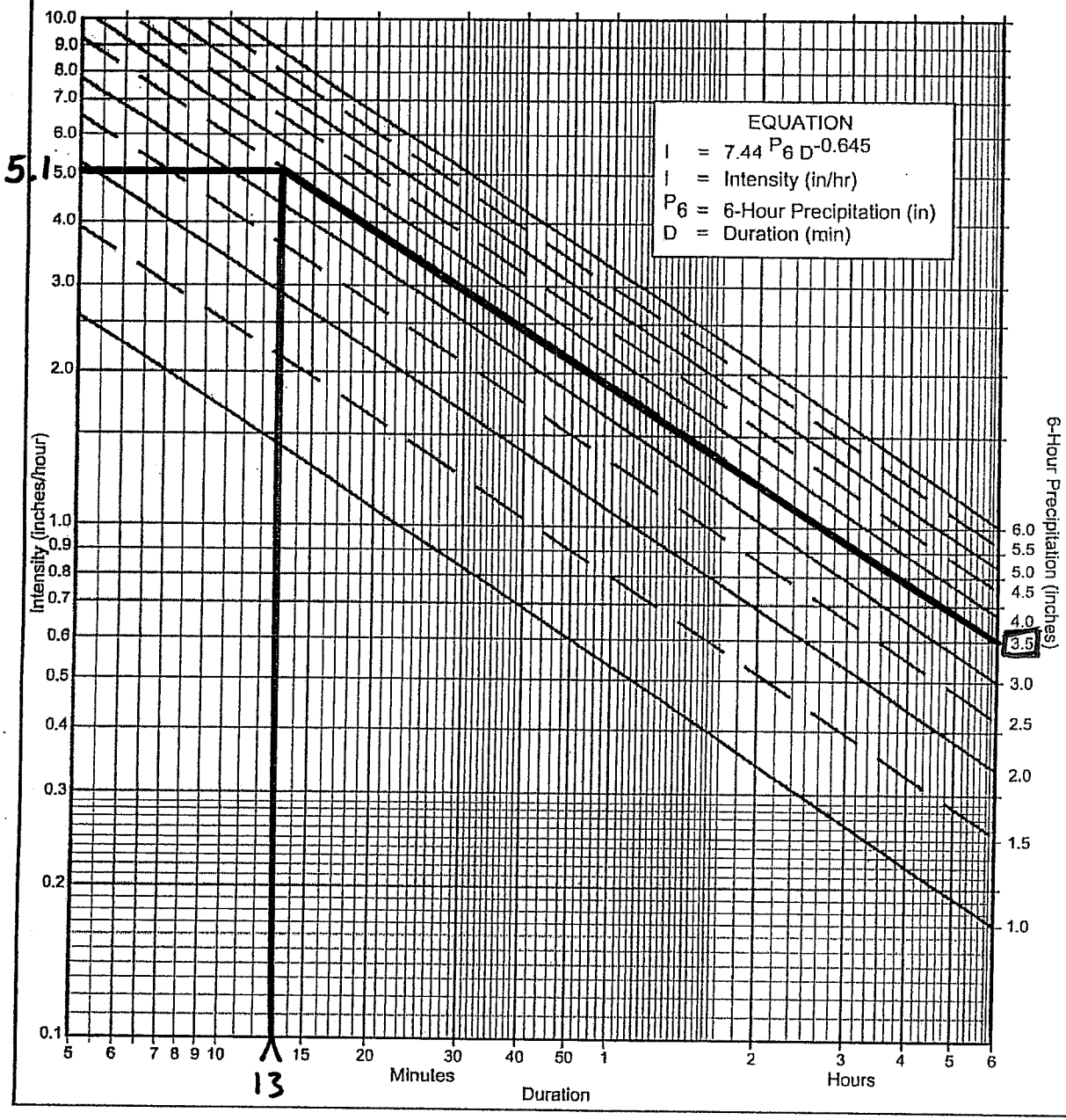
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

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

Intensity-Duration Design Chart - Template

FIGURE

3-1



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.5 in., P_{24} = 6.5, $\frac{P_6}{P_{24}}$ = 54 %(2)

(c) Adjusted P_6(2) = 3.5 in.

(d) t_x = 13 min.

(e) I = 5.1 in./hr.

