TPM 21013
506 - 042

CEQA PRELIMINARY
HYDROLOGY/DRAINAGE STUDY

FOR

TENTATIVE PARCEL MAP
LAVELL STREET
SAN DIEGO, CA
A.P.N. 585-120-29

June, 2007

Prepared by

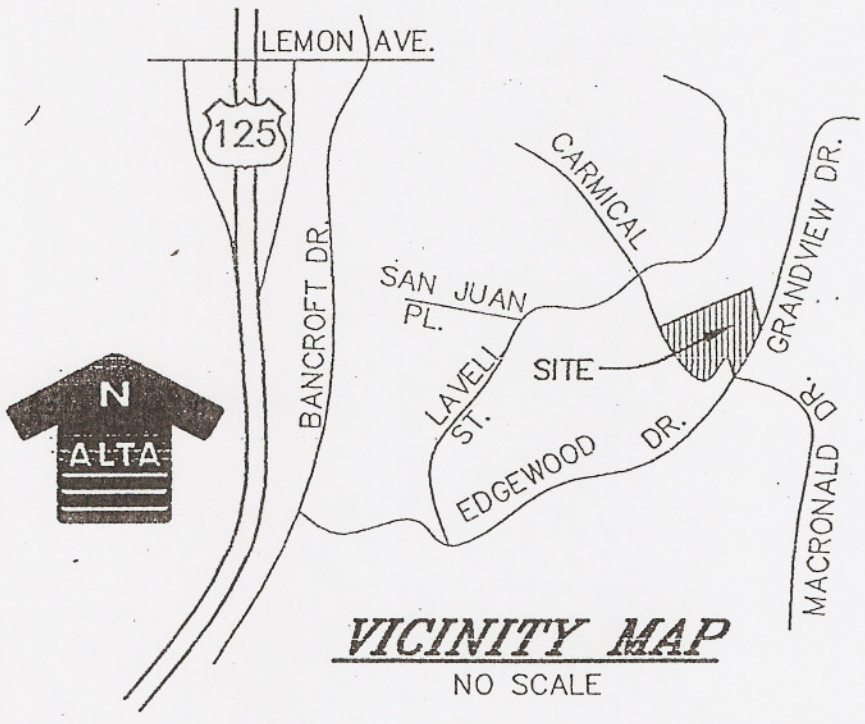
ALTA CONSULTANTS

PLANNING ENGINEERING SURVEYING

4901 Morena Blvd., Suite 409,
San Diego, CA 92117
Tel, (858) 581- 6101, FAX (858) 581- 6138

6-5-07

Bartolome J. Pastor
Registration Expires 3/31/07



VICINITY MAP

NO SCALE

DRAINAGE STUDY REPORT

PROJECT DESCRIPTION:

The project site is predominantly on hilly and rocky formation site at an average slope of 50%. Parcel 1 is an existing residential development and the proposed single family residential projects will be constructed on Parcel 2 and Parcel 3 and will be access from Lavell Street with a single private driveway. The watershed area that affects the project is approximately 3.3 acres; 2.2 acres of which are offsite and 1.1 acres are project site. It is located in the Mount Helix Neighborhood Community.

METHOD:

The drainage study includes post-development hydrology, and pre-development hydrology... The hydrologic soil group classification is "B". The pre-development hydrology is being prepared to analyze the increase of runoff generated by post-development project. The watershed areas of the existing development is based on Table 3-1, County Element 2.9 DU/A with runoff coefficient 0.41. The time of concentration is calculated in combination of maximum overland flow length and initial time of concentration (Table 3-2) and nomograph (Figure 3-4). The proposed driveways and the dwelling units are impervious with minor landscape area are considered to have runoff coefficient of C=0.87. The routing time is conveyed through curb and gutter flow and into a catch basin. The undisturbed natural terrain C1 will remain an open space with runoff coefficient of C=0.25. The post-development project generate a total storm water runoff of Q=11.01 cubic feet per second. The pre-development watershed having coefficient of runoff C = 0.34 is generating a total storm water runoff of Q = 6.59 cu.ft./sec. The project will increase storm water generation by 67.71%. The increase of runoff increases the outfall velocity. To reduce the outlet velocity detention basin and riprap energy dissipators will be designed and constructed to mitigate the erosive outfall velocities. The hydrology study is based on the City of San Diego Drainage Design Manual, 1984 Edition, County of San Diego Hydrology Manual, 2003 Edition and Handbook of Hydraulics, by Brater & King. All runoff calculations are based on Rational Method.

CONCLUSION:

The onsite development of 1.1 acres and the existing offsite of 2.2 acres generate storm water at the rate of 11.01 cubic feet per second. Majority of the development runoffs are

detained temporarily in a detention basin while releasing the existing pre-development storm water runoffs thru a riprap energy dissipator thus reducing its erosive velocity.

ADD-ON INFORMATIONS

Identify and discuss, with appropriate backup/research information, the following questions item by item: Note: quote each question and provide a response.
Would the project:

1. "Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a steam or river, in a manner which would result in substantial erosion or siltation on-of off-site?"
   The project will not alter the drainage pattern of the site and no stream or river is affected to cause erosion or siltation on-of off-site.

2. "Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a steam or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?"
   No stream or river on- or offsite that is affected by the project runoff. The increases of the rate of runoff are mitigated with the construction of detention basins that result in no flooding on the downstream properties.

3. "Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage system?"
   There have been no planned or existing drainage systems that warrant the study of its capacity. The proposed detention basin will ensure that pre-development runoff will continuously be discharge and any existing drainage systems downstream will always handle the current capacity.

4. "Place housing within a 100-year flood hazard area as mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map of other flood hazard delineation map, including County Floodplain Map? For example; research the forgoing and provide same (to indicate applicability or not) in the study?"
   There are no 100-year flood hazard maps applicable to the project, federal, county or insurance maps.

5. "Place within a 100-year flood hazard area structures which would impede or redirect flood flows?"
   Not applicable.

6. "Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam on-site or offsite?"
   Neither existing structures nor people living within the immediate downstream area of the project will be endangered should the detention basins break and caused flooding.

