

DRAINAGE STUDY

FOR

The Pearl

Solana Beach, California

Engineer:

SWS ENGINEERING, INC.

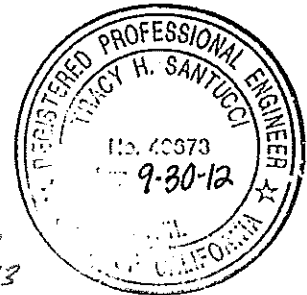
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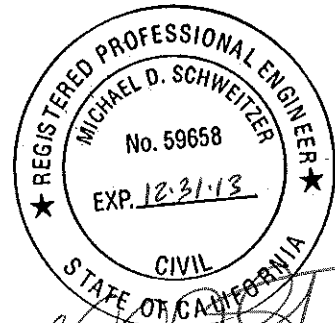


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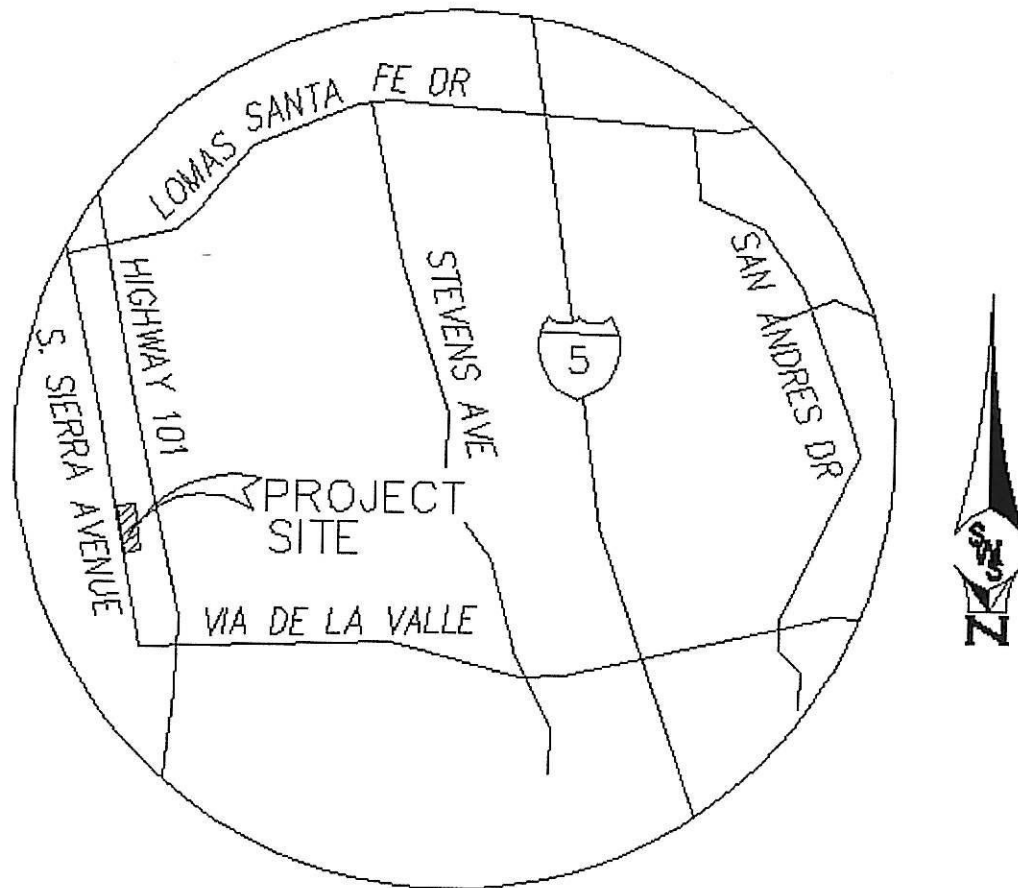
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MAPS

- Exhibit A – Pre-Development Hydrology Map
- Exhibit B – Post-Development Hydrology Map

1.0 PROJECT DESCRIPTION

The proposed project is an affordable housing project on approximately 0.29 acres. The project proposes one multistory building with a mix of commercial and residential units.



VICINITY MAP

NOT TO SCALE

2.0 PURPOSE

The purpose of this study is to determine the peak runoff rates and velocities for the pre-development and post-development conditions. Comparisons will be made at the same discharge points for each drainage basin affecting the site and adjacent properties.

3.0 METHODOLOGY

The Rational Method as outlined in the San Diego County Hydrology Manual, dated June 2003, was used to determine the runoff flow rate. The 100-year frequency storm event was analyzed to determine peak runoff rates discharging the site for both the existing and post-development condition.

Soil type was determined to be type D from the Soil Hydrologic Groups map (see Appendix A). Runoff coefficients, "C", were determined from Table 3-1 (Appendix A):

- Pre-Development
 - On-Site/Off-Site → Use High Density Residential (HDR), C = 0.79
 - Off-Site Slope → Use Undisturbed Natural Terrain (HDR), C = 0.35
- Post-Development
 - On-Site/Off-Site → Use High Density Residential (HDR), C = 0.79
 - Off-Site Slope → Use Undisturbed Natural Terrain (HDR), C = 0.35

4.0 HYDROLOGY

4.1 Pre-Development Conditions

A pre-development hydrology map delineating basin areas, flow paths, and concentration points has been prepared and is attached to this report as Exhibit "A". Pre-development hydrology calculations can be found in Appendix B.

The existing property is a public city parking lot along South Sierra Avenue. The project is bounded by an existing fitness center to the north, timeshare apartments to the east and south, and South Sierra Avenue to the west. The northern parking lot of the eastern timeshare apartments drain westerly through a concrete ribbon gutter and sheet flows down the existing slope. The runoff confluences with the runoff from the existing parking lot and easterly vegetated slope before discharging at the northwest corner of the parking lot in South Sierra Avenue at Node 100 (See Exhibit A for Node Locations).

4.2 Post-Development Conditions

A Post-Development Hydrology Map delineating basin areas, flow paths and concentration points has been prepared for the tributary basins and is located in the back of this report as Exhibit 'B'.