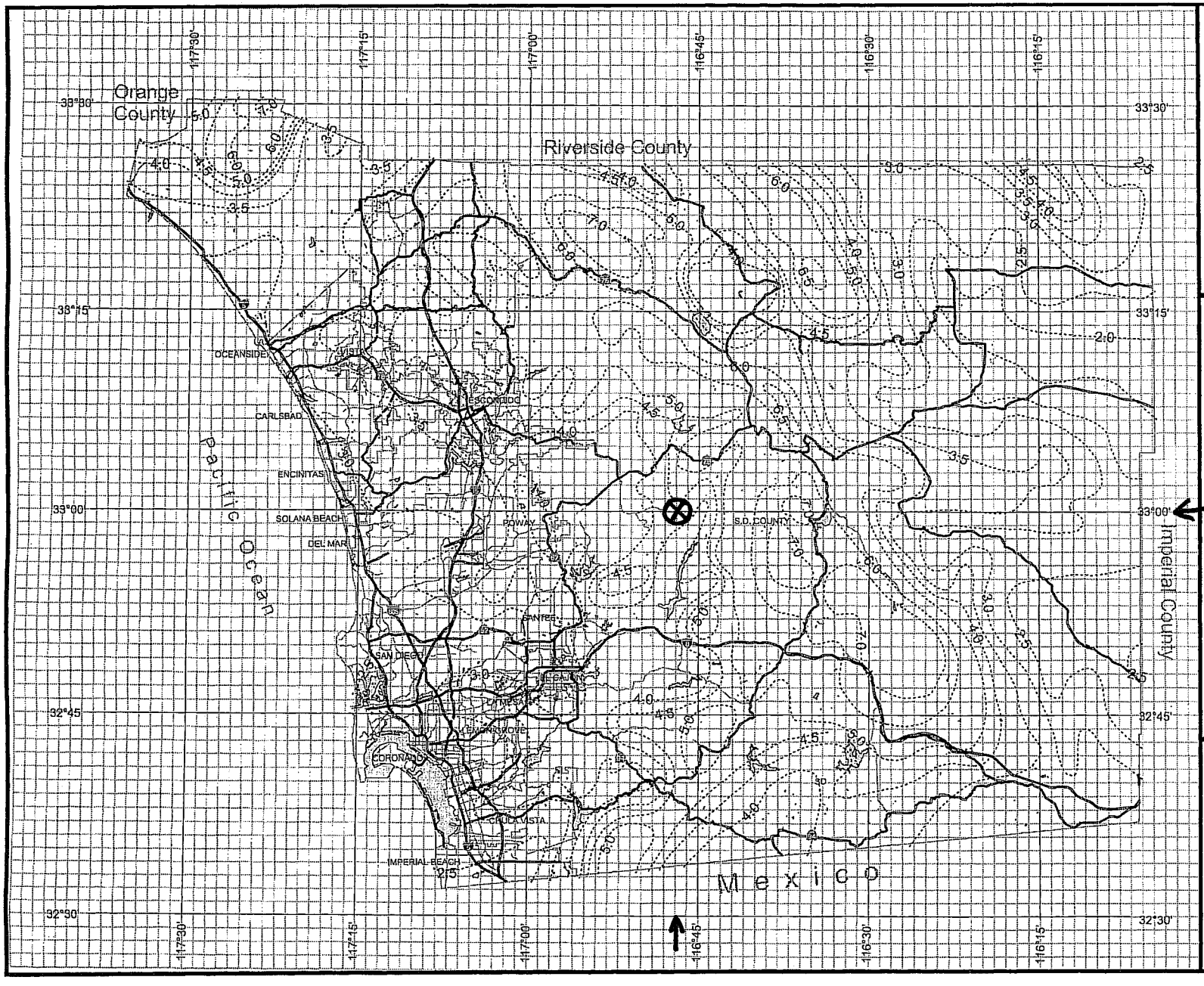
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

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	0.69	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 24 Hours

Isopluvial (inches)