REFERENCES: CHARTS, TABLES & MAPS

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

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

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

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

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

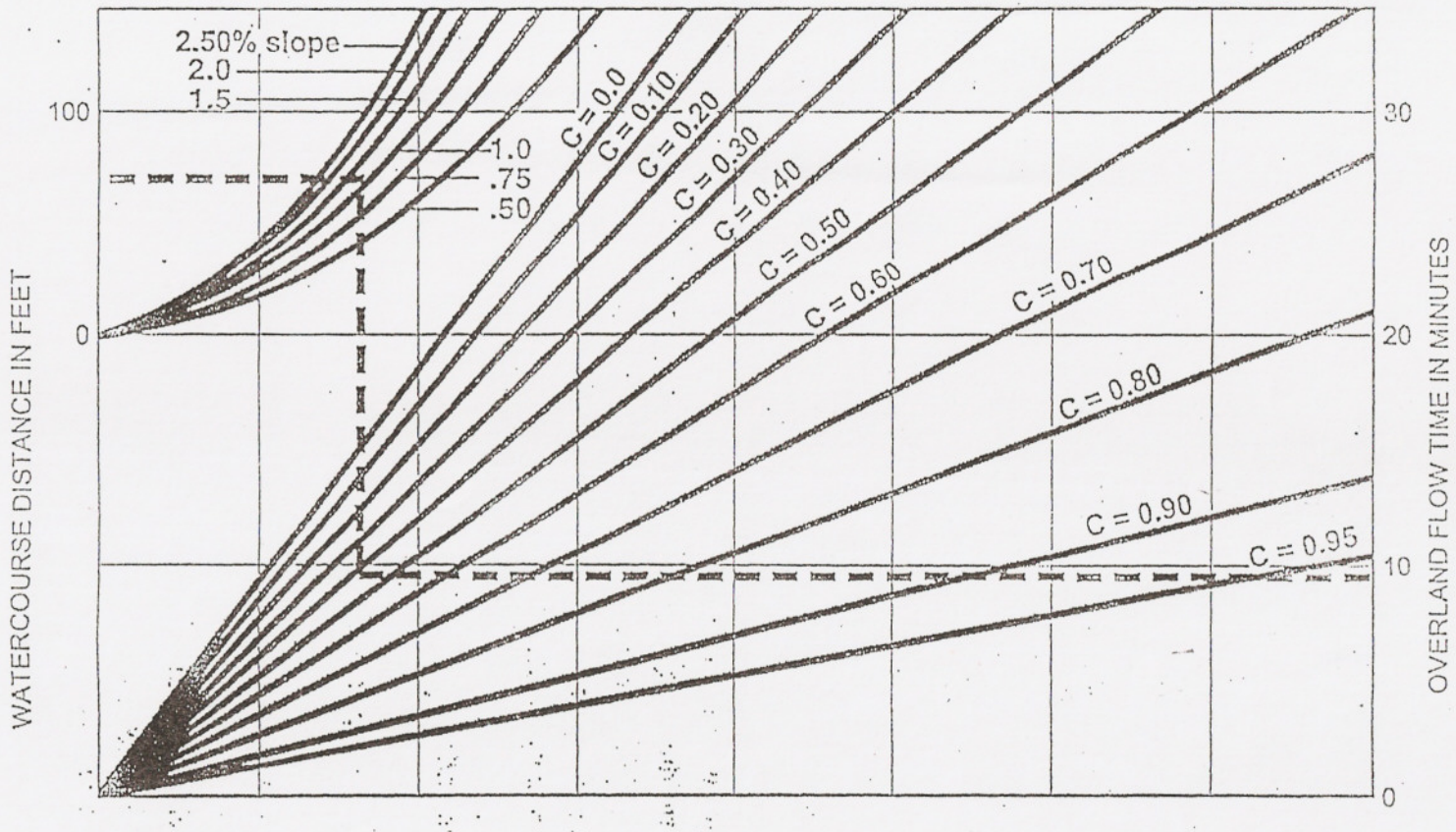
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved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

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)

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

*See Table 3-1 for more detailed description



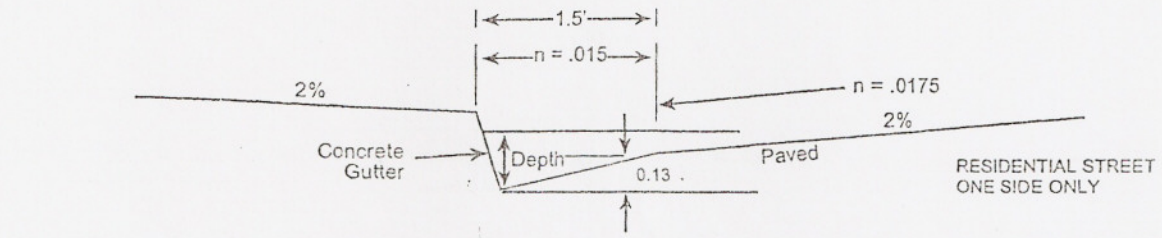
EXAMPLE:
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

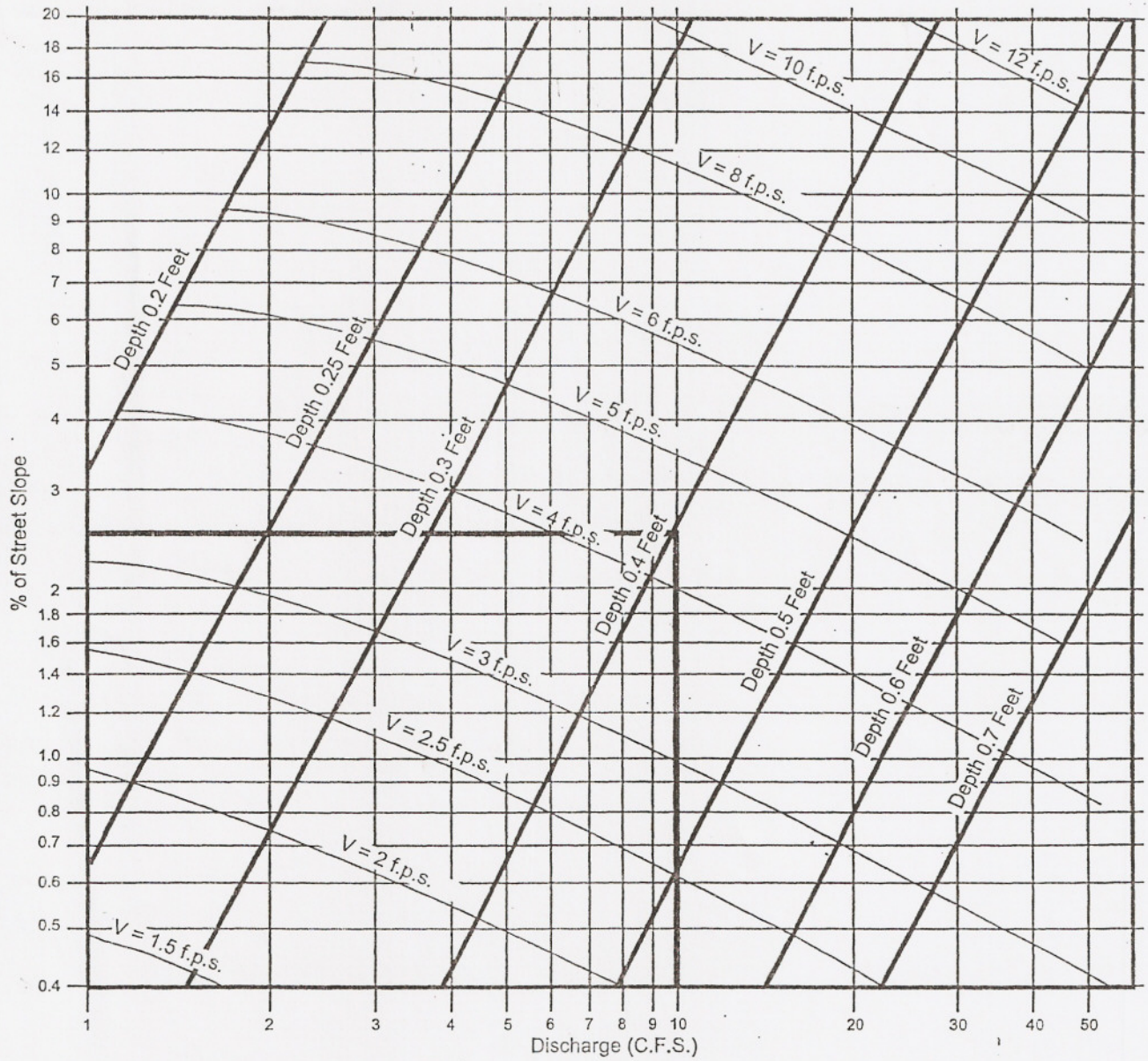
$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph



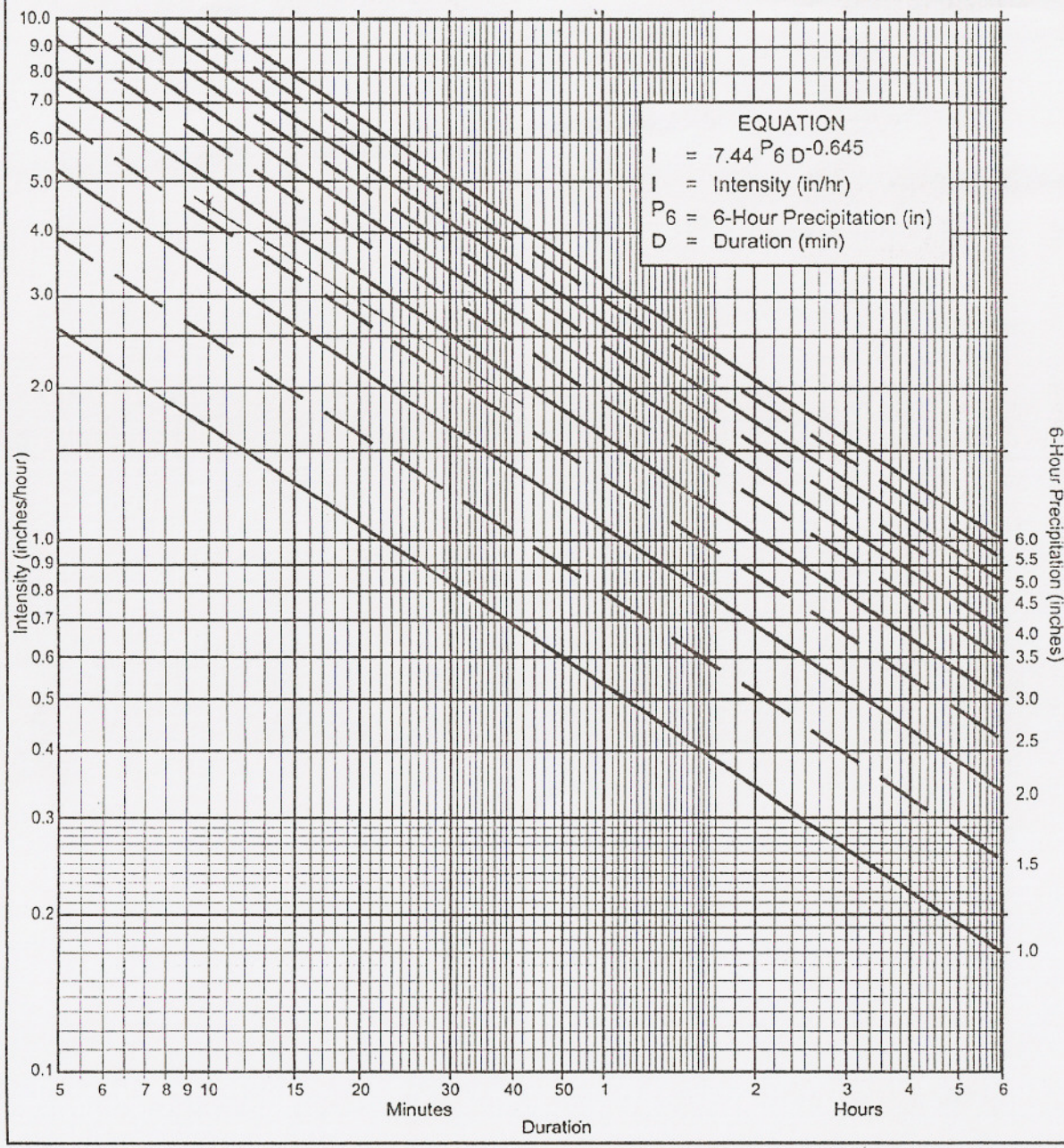


EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

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

FIGURE 3-6

Gutter and Roadway Discharge - Velocity Chart



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.

LAT. 116°59'30"
LONG. 32°45'52"

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.7 in., P_{24} = 5.5 $\frac{P_6}{P_{24}}$ = 49.09%(2)

(c) Adjusted P_6(2) = 2.7 in.

(d) t_x = 10 min.

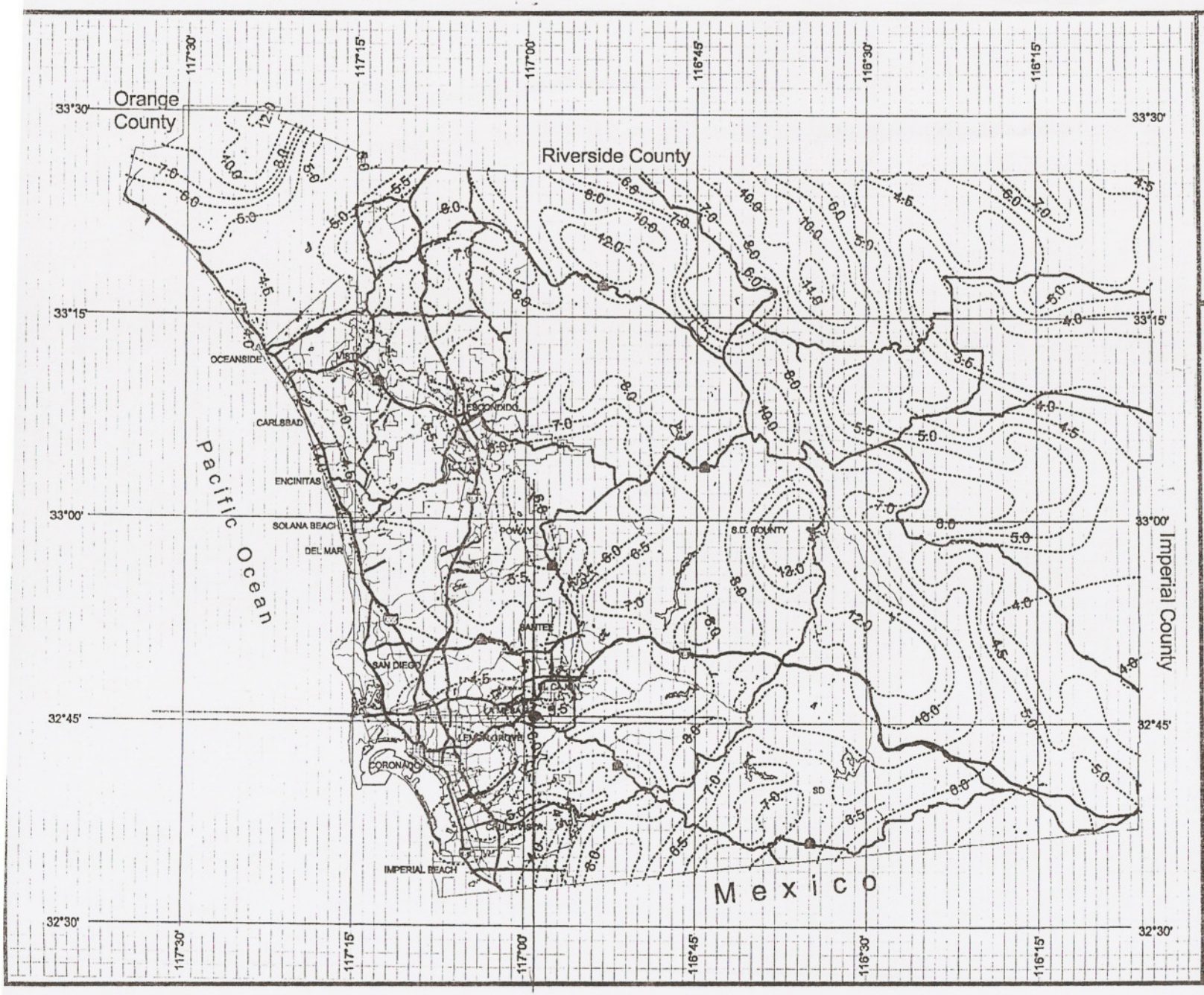
(e) I = 4.5 in./hr.