In the proposed condition the northern parking lot of the eastern timeshare apartments continues to drain westerly through a concrete ribbon gutter, but is intercepted by a catch basin and underground storm drain system. The runoff from the existing vegetated eastern slope drains to

a proposed concrete browditch behind the building then flows to the north. It enters a catch basin and confluences with the runoff from the eastern parking lot within the storm drain system, before discharging westerly through a curb outlet onto South Sierra Avenue at Node 100. The runoff from the proposed building will drain northwesterly towards South Sierra Avenue and confluence with the runoff from the east as in existing conditions.

4.3 Conditions of Concern

The storm water runoff discharges to the same discharge points in the post-development condition as in pre-developed conditions. Since the proposed project does not increase the runoff from the pre-developed condition, therefore there are no conditions of concern associated with the project.

5.0 CONCLUSION

The development of the project site will decrease the pre-development flow rate of storm water runoff by 0.4 cfs in the 100-year storm event. Table 1 below provides a summary of the pre- and post-development areas and flows.

Table 1 – Pre and Post-Development Areas and Flows

Basin / Node	Area (ac)		Q ₁₀₀ (cfs)		
	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev	+/-
100	0.8	0.8	3.5	3.1	-0.4

Since the flow rate will be decreased, there should be no negative impacts to any adjacent properties.

REFERENCES

County of San Diego Department of Public Works Flood Control Section. *San Diego County Hydrology Manual*. (June 2003)

County of San Diego Department of Planning and Land Use. *San Diego County Low Impact Development Handbook*. (December 31, 2007)

County of San Diego. *San Diego County Standard Urban Stormwater Mitigation Plan*. (January 8, 2011)

City of Solana Beach. *Drainage Master Plan*. (December 2010)

APPENDIX A

Reference Charts

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"			
NRCS Elements	County Elements	% IMPER.	Soil Type		
			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, C_p , 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.

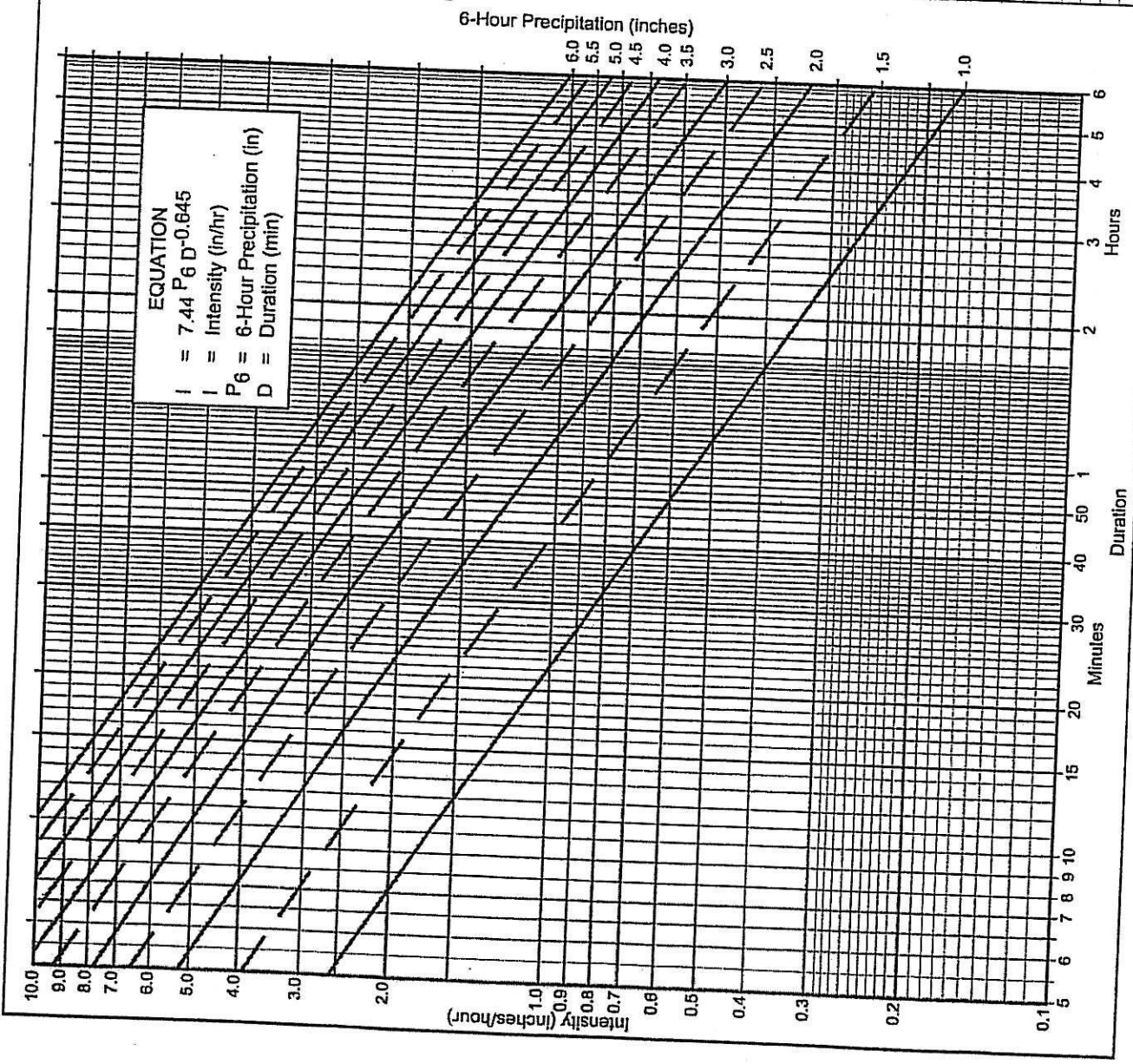
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved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



Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation not applicable to Desert.
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency _____ year
- (b) $P_6 =$ _____ in., $P_{24} =$ _____, $\frac{P_6}{P_{24}} =$ _____ % (2)
- (c) Adjusted $P_6^{(2)} =$ _____ in.
- (d) $t_x =$ _____ min.
- (e) $I =$ _____ in./hr.