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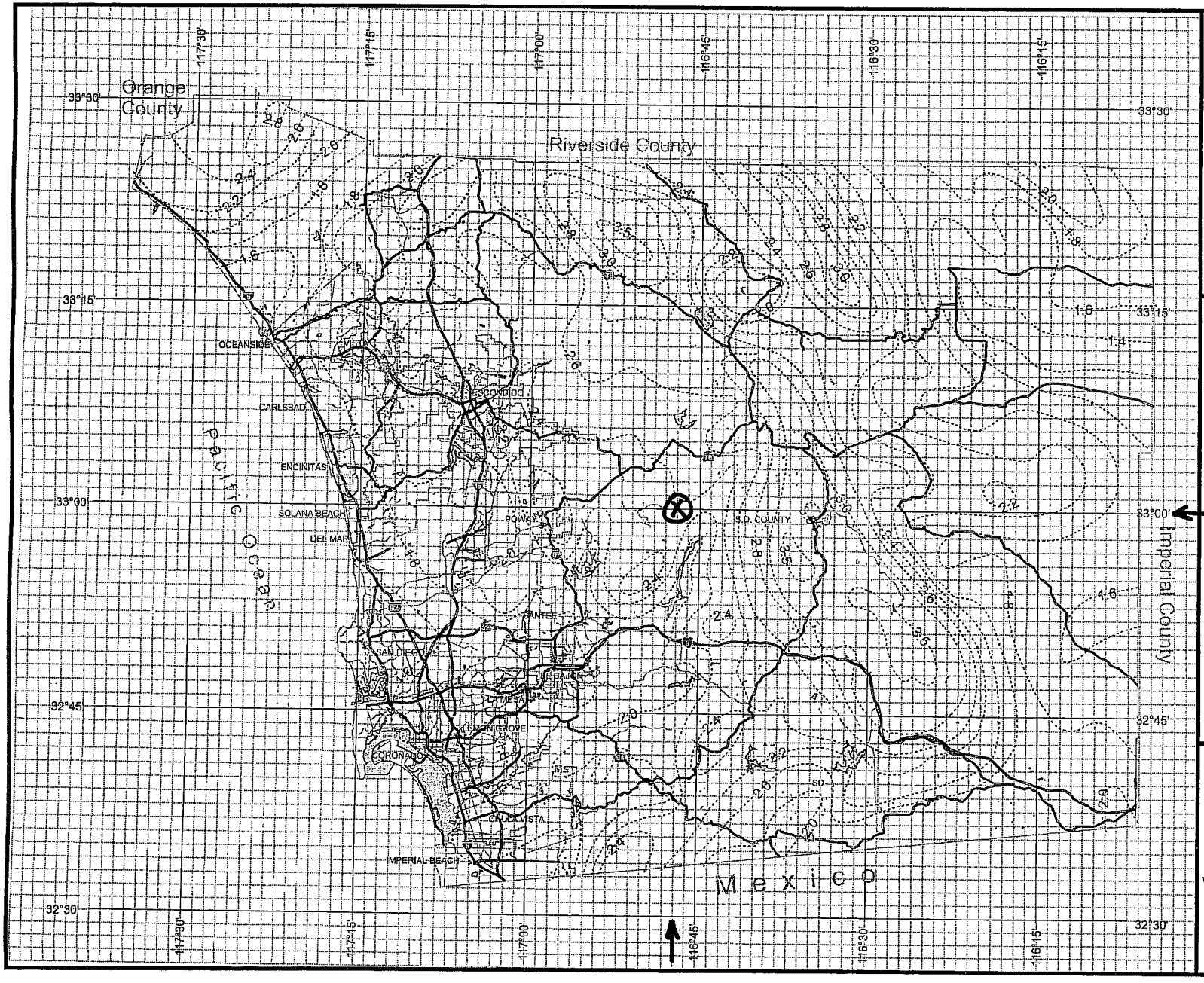
-3- 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 6 Hours

-------- Isopluvial (inches)