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



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

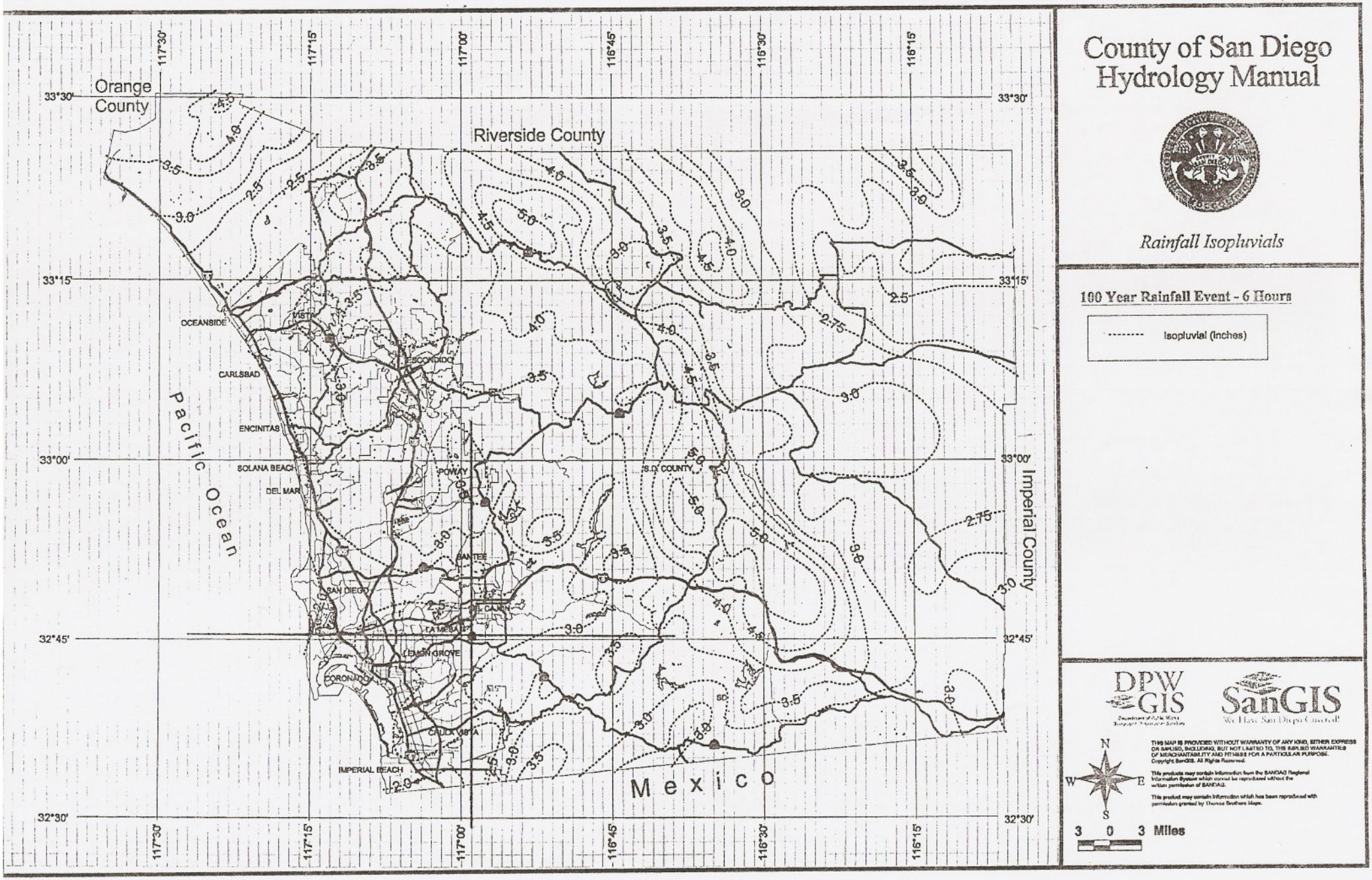
Isopluvial (Inches)

DPW GIS

SanGIS

N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (Inches)