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

P_6 Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
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	1.36	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	1.05	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
160	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	0.36	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

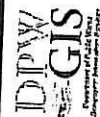
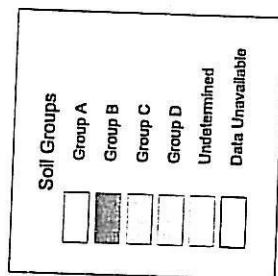
FIGURE

County of San Diego Hydrology Manual



Soil Hydrologic Groups

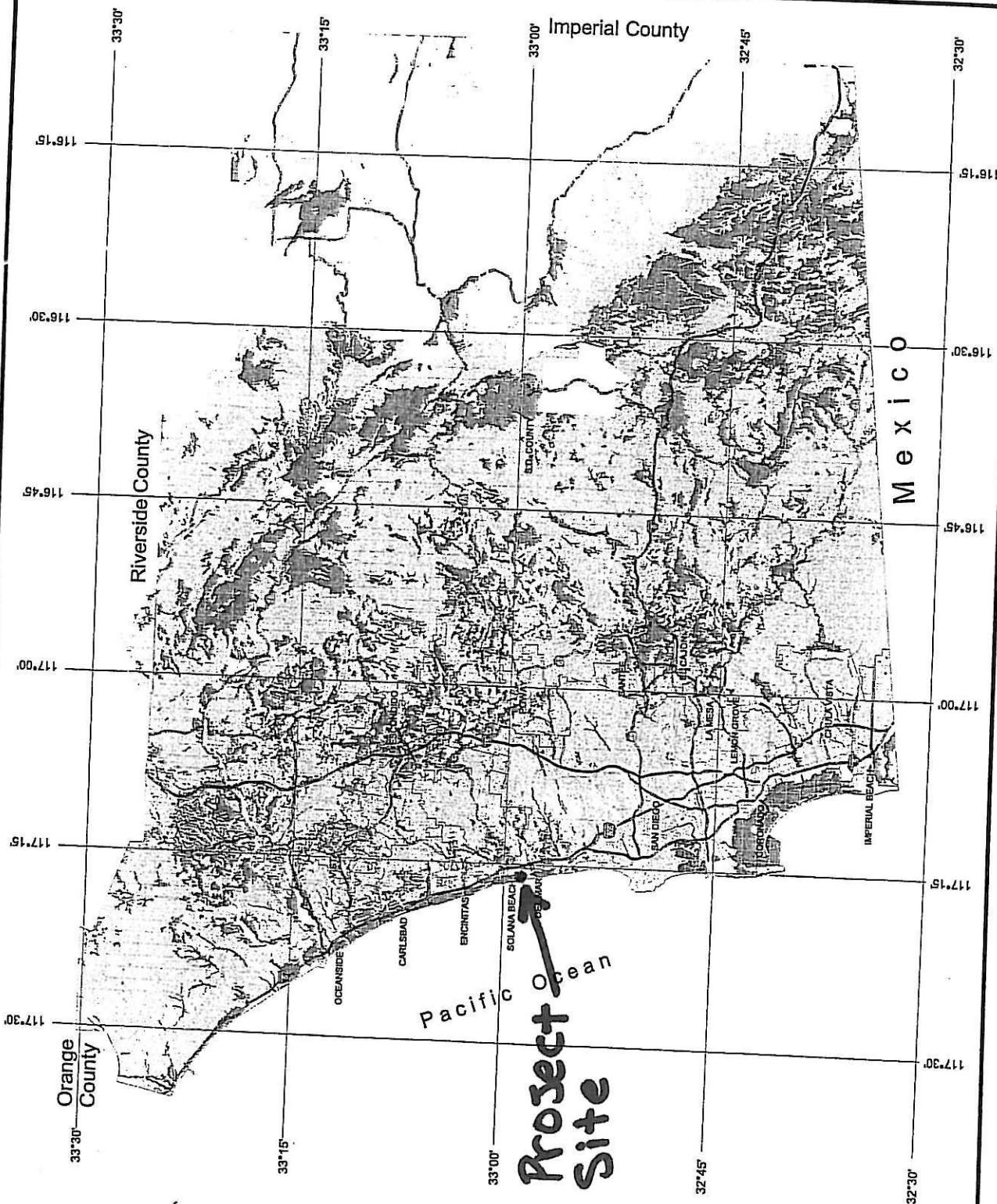
Legend



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County of San Diego Hydrology Manual



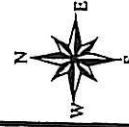
Rainfall Isophyets

100 Year Rainfall Event - 6 Hours

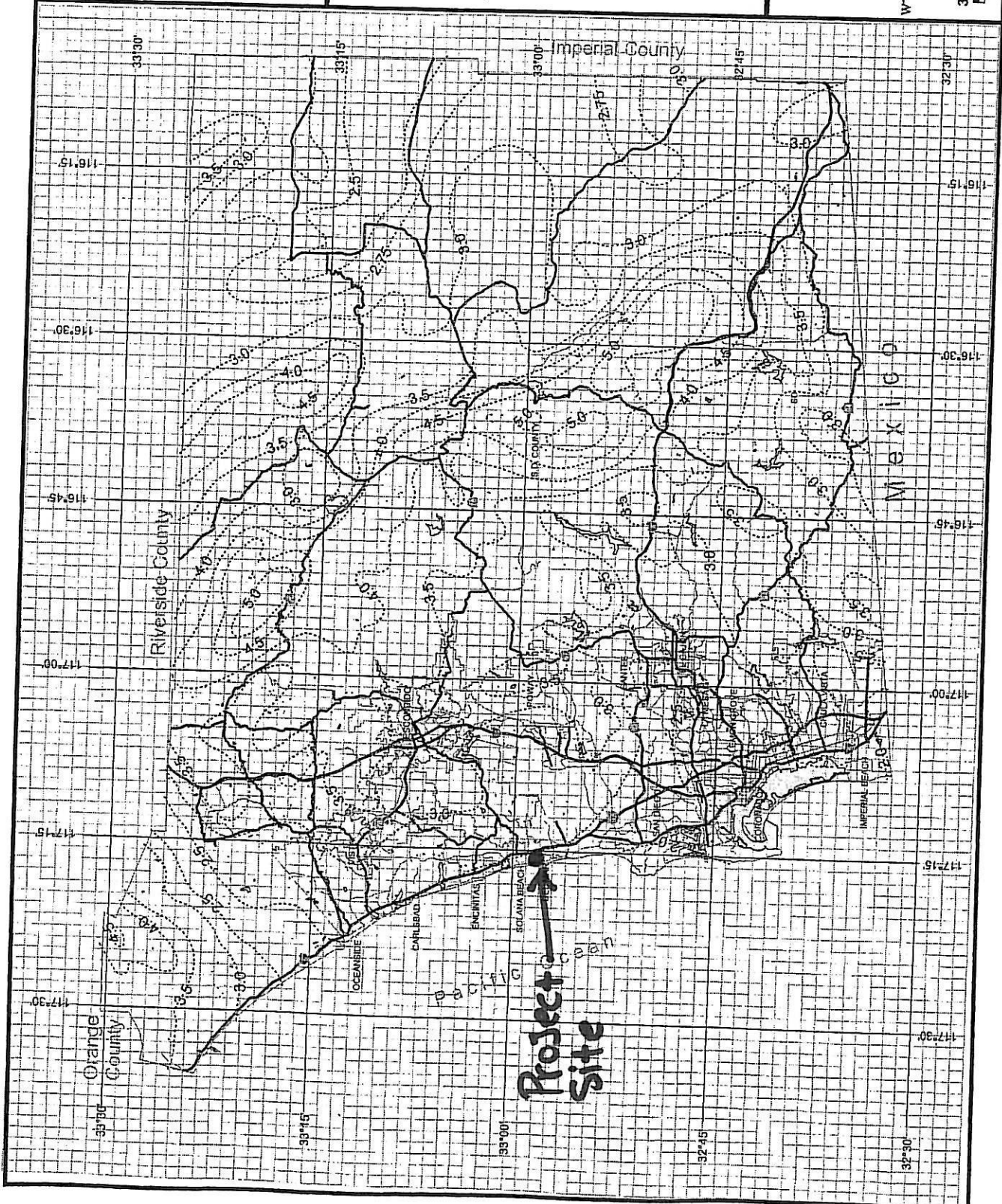
..... Isophyetal (inches)