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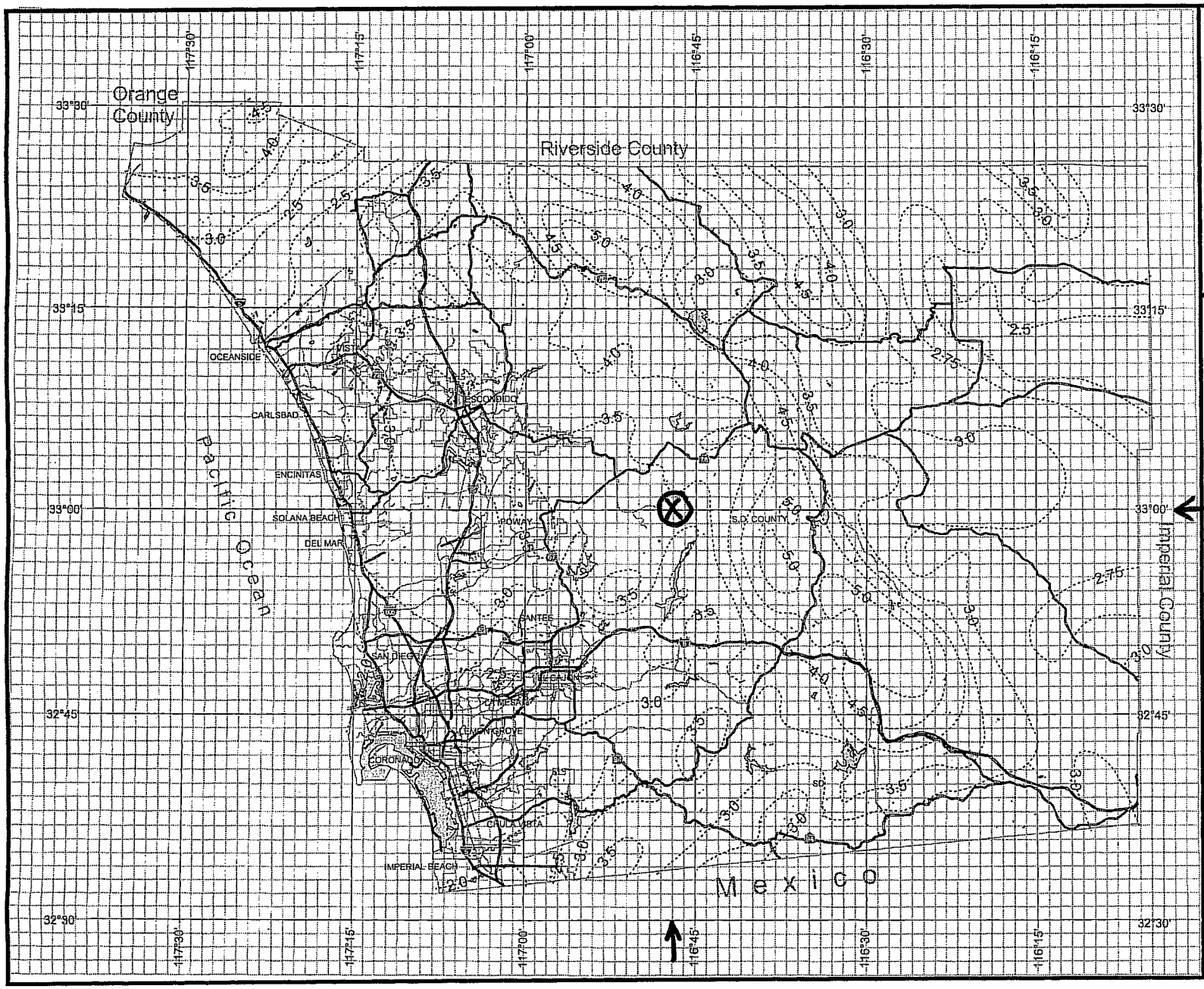