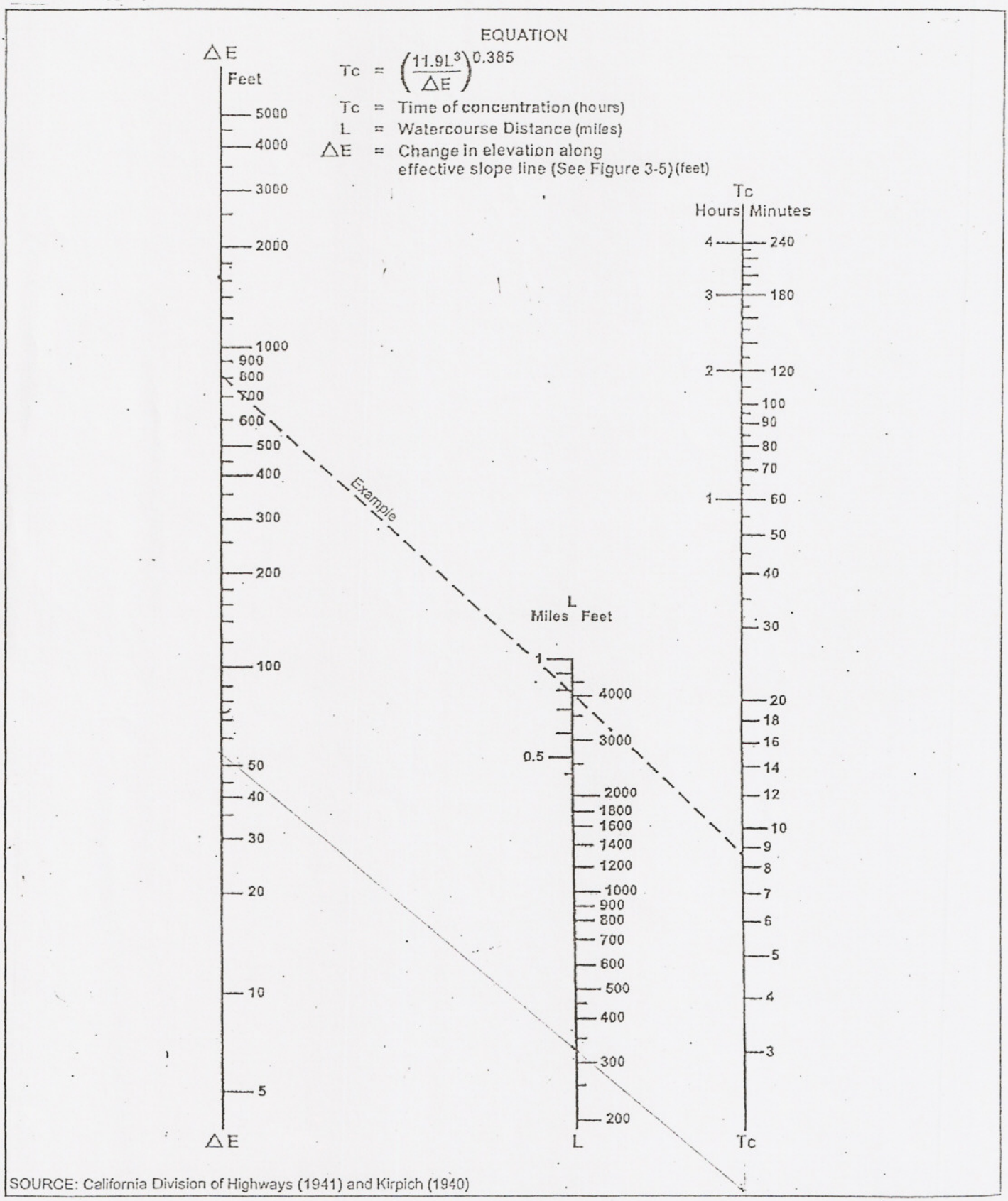
DPW GIS

SanGIS

We Have San Diego Covered!

N W E S

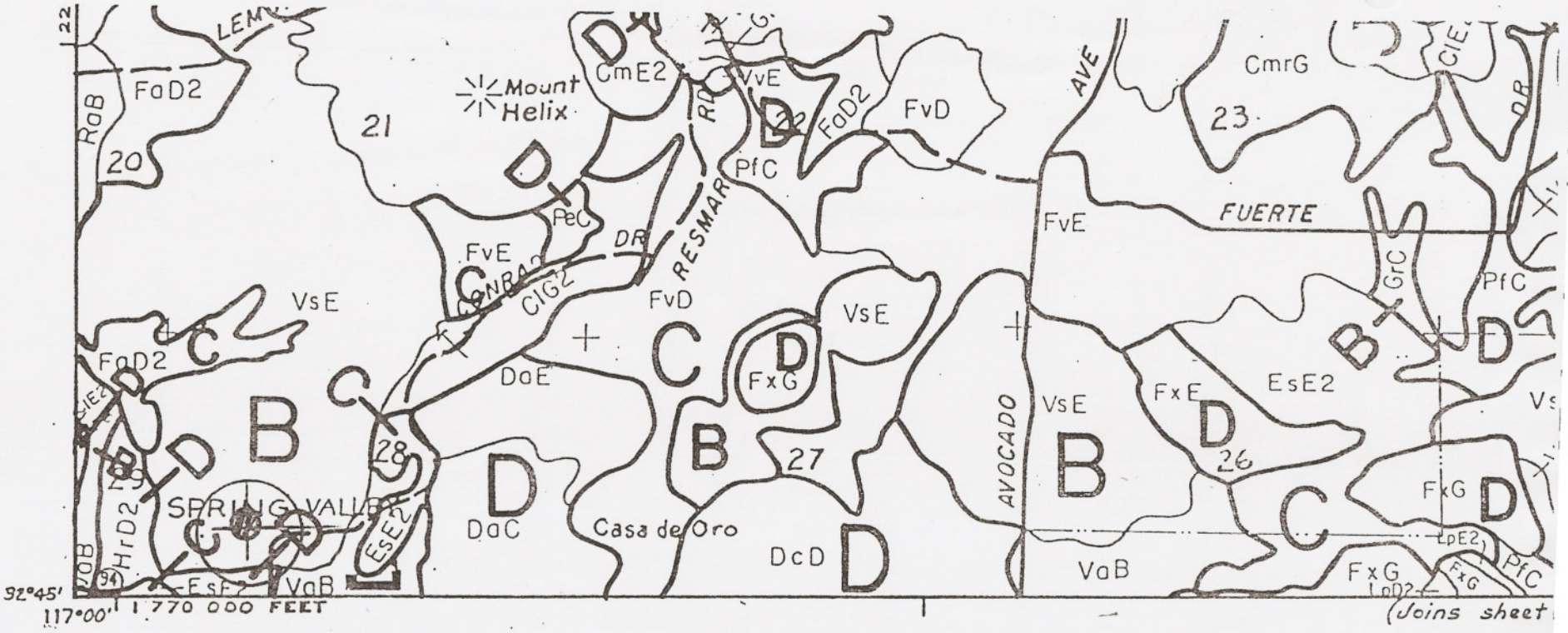
3 0 3 Miles



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



San Diego County Soils Interpretation Study

HYDROLOGIC SOIL GROUPS - Runoff Potential

SEE CAUTION

Group A	Group B	Group C	
A — Low Runoff Potential	B — Moderate Runoff Potential	C — High Runoff Potential	D

POST DEVELOPMENT
HYDROLOGY CALCULATIONS

POST-DEVELOPMENT HYDROLOGY CALCULATION Page 1 of 3 Pages

Project: Tentative Parcel Map Date: Sept.12, 2006

Location: Lavell Street

Storm Frequency: 100 Year

Soil Group Classification: B

Precipitation		P_6 =	2.7	Inches
INITIAL HYDROLOGY (KIRPICH EQUATION)				
Node 1 - Node 2				
Area "A"	A =	2.1	Ac.	
High Elevation	Hi =	765		
Lower Elevation	Lo =	690		
Difference Elevation	H =	75	Ft.	
Distance Travel	L =	423	Ft.	
Effective Slope	So =	17.73%		
Initial Distance Travel	Lm =	100.00	Ft.	Table 3-2
Initial Time Travel	Ti =	3.33	Minutes	Extrapolated
Remaining Dist. Travel	Lr =	323.00	Ft.	
Remaining Diff. Elev.	Hr =	57.27	Ft.	
Remaining Time Travel	Tr =	1.30	Minutes	
Time of Concentration	Tc =	4.63	Minutes	Fig. 3-4
Intensity	I =	7.48	In./hr.	
Runoff Coefficient	C =	0.41	Residential	2.9 DU/A
Cx A	CA =	0.861		
Designed Runoff	Q =	6.44	CFS	
GUTTER FLOW				
Node 2 - Node 3				
Area "B"	A =	0.5	Ac.	
Distance Travel	L =	114	Ft.	
Effective Slope	S =	12.00%		
Gutter Velocity	V =	8.50		Fig. 3-6
Time Travel	Tr =	0.22	Minutes	
Time of Concentration	Tc =	4.85	Minutes	
Intensity	I =	7.26	In./hr.	
Runoff Coefficient	C =	0.87	Residential	Driveway
Summation of C x A	$\sum$CA =	1.296		
Designed Runoff	Q =	9.40	CFS	
HYDROLOGY OF PIPES				
Node 3 - Node 4				
Area "C"	A =	0.3	Ac.	
Designed Runoff	Q =	9.70	CFS	
Pipe Length	L =	75.00	Ft.	
Pipe Diameter	d =	1.00	Ft.	
Pipe Slope	So =	21.33%		
Manning's Coef.	.n =	0.013		
Depth of Water	y =	0.55	Ft.	
Velocity	V =	21.80	Ft./Sec.	
Velocity Head	hv =	7.38	Ft.	
Travel Time	Tt =	0.06	Minutes	
Time of Concentration	Tc =	4.91	Minutes	
Intensity	I =	7.20	In./hr.	
Runoff Coefficient	C =	0.25		Open Space