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3 0 3 Miles



County of San Diego Hydrology Manual



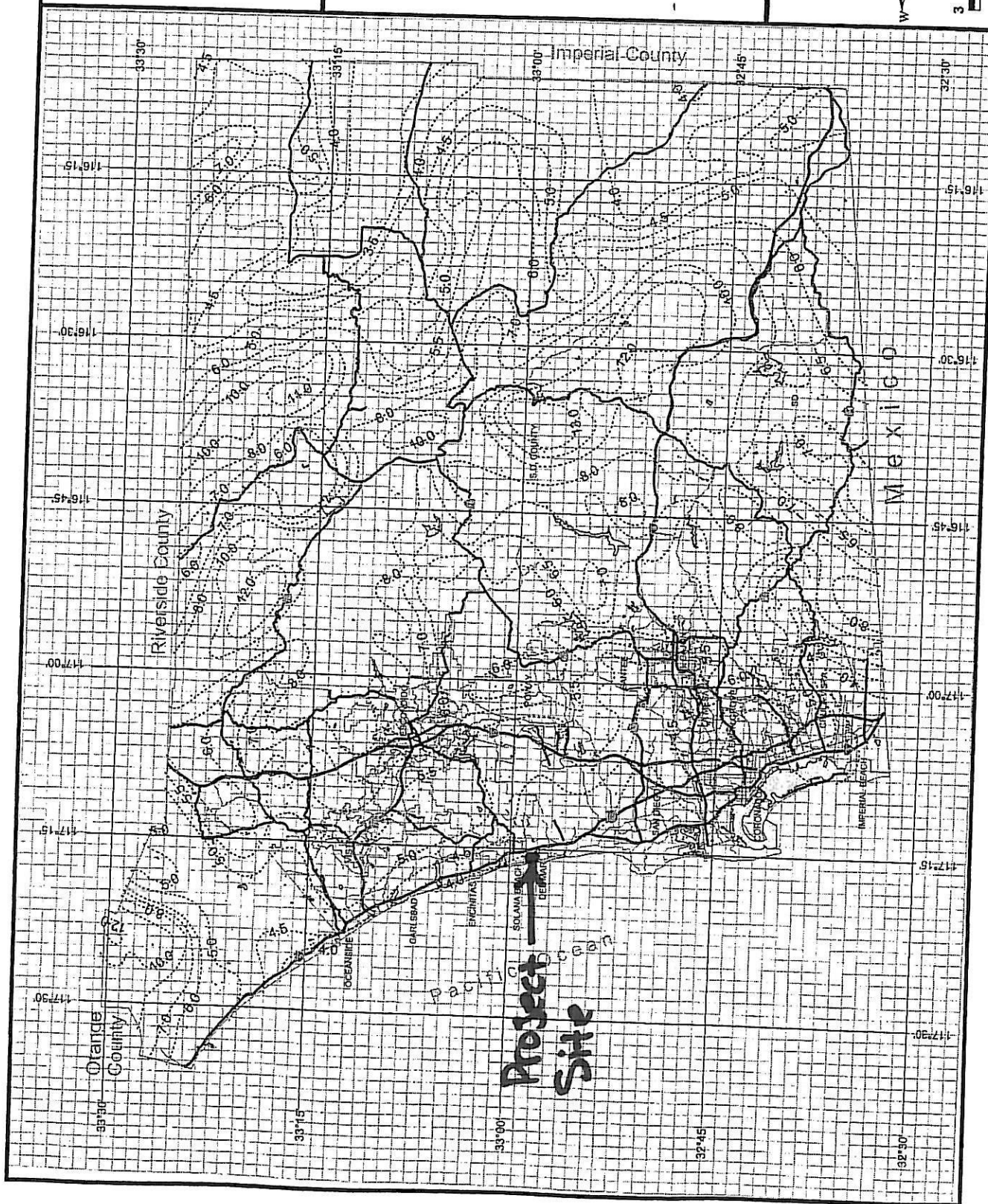
Rainfall Isoplethals

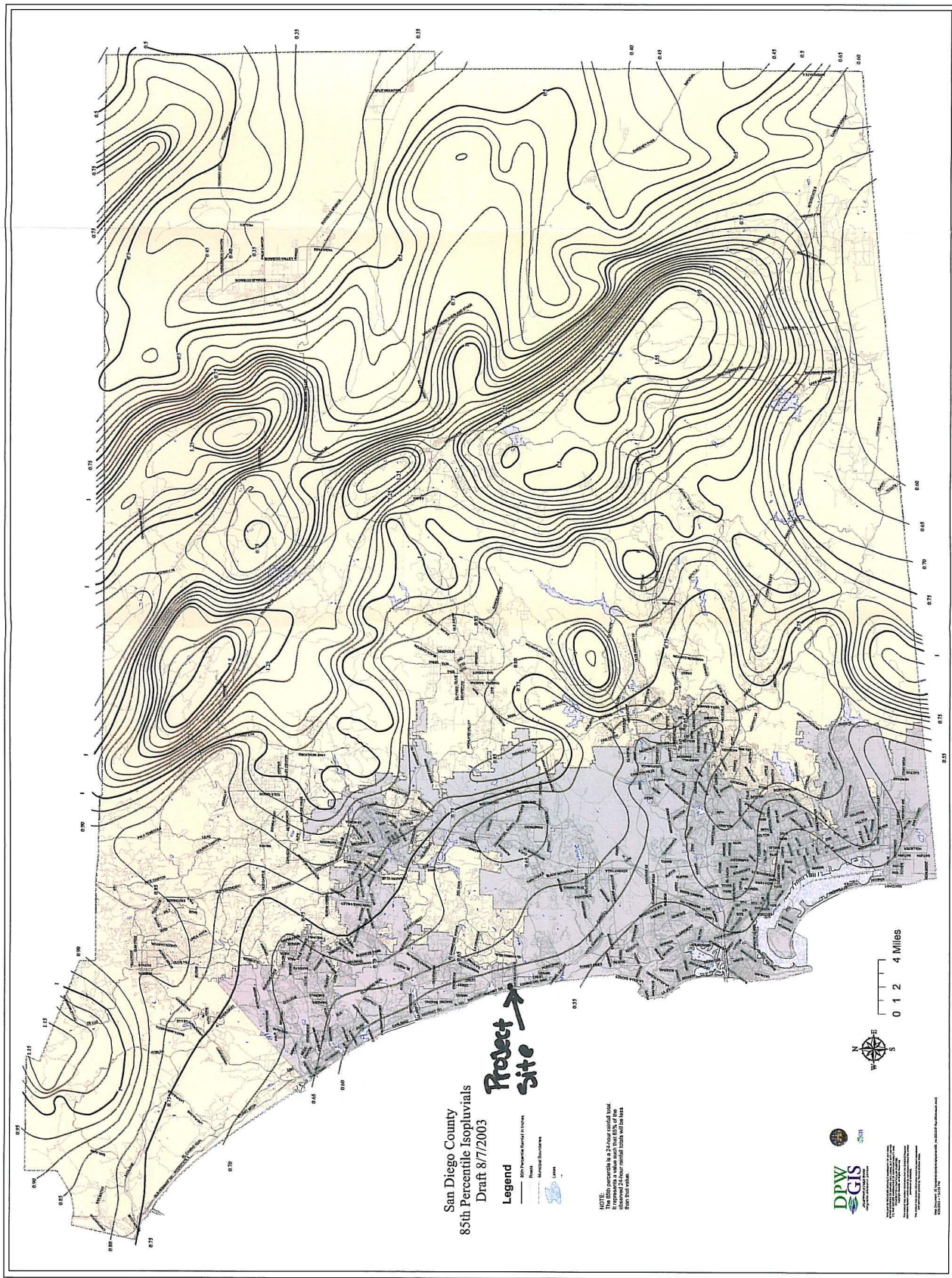
100 Year Rainfall Event - 24 Hours

Isoplethial (inches)



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San Diego County
85th Percentile Isoplethials
Draft 8/7/2003

Project Site →

Legend

- 85th Percentile Isopleth
- Feature
- Municipal Boundary
- Water

NOTE: This map is a 2.5-foot contour map. It represents a value that the 85th of the population would exceed during the 100-year flood event.



0 1 2 4 Miles

APPENDIX B

Pre-Development Hydrology Calculations

WEIGHTED RUNOFF COEFFICIENT CALCULATIONS

The Pearl - Existing

U/S NODE	D/S NODE	High Density Residential		Natural Terrain		Total Area A_T (acres)	Weighed C C_w
		A_1 (acres)	C_1	A_2 (acres)	C_2		
103	104	0.03	0.79	0.01	0.35	0.04	0.68
106	104	0.2	0.79	0.1	0.35	0.30	0.64

EX100

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 02/23/11

The Pearl
100 YEAR EXISTING CONDITION HYDROLOGIC ANALYSIS
PREPARED BY: TF DATE: 02-23-11

***** Hydrology Study Control Information *****

Program License Serial Number 6144

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.000
P6/P24 = 62.5%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL]
(43.0 DU/A or Less)
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance = 75.000(Ft.)
Highest elevation = 70.000(Ft.)
Lowest elevation = 68.500(Ft.)