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

33°00 N
116°47' W

3.5

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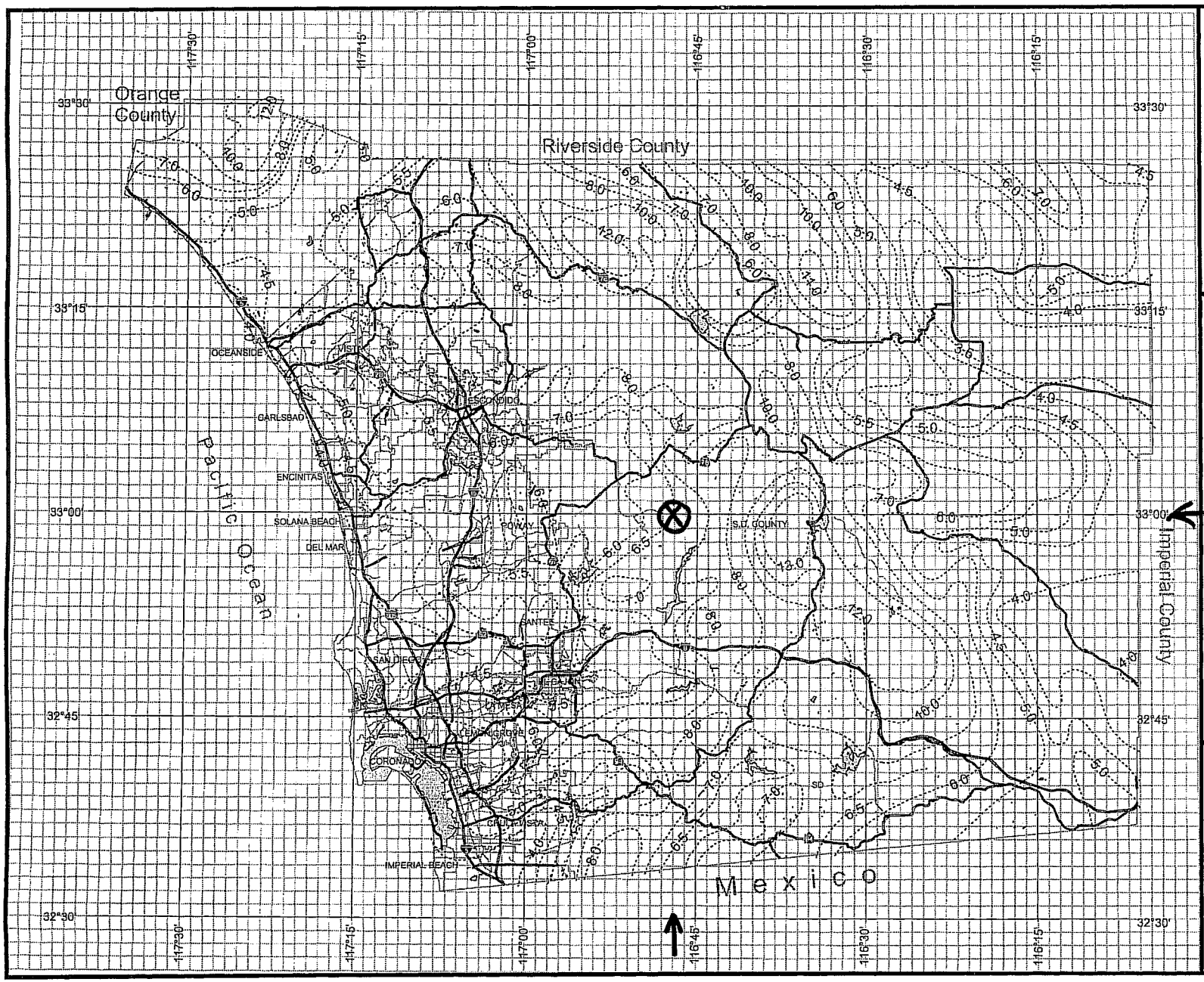
N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

33°00 N
116°47'W

6.5

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3 0 3 Miles

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Add the following table to Section 200-1.6 (Page 1) in the Standard Special Provisions.

Selection of Riprap and Filter Blanket Material

Velocity Ft/Sec. (1)	Rock Class (2)	Riprap Thickness T	Filter Blanket (3) Upper Layer Option 1 (4) Sec. 200	Option 2 (4) Sec. 400	Option 3 (5)	Lower Layer
			AGGREGATE SIZE			
6-7	No.3 Backing	.6	3/16"	C2	D. G.	-
7-8	No.2 Backing	1.0	1/4"	B3	D. G.	-
8-9.5	Facing	1.4	3/8"	-	D. G.	-
9.5-11	Light	2.0	1/2"	-	3/4", 1½" P.B.	-
11-13	½ Ton	2.7	3/4"	-	" , " " "	Sand
13-15	½ Ton	3.4	1"	-	" , " P.B.	"
15-17	1 Ton	4.3	1½"	-	Type B	Sand
17-20	2 Ton	5.4	2"	-	OR " "	Sand

NOTES:

(1). Average velocity in pipe or bottom velocity in energy dissipator, whichever is greater. (See "Riprap Selection Methods", D. S&FC, County

(2). If desired riprap and filter blanket class is not available, use larger class.

(3). Filter blanket thickness = 1 Foot or T, whichever is less.

(4). Standard specifications for public works construction of Southern California Chapter of APWA and AGC. See Pg. 469

(5). D. G. = Decomposed Granite, 1 MM to 10 MM

P. B. = Processed Miscellaneous Base

Type B = Type B bedding material