POST-DEVELOPMENT HYDROLOGY CALCULATION

Project: Tentative Parcel Map
Location: Lavell Street
Storm Frequency: 100 Year
Soil Group Classification: B

Date: Sept.12, 2006

Summation of C x A	∑CA =	1.371		
Total Design Runoff	Q =	9.87	CFS	

OVERLAND - TIME

Node 5 to Node 6				
Area "D"	A =	0.2	Ac.	
Distance Travel	L =	103	Ft.	
Pad Slope	S =	0.50%		
Initial Distance Travel	Lm =	50.00	Ft.	Table 3-2
Initial Time Travel	Ti =	11.30	Minutes	
Remaining Dist. Travel	Lr =	53.00	Ft.	
Remaining Time Travel	Tr =	3.80	Minutes	Fig. 3-3
Time of Concentration	Tc =	15.10	Minutes	
Intensity	I =	3.49	In./hr.	
Runoff Coefficient	C =	0.87	Residential	Driveway
A x C	AC =	0.174		
Designed Runoff	Q =	0.61	CFS	
Node 6 to Node 4				
Designed Runoff	Q =	0.61	CFS	
Pipe Length	L =	93.00	Ft.	
Pipe Diameter	d =	0.83	Ft.	
Pipe Slope	So =	36.56%		
Manning's Coef.	.n =	0.013		
Depth of Water	y =	0.12	Ft.	
Velocity	V =	12.36	Ft./Sec.	
Velocity Head	hv =	2.37	Ft.	
Travel Time	Tt =	0.13	Minutes	
Time of Concentration	Tc =	15.22	Minutes	
Intensity	I =	3.47	In./hr.	
Confluence @ Node 4	Q	Tc	I	
Q1 =	9.87	4.91	7.20	
Q2 =	0.61	15.22	3.47	
Confluence Q =	10.07	cfs		

OVERLAND - TIME

Node 7 - Node 8				
Area "E"	A =	0.1	Ac.	
Distance Travel	L =	72	Ft.	
Pad Slope	S =	1.00%		
Time of Concentration	Tc =	10.50	Minutes	Table 3-2
Intensity	I =	4.41	In./hr.	
Runoff Coefficient	C =	0.87		Pad
A x C	AC =	0.087		
Designed Runoff	Q =	0.38	CFS	

POST-DEVELOPMENT HYDROLOGY CALCULATION Page 3 of 3 Pages

Project: Tentative Parcel Map Date: Sept.12, 2006

Location: Lavell Street

Storm Frequency: 100 Year

Soil Group Classification: B

Node 8 - Node 9				
Area "F"	A =	0.1	Ac.	
Designed Runoff	Q =	0.38	CFS	
Pipe Length	L =	59.00	Ft.	
Pipe Diameter	d =	0.83	Ft.	
Pipe Slope	So =	21.33%		
Manning's Coef.	.n =	0.013		
Depth of Water	y =	0.11	Ft.	
Velocity	V =	8.88	Ft./Sec.	
Velocity Head	hv =	1.22	Ft.	
Travel Time	Tt =	0.11	Minutes	
Time of Concentration	Tc =	10.61	Minutes	
Intensity	I =	4.38	In./hr.	
Runoff Coefficient	C =	0.41	Residential	Driveway
Summation C x A	$\sum$ AC =	0.128		
Designed Runoff	Q =	0.56		

POST-DEVELOPMENT HYDROLOGY CALCULATION Page 1 of 3 Pages

Project: Tentative Parcel Map Date: Sept.12, 2006

Location: Lavell Street

85 Percentile Rainfall Intensity Chart

Soil Group Classification: B

Precipitation		P_{85} =	0.65	Ins/Hr.
INITIAL HYDROLOGY (KIRPICH EQUATION)				
Node 1 - Node 2				
Area "A"	A =	2.1	Ac.	
High Elevation	Hi =	765		
Lower Elevation	Lo =	690		
Difference Elevation	H =	75	Ft.	
Distance Travel	L =	423	Ft.	
Effective Slope	So =	17.73%		
Initial Distance Travel	Lm =	100.00	Ft.	Table 3-2
Initial Time Travel	Ti =	3.33	Minutes	Extrapolated
Remaining Dist. Travel	Lr =	323.00	Ft.	
Remaining Diff. Elev.	Hr =	57.27	Ft.	
Remaining Time Travel	Tr =	1.30	Minutes	
Time of Concentration	Tc =	4.63	Minutes	Fig. 3-4
Intensity	I =	1.80	In./hr.	
Runoff Coefficient	C =	0.41	Residential	2.9 DU/A
Cx A	CA =	0.861		
Designed Runoff	Q =	1.55	CFS	
GUTTER FLOW				
Node 2 - Node 3				
Area "B"	A =	0.5	Ac.	
Distance Travel	L =	114	Ft.	
Effective Slope	S =	12.00%		
Gutter Velocity	V =	6.00		Fig. 3-6
Time Travel	Tr =	0.32	Minutes	
Time of Concentration	Tc =	4.94	Minutes	
Intensity	I =	1.73	In./hr.	
Runoff Coefficient	C =	0.87	Residential	Driveway
Summation of C x A	$\sum$CA =	1.296		
Designed Runoff	Q =	2.24	CFS	
HYDROLOGY OF PIPES				
Node 3 - Node 4				
Area "C"	A =	0.3	Ac.	
Designed Runoff	Q =	9.70	CFS	
Pipe Length	L =	75.00	Ft.	
Pipe Diameter	d =	1.00	Ft.	
Pipe Slope	So =	21.33%		
Manning's Coef.	.n =	0.013		
Depth of Water	y =	0.55	Ft.	
Velocity	V =	21.80	Ft./Sec.	
Velocity Head	hv =	7.38	Ft.	
Travel Time	Tt =	0.06	Minutes	
Time of Concentration	Tc =	5.00	Minutes	
Intensity	I =	1.71	In./hr.	
Runoff Coefficient	C =	0.25		Open Space