Elevation difference = 1.500(Ft.) slope = 2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of 2.00 %, in a development type of
43.0 DU/A or Less
In Accordance with Table 3-2
Initial Area Time of Concentration = 4.00 minutes
(for slope value of 2.00 %)
Calculated TC of 4.000 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff = 0.520(CFS)
Total initial stream area = 0.100(Ac.)

EX100

 Process from Point/Station 102.000 to Point/Station 103.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 68.000(Ft.)
 Downstream point elevation = 62.000(Ft.)
 Channel length thru subarea = 160.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 5.000
 Slope or 'Z' of right channel bank = 5.000
 Estimated mean flow rate at midpoint of channel = 1.041(CFS)
 Manning's 'N' = 0.015
 Maximum depth of channel = 0.500(Ft.)
 Flow(q) thru subarea = 1.041(CFS)
 Depth of flow = 0.065(Ft.), Average velocity = 2.988(Ft/s)
 Channel flow top width = 5.654(Ft.)
 Flow velocity = 2.99(Ft/s)
 Travel time = 0.89 min.
 Time of concentration = 4.89 min.
 Critical depth = 0.106(Ft.)
 Adding area flow to channel
 Calculated TC of 4.893 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
 Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
 User specified 'C' value of 0.790 given for subarea
 Rainfall intensity = 6.587(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.790 CA = 0.237
 Subarea runoff = 1.041(CFS) for 0.200(Ac.)
 Total runoff = 1.561(CFS) Total area = 0.300(Ac.)
 Depth of flow = 0.083(Ft.), Average velocity = 3.470(Ft/s)
 Critical depth = 0.139(Ft.)

 Process from Point/Station 103.000 to Point/Station 104.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 62.000(Ft.)
 Downstream point elevation = 59.500(Ft.)
 Channel length thru subarea = 53.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 5.000
 Slope or 'Z' of right channel bank = 5.000
 Estimated mean flow rate at midpoint of channel = 1.665(CFS)
 Manning's 'N' = 0.015
 Maximum depth of channel = 0.500(Ft.)
 Flow(q) thru subarea = 1.665(CFS)
 Depth of flow = 0.081(Ft.), Average velocity = 3.821(Ft/s)
 Channel flow top width = 5.807(Ft.)
 Flow velocity = 3.82(Ft/s)
 Travel time = 0.23 min.
 Time of concentration = 5.12 min.
 Critical depth = 0.145(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 6.484(In/Hr) for a 100.0 year storm
 User specified 'C' value of 0.680 given for subarea
 Rainfall intensity = 6.484(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.777 CA = 0.264
 Subarea runoff = 0.152(CFS) for 0.040(Ac.)
 Total runoff = 1.713(CFS) Total area = 0.340(Ac.)

EX100
Depth of flow = 0.082(Ft.), Average velocity = 3.861(Ft/s)
Critical depth = 0.146(Ft.)

+++++
Process from Point/Station 104.000 to Point/Station 104.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 0.340(Ac.)
Runoff from this stream = 1.713(CFS)
Time of concentration = 5.12 min.
Rainfall intensity = 6.484(In/Hr)

+++++
Process from Point/Station 105.000 to Point/Station 106.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL
(43.0 DU/A or Less)]
Impervious value, Ai = 0.800
Sub-Area C value = 0.790
Initial subarea total flow distance = 75.000(Ft.)
Highest elevation = 65.000(Ft.)
Lowest elevation = 63.500(Ft.)
Elevation difference = 1.500(Ft.) slope = 2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of 2.00 %, in a development type of
43.0 DU/A or Less
In Accordance with Table 3-2
Initial Area Time of Concentration = 4.00 minutes
(for slope value of 2.00 %)
Calculated TC of 4.000 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff = 0.468(CFS)
Total initial stream area = 0.090(Ac.)

+++++
Process from Point/Station 106.000 to Point/Station 104.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 60.500(Ft.)
Downstream point elevation = 59.500(Ft.)
Channel length thru subarea = 108.000(Ft.)
Channel base width = 5.000(Ft.)
Slope or 'Z' of left channel bank = 5.000
Slope or 'Z' of right channel bank = 5.000
Estimated mean flow rate at midpoint of channel = 1.138(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 1.138(CFS)
Depth of flow = 0.104(Ft.), Average velocity = 1.981(Ft/s)
Channel flow top width = 6.040(Ft.)
Flow Velocity = 1.98(Ft/s)

EX100

Travel time = 0.91 min.
 Time of concentration = 4.91 min.
 Critical depth = 0.113(Ft.)
 Adding area flow to channel
 Calculated TC of 4.909 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
 Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
 User specified 'C' value of 0.640 given for subarea
 Rainfall intensity = 6.587(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 ($Q=KCIA$) is $C = 0.675$ $CA = 0.263$
 Subarea runoff = 1.265(CFS) for 0.300(Ac.)
 Total runoff = 1.733(CFS) Total area = 0.390(Ac.)
 Depth of flow = 0.133(Ft.), Average velocity = 2.300(Ft/s)
 Critical depth = 0.146(Ft.)

++++++
 Process from Point/Station 104.000 to Point/Station 104.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 0.390(Ac.)
 Runoff from this stream = 1.733(CFS)
 Time of concentration = 4.91 min.
 Rainfall intensity = 6.587(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	1.713	5.12	6.484
2	1.733	4.91	6.587
Qmax(1) =			
	1.000 *	1.000 *	1.713) +
	0.984 *	1.000 *	1.733) + = 3.419
Qmax(2) =			
	1.000 *	0.958 *	1.713) +
	1.000 *	1.000 *	1.733) + = 3.374

Total of 2 streams to confluence:
 Flow rates before confluence point:
 1.713 1.733
 Maximum flow rates at confluence using above data:
 3.419 3.374
 Area of streams before confluence:
 0.340 0.390
 Results of confluence:
 Total flow rate = 3.419(CFS)
 Time of concentration = 5.124 min.
 Effective stream area after confluence = 0.730(Ac.)

++++++
 Process from Point/Station 104.000 to Point/Station 100.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 59.500(Ft.)
 Downstream point elevation = 58.500(Ft.)
 Channel length thru subarea = 59.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 5.000

EX100

Slope or 'z' of right channel bank = 5.000
 Estimated mean flow rate at midpoint of channel = 3.487(CFS)
 Manning's 'N' = 0.015
 Maximum depth of channel = 0.500(Ft.)
 Flow(q) thru subarea = 3.487(CFS)
 Depth of flow = 0.167(Ft.), Average velocity = 3.570(Ft/s)
 Channel flow top width = 6.673(Ft.)
 Flow Velocity = 3.57(Ft/s)
 Travel time = 0.28 min.
 Time of concentration = 5.40 min.
 Critical depth = 0.229(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 6.269(In/Hr) for a 100.0 year storm
 User specified 'C' value of 0.790 given for subarea
 Rainfall intensity = 6.269(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.726 CA = 0.559
 Subarea runoff = 0.085(CFS) for 0.040(Ac.)
 Total runoff = 3.503(CFS) Total area = 0.770(Ac.)
 Depth of flow = 0.168(Ft.), Average velocity = 3.576(Ft/s)
 Critical depth = 0.229(Ft.)
 End of computations, total study area = 0.770 (Ac.)