POST-DEVELOPMENT HYDROLOGY CALCULATION

Project: Tentative Parcel Map Date: Sept.12, 2006

Location: Lavell Street

85 Percentile Rainfall Intensity Chart

Soil Group Classification: B

Summation of C x A	∑CA =	1.371		
Total Design Runoff	Q =	2.35	CFS	

OVERLAND - TIME
Node 5 to Node 6

Area "D"	A =	0.2	Ac.	
Distance Travel	L =	103	Ft.	
Pad Slope	S =	0.50%		
Initial Distance Travel	Lm =	50.00	Ft.	Table 3-2
Initial Time Travel	Ti =	11.30	Minutes	
Remaining Dist. Travel	Lr =	53.00	Ft.	
Remaining Time Travel	Tr =	3.80	Minutes	Fig. 3-3
Time of Concentration	Tc =	15.10	Minutes	
Intensity	I =	0.84	In./hr.	
Runoff Coefficient	C =	0.87	Residential	Driveway
A x C	AC =	0.174		
Designed Runoff	Q =	0.15	CFS	
Node 6 to Node 4				
Designed Runoff	Q =	0.15	CFS	
Pipe Length	L =	93.00	Ft.	
Pipe Diameter	d =	0.83	Ft.	
Pipe Slope	So =	36.56%		
Manning's Coef.	.n =	0.013		
Depth of Water	y =	0.06	Ft.	
Velocity	V =	8.10	Ft./Sec.	
Velocity Head	hv =	1.02	Ft.	
Travel Time	Tt =	0.19	Minutes	
Time of Concentration	Tc =	15.29	Minutes	
Intensity	I =	0.83	In./hr.	
Confluence @ Node 4	Q	Tc	I	
Q1 =	2.35	5.00	1.71	
Q2 =	0.15	15.29	0.83	
Confluence Q =	2.40	cfs		

OVERLAND - TIME
Node 7 - Node 8

Area "E"	A =	0.1	Ac.	
Distance Travel	L =	72	Ft.	
Pad Slope	S =	1.00%		
Time of Concentration	Tc =	10.50	Minutes	Table 3-2
Intensity	I =	1.06	In./hr.	
Runoff Coefficient	C =	0.87		Pad
A x C	AC =	0.087		
Designed Runoff	Q =	0.09	CFS	

POST-DEVELOPMENT HYDROLOGY CALCULATION Page 3 of 3 Pages

Project: Tentative Parcel Map Date: Sept.12, 2006

Location: Lavell Street

85 Percentile Rainfall Intensity Chart

Soil Group Classification: B

Node 8 - Node 9				
Area "F"	A =	0.1	Ac.	
Designed Runoff	Q =	0.38	CFS	
Pipe Length	L =	59.00	Ft.	
Pipe Diameter	d =	0.83	Ft.	
Pipe Slope	So =	21.33%		
Manning's Coef.	.n =	0.013		
Depth of Water	y =	0.11	Ft.	
Velocity	V =	8.88	Ft./Sec.	
Velocity Head	hv =	1.22	Ft.	
Travel Time	Tt =	0.11	Minutes	
Time of Concentration	Tc =	10.61	Minutes	
Intensity	I =	1.05	In./hr.	
Runoff Coefficient	C =	0.41	Residential	Driveway
Summation C x A	$\sum$ AC =	0.128		
Designed Runoff	Q =	0.13		

NATURAL WATERSHED HYDROLOGY CALCULATIONS

EXISTING WATERSHED HYDROLOGY CALCULATION Page 1 11-Sep-06

Project Name: TENTATIVE PARCEL MAP
ADDRESS: LAVELL STREET
Job No, 346-01
Storm Frequency = 100 YEARS
Soil Classification "B"

				Remarks
Precipitation =	P6 =	2.7		Figure 3-1
Runoff Coefficient =	C =	0.34		Table 3-1
INITIAL HYDROLOGY (KIRPICH EQUATION)				**NATURAL GROUND**
NODE 1 TO 2				
Area A				
Area	A =	2.79	Ac.	Remarks
Difference Elevation	H =	114	Ft.	
Distance Travel	L =	627	Ft.	
Effective Slope	So =	18.18%		
Initial Distance Travel	Lm =	100.00	Ft.	Table 3-2
Initial Time Travel	Ti =	3.95	Minutes	Extrapolated
Remaining Dist. Travel	Lr =	527.00	Ft.	
Remaining Diff. Elev.	Hr =	95.82	Ft.	
Remaining Time Travel	Tr =	1.88	Minutes	Fig. 3-4
Time of Concentration	Tc =	5.83	Minutes	
Intensity	I =	6.44	In./hr.	
C x A	CA =	0.9486		
Designed Runoff	Q =	6.11	CFS	
INITIAL HYDROLOGY (KIRPICH EQUATION)				**NATURAL GROUND**
NODE 3 TO 4				
Area B				
Area	A =	0.21	Ac.	Remarks
High Elevation	Hi=	714	Ft.	
Low Elevation	Lo=	674	Ft.	
Difference Elevation	H =	40	Ft.	
Distance Travel	L =	99	Ft.	
Effective Slope	So =	40.40%		
Time of Concentration	Tc =	6.90	Minutes	Fig. 3-4
Intensity	I =	5.78	In./hr.	
C x A	CA =	0.0714		
Designed Runoff	Q =	0.41	CFS	

EXISTING WATERSHED HYDROLOGY CALCULATION Page 2 11-Sep-06

Project Name: TENTATIVE PARCEL MAP

ADDRESS: LAVELL STREET

Job No, 346-01

Storm Frequency = 100 YEARS

Soil Classification "B"

				Remarks
Precipitation =	P6 =	2.7		Figure 3-1
Runoff Coefficient =	C =	0.34		Table 3-1
INITIAL HYDROLOGY (KIRPICH EQUATION)				**NATURAL GROUND**
NODE 5 TO 6				
Area C				
Area	A =	0.04	Ac.	Remarks
Difference Elevation	H =	34.5	Ft.	
Distance Travel	L =	96	Ft.	
Effective Slope	So =	35.94%		
Time of Concentration	Tc =	6.90	Minutes	Fig. 3-4
Intensity	I =	5.78	In./hr.	
C x A	CA =	0.0136		
Designed Runoff	Q =	0.08	CFS	