APPENDIX C

Post-Development Hydrology Calculations

WEIGHTED RUNOFF COEFFICIENT CALCULATIONS

The Pearl - Developed

U/S NODE	D/S NODE	High Density Residential		Natural Terrain		Total Area A_T (acres)	Weighed C C_w
		A_1 (acres)	C_1	A_2 (acres)	C_2		
106	104	0.02	0.79	0.07	0.35	0.09	0.45
108	100	0.28	0.79	0.02	0.35	0.30	0.76

The first part of the paper discusses the importance of maintaining accurate records of all transactions. It is essential for the business to have a clear and concise record of all income and expenses, as this will be necessary for the preparation of the tax return. The second part of the paper discusses the importance of keeping up to date with the latest tax laws and regulations. It is important to consult with a tax professional to ensure that the business is in compliance with all applicable laws. The third part of the paper discusses the importance of maintaining proper documentation for all transactions. This includes keeping receipts, invoices, and other documents that will be needed to support the tax return. The fourth part of the paper discusses the importance of keeping up to date with the latest tax software and programs. This will ensure that the business is able to accurately calculate its tax liability and prepare its tax return. The fifth part of the paper discusses the importance of keeping up to date with the latest tax forms and schedules. This will ensure that the business is able to accurately complete its tax return. The sixth part of the paper discusses the importance of keeping up to date with the latest tax rates and deductions. This will ensure that the business is able to take full advantage of all available tax benefits. The seventh part of the paper discusses the importance of keeping up to date with the latest tax credits and exemptions. This will ensure that the business is able to take full advantage of all available tax benefits. The eighth part of the paper discusses the importance of keeping up to date with the latest tax treaties and agreements. This will ensure that the business is able to take full advantage of all available tax benefits. The ninth part of the paper discusses the importance of keeping up to date with the latest tax court decisions and rulings. This will ensure that the business is able to take full advantage of all available tax benefits. The tenth part of the paper discusses the importance of keeping up to date with the latest tax legislation and regulations. This will ensure that the business is able to take full advantage of all available tax benefits.

DEV100

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 02/23/11

The Pearl
100 YEAR DEVELOPED CONDITION HYDROLOGIC ANALYSIS
PREPARED BY: TF DATED: 02-23-11

***** Hydrology Study Control Information *****

Program License Serial Number 6144

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.000
P6/P24 = 62.5%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL]
(43.0 DU/A or Less)
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance = 75.000(Ft.)
Highest elevation = 70.000(Ft.)
Lowest elevation = 68.500(Ft.)
Elevation difference = 1.500(Ft.) Slope = 2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of 2.00 %, in a development type of
43.0 DU/A or Less
In Accordance with Table 3-2
Initial Area Time of Concentration = 4.00 minutes
(for slope value of 2.00 %)
Calculated TC of 4.000 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff = 0.520(CFS)
Total initial stream area = 0.100(Ac.)

DEV100

+++++
 Process from Point/Station 102.000 to Point/Station 103.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 68.000(Ft.)
 Downstream point elevation = 62.000(Ft.)
 Channel length thru subarea = 160.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 5.000
 Slope or 'Z' of right channel bank = 5.000
 Estimated mean flow rate at midpoint of channel = 1.041(CFS)
 Manning's 'N' = 0.015
 Maximum depth of channel = 0.500(Ft.)
 Flow(q) thru subarea = 1.041(CFS)
 Depth of flow = 0.065(Ft.), Average velocity = 2.988(Ft/s)
 Channel flow top width = 5.654(Ft.)
 Flow Velocity = 2.99(Ft/s)
 Travel time = 0.89 min.
 Time of concentration = 4.89 min.
 Critical depth = 0.106(Ft.)
 Adding area flow to channel
 Calculated TC of 4.893 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
 Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
 User specified 'C' value of 0.790 given for subarea
 Rainfall intensity = 6.587(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.790 CA = 0.237
 Subarea runoff = 1.041(CFS) for 0.200(Ac.)
 Total runoff = 1.561(CFS) Total area = 0.300(Ac.)
 Depth of flow = 0.083(Ft.), Average velocity = 3.470(Ft/s)
 Critical depth = 0.139(Ft.)

+++++
 Process from Point/Station 103.000 to Point/Station 104.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 59.600(Ft.)
 Downstream point/station elevation = 59.200(Ft.)
 Pipe length = 46.00(Ft.) Slope = 0.0087 Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 1.561(CFS)
 Nearest computed pipe diameter = 12.00(In.)
 Calculated individual pipe flow = 1.561(CFS)
 Normal flow depth in pipe = 5.79(In.)
 Flow top width inside pipe = 11.99(In.)
 Critical Depth = 6.37(In.)
 Pipe flow velocity = 4.17(Ft/s)
 Travel time through pipe = 0.18 min.
 Time of concentration (TC) = 5.08 min.

+++++
 Process from Point/Station 104.000 to Point/Station 104.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
 Stream flow area = 0.300(Ac.)
 Runoff from this stream = 1.561(CFS)
 Time of concentration = 5.08 min.
 Rainfall intensity = 6.523(In/Hr)

DEV100

+++++
 Process from Point/Station 105.000 to Point/Station 106.000
 **** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 1.000
 [HIGH DENSITY RESIDENTIAL]
 (43.0 DU/A or Less)
 Impervious value, $A_i = 0.800$
 Sub-Area C Value = 0.790
 Initial subarea total flow distance = 75.000(Ft.)
 Highest elevation = 65.000(Ft.)
 Lowest elevation = 63.500(Ft.)
 Elevation difference = 1.500(Ft.) slope = 2.000 %
 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
 The maximum overland flow distance is 75.00 (Ft)
 for the top area slope value of 2.00 %, in a development type of
 43.0 DU/A or Less
 In Accordance With Table 3-2
 Initial Area Time of Concentration = 4.00 minutes
 (for slope value of 2.00 %)
 Calculated TC of 4.000 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
 Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.790$
 Subarea runoff = 0.208(CFS)
 Total initial stream area = 0.040(Ac.)

+++++
 Process from Point/Station 106.000 to Point/Station 104.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 62.300(Ft.)
 Downstream point elevation = 60.700(Ft.)
 Channel length thru subarea = 130.000(Ft.)
 Channel base width = 1.500(Ft.)
 Slope or 'Z' of left channel bank = 2.000
 Slope or 'Z' of right channel bank = 2.000
 Estimated mean flow rate at midpoint of channel = 0.367(CFS)
 Manning's 'N' = 0.015
 Maximum depth of channel = 0.500(Ft.)
 Flow(q) thru subarea = 0.367(CFS)
 Depth of flow = 0.100(Ft.), Average velocity = 2.161(Ft/s)
 Channel flow top width = 1.899(Ft.)
 Flow velocity = 2.16(Ft/s)
 Travel time = 1.00 min.
 Time of concentration = 5.00 min.
 Critical depth = 0.116(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 6.585(In/Hr) for a 100.0 year storm
 User specified 'C' value of 0.450 given for subarea
 Rainfall intensity = 6.585(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 ($Q=KCIA$) is $C = 0.555$ $CA = 0.072$
 Subarea runoff = 0.267(CFS) for 0.090(Ac.)
 Total runoff = 0.475(CFS) Total area = 0.130(Ac.)
 Depth of flow = 0.116(Ft.), Average velocity = 2.361(Ft/s)
 Critical depth = 0.137(Ft.)