Project Name: TENTATIVE PARCEL MAP

Location: Lavell Street

Date: August 28, 2006

Job No. 346-01

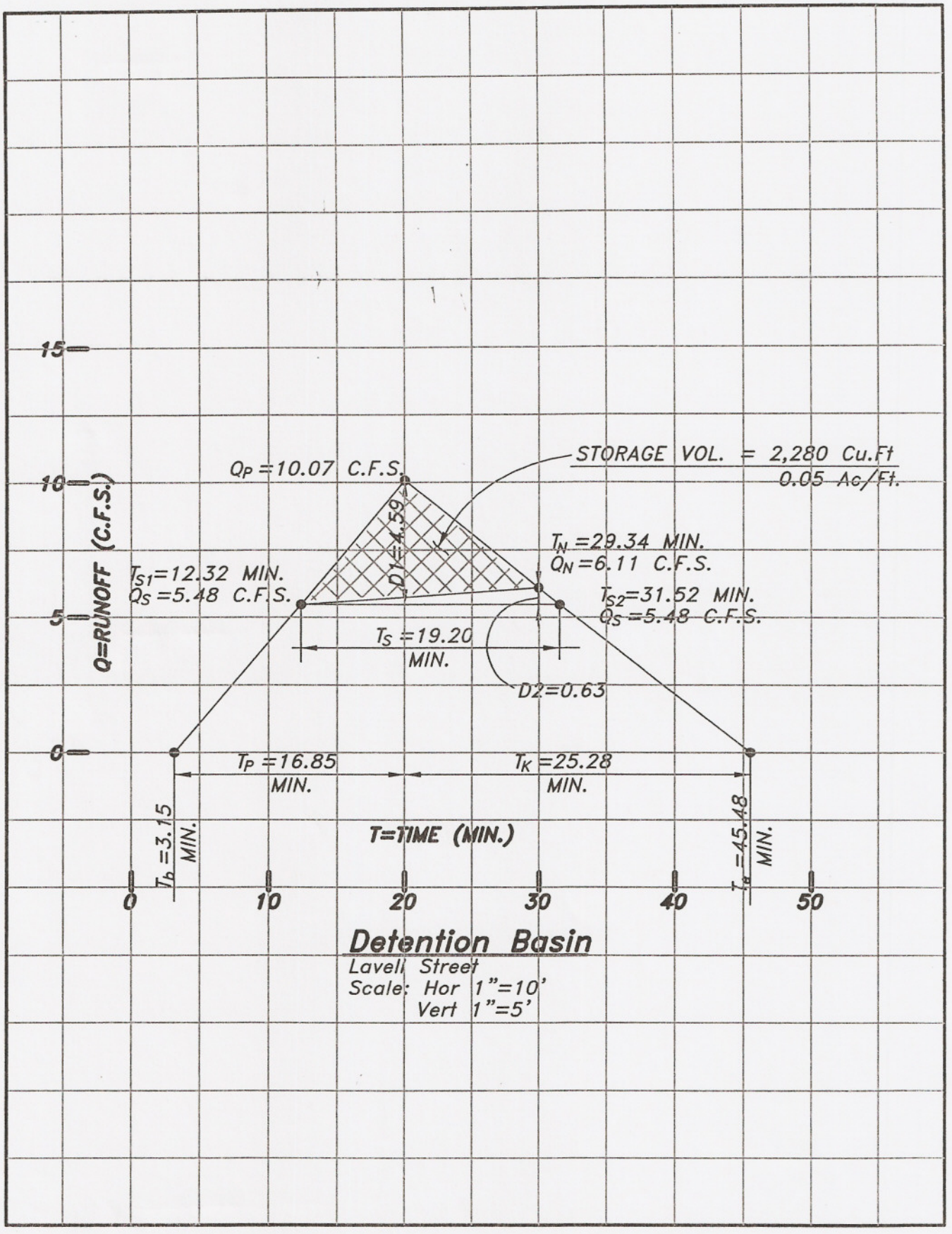
HYDRAULICS

EXTENDED DETENTION BASIN

BASIN "A"

See Figure "A"

INPUT VARIABLES (Industrial Development)		**100 Year**	
Six (6)Hour Precipitation Amount (Inches)	P_6 =	2.70	Fig. 3-1
Distance	L =	1,217	
Pad Slope	S = %	3.12%	(See Pg. 1 Hydrology)
Time of Concentration (Min.)	Tc =	15.22	Min. (See Pg. 1 Hydrology)
Coefficient of Runoff	C =	0.87	Table 3-1
Area	A =	14.00	CFS
Time to Peck (Tp = 1.1072 x Tc)	Tp =	16.85	Minutes
Time of Hydrograph to Begin (Tb = 20 - Tp)	Tb =	3.15	Minutes
Time of Hydrograph to End (Te = 20 + 1.5xTp)	Te =	45.28	Minutes
$I_{Tc} = 7.44 \times P6/Tc^{\wedge}.645$	I_{Tc} =	3.47	Ins/hr.
Qp = C x I_{Tc} x A, (C.F.S.)	Qp =	10.07	CFS (See Pg.1 Hydrology)
SURROUNDING FLOW (Qs)			
Depth of Precipitation for 2 Hours ($D_{120} = 0.6785 \times P_6$)	D_{120} =	1.83	Inches
Depth of Precipitation for Hydrograph ($D_H = P_6 \times Tc^{\wedge}.355/5.83$)	D_H =	1.22	Inches
Surrounding Intensity: Is = 60(D_{120} - D_H) / (120 - 2.5Tc)	Is =	0.45	Ins./hr.
Qs = C x Is x A ,(C.F.S.)	Qs =	5.48	CFS
OUTFLOW (Existing Condition)			
Runoff Coefficient	C =	0.35	Table 3-1
Length of Travel	L =	627	Ft.
Difference in Elevation	H =	114	Ft
Effective Slope	S =	18.18%	% (See Pg 2 Pre-Hydrology)
Time of Concentration	Tc =	5.83	Min. (Pre-Hydrology)
Intensity in Ins./Hr.	I =	4.66	Ins./Hr
Runoff (CFS)	Qn =	6.11	CFS (See Pg. 2 Pre-Hydrology)
RESERVOIR STORAGE			
D1 = Qp -Qs	D1 =	4.59	CFS
D2 = Qn - Qs	D2 =	0.63	CFS
Ts1 =Begin Surrounding Time	Ts1 =	12.32	Minutes
Ts_2 = End Surrounding Time	Ts_2 =	31.52	Minutes
Tn = Outflow Hydrograph Time Intercept	Tn =	29.94	Minutes
Vr =[(D1-D2) x (Ts2-Ts1)] / 2 x 60: (Cu.Ft.)	Vr =	2,280	Cu.Ft.
Volume in Acre-Foot	Ac/Ft =	0.05	



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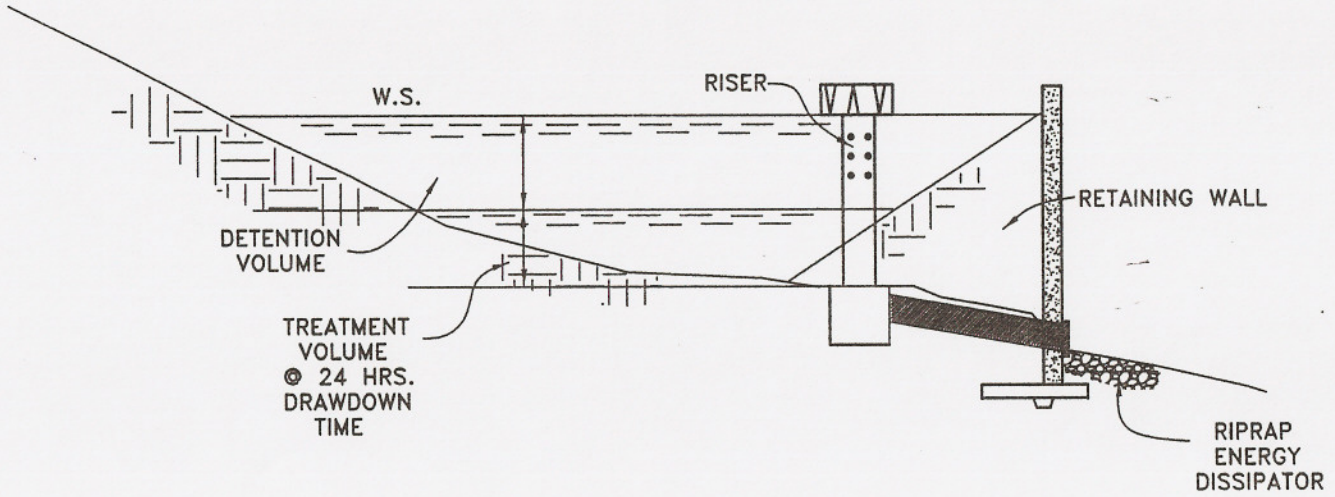

TYPICAL EXTEND DETENTION BASIN

NO SCALE