DEV100

 Process from Point/Station 104.000 to Point/Station 104.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 0.130(Ac.)
 Runoff from this stream = 0.475(CFS)
 Time of concentration = 5.00 min.
 Rainfall intensity = 6.585(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	1.561	5.08	6.523
2	0.475	5.00	6.585
Qmax(1) =			
	1.000 *	1.000 *	1.561) +
	0.991 *	1.000 *	0.475) + =
Qmax(2) =			2.031
	1.000 *	0.985 *	1.561) +
	1.000 *	1.000 *	0.475) + =
			2.013

Total of 2 streams to confluence:
 Flow rates before confluence point:
 1.561 0.475
 Maximum flow rates at confluence using above data:
 2.031 2.013
 Area of streams before confluence:
 0.300 0.130
 Results of confluence:
 Total flow rate = 2.031(CFS)
 Time of concentration = 5.077 min.
 Effective stream area after confluence = 0.430(Ac.)

 Process from Point/Station 104.000 to Point/Station 100.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 59.200(Ft.)
 Downstream point/station elevation = 58.100(Ft.)
 Pipe length = 66.00(Ft.) Slope = 0.0167 Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 2.031(CFS)
 Nearest computed pipe diameter = 9.00(In.)
 Calculated individual pipe flow = 2.031(CFS)
 Normal flow depth in pipe = 7.01(In.)
 Flow top width inside pipe = 7.47(In.)
 Critical Depth = 7.76(In.)
 Pipe flow velocity = 5.50(Ft/s)
 Travel time through pipe = 0.20 min.
 Time of concentration (TC) = 5.28 min.

 Process from Point/Station 100.000 to Point/Station 100.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
 Stream flow area = 0.430(Ac.)
 Runoff from this stream = 2.031(CFS)
 Page 4

DEV100
Time of concentration = 5.28 min.
Rainfall intensity = 6.362(In/Hr)

+++++
Process from Point/Station 107.000 to Point/Station 108.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL]
(43.0 DU/A or Less)
Impervious value, A_i = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance = 65.000(Ft.)
Highest elevation = 59.500(Ft.)
Lowest elevation = 58.800(Ft.)
Elevation difference = 0.700(Ft.) slope = 1.077 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 65.00 (Ft)
for the top area slope value of 1.08 %, in a development type of
43.0 DU/A or Less
In Accordance with Table 3-2
Initial Area Time of Concentration = 4.70 minutes
(for slope value of 1.00 %)
Calculated TC of 4.700 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.790$
Subarea runoff = 0.208(CFS)
Total initial stream area = 0.040(Ac.)

+++++
Process from Point/Station 108.000 to Point/Station 100.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 58.800(Ft.)
Downstream point elevation = 58.100(Ft.)
Channel length thru subarea = 176.000(Ft.)
Channel base width = 5.000(Ft.)
Slope or 'Z' of left channel bank = 5.000
Slope or 'Z' of right channel bank = 5.000
Estimated mean flow rate at midpoint of channel = 0.852(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 0.852(CFS)
Depth of flow = 0.112(Ft.), Average velocity = 1.362(Ft/s)
Channel flow top width = 6.124(Ft.)
Flow Velocity = 1.36(Ft/s)
Travel time = 2.15 min.
Time of concentration = 6.85 min.
Critical depth = 0.094(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 5.374(In/Hr) for a 100.0 year storm
User specified 'C' value of 0.760 given for subarea
Rainfall intensity = 5.374(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
($Q=KCIA$) is $C = 0.764$ $CA = 0.260$
Subarea runoff = 1.187(CFS) for 0.300(Ac.)
Total runoff = 1.395(CFS) Total area = 0.340(Ac.)
Page 5

DEV100

Depth of flow = 0.150(Ft.), Average velocity = 1.619(Ft/s)
 Critical depth = 0.129(Ft.)

+++++
 Process from Point/Station 100.000 to Point/Station 100.000
 ***** CONFLUENCE OF MINOR STREAMS *****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 0.340(Ac.)
 Runoff from this stream = 1.395(CFS)
 Time of concentration = 6.85 min.
 Rainfall intensity = 5.374(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	2.031	5.28	6.362
2	1.395	6.85	5.374
Qmax(1) =			
	1.000 *	1.000 *	2.031) +
	1.000 *	0.770 *	1.395) + =
Qmax(2) =			
	0.845 *	1.000 *	2.031) +
	1.000 *	1.000 *	1.395) + =
			3.111

Total of 2 streams to confluence:
 Flow rates before confluence point:

2.031 1.395
 Maximum flow rates at confluence using above data:
 3.105 3.111

Area of streams before confluence:
 0.430 0.340

Results of confluence:

Total flow rate = 3.111(CFS)
 Time of concentration = 6.854 min.
 Effective stream area after confluence = 0.770(Ac.)
 End of computations, total study area = 0.770 (Ac.)

APPENDIX D

Water Quality Calculations

The Pearl
WQ for Raised Landscape Planters
01-23-12

WQ Volume Calculation					Planter Detail						
Planter #	85th% (in)	C-value	Rooftop Drainage Area (sf)	Treatment Volume Req'd (cf)	Planter Area (sf)	Soil Depth (ft)	Volume Fraction of Voids	Storage Volume of Voids (cf)	Ponding Depth Above Soil (in)	Ponding Volume Above Soil (cf)	Total Storage Volume of Planter (cf)
1	0.58	0.87	851	35.8	131.0	2.33	0.30	91.6	6	65.5	157.1
2	0.58	0.87	563	23.7	25.0	2	0.30	15.0	6	12.5	27.5
3	0.58	0.87	563	23.7	25.0	2	0.30	15.0	6	12.5	27.5
4	0.58	0.87	662	27.8	68.6	1	0.30	20.6	6	34.3	54.8
5	0.58	0.87	711	29.9	214.0	1	0.30	64.2	6	107.0	171.2
6	0.58	0.87	4,118	173.2	253.0	1.67	0.30	126.8	6	126.5	253.3
7	0.58	0.87	1,040	43.7	54.2	2	0.30	32.5	6	27.1	59.6

Volume Provided > Volume Required
Therefore design OK!

EXHIBIT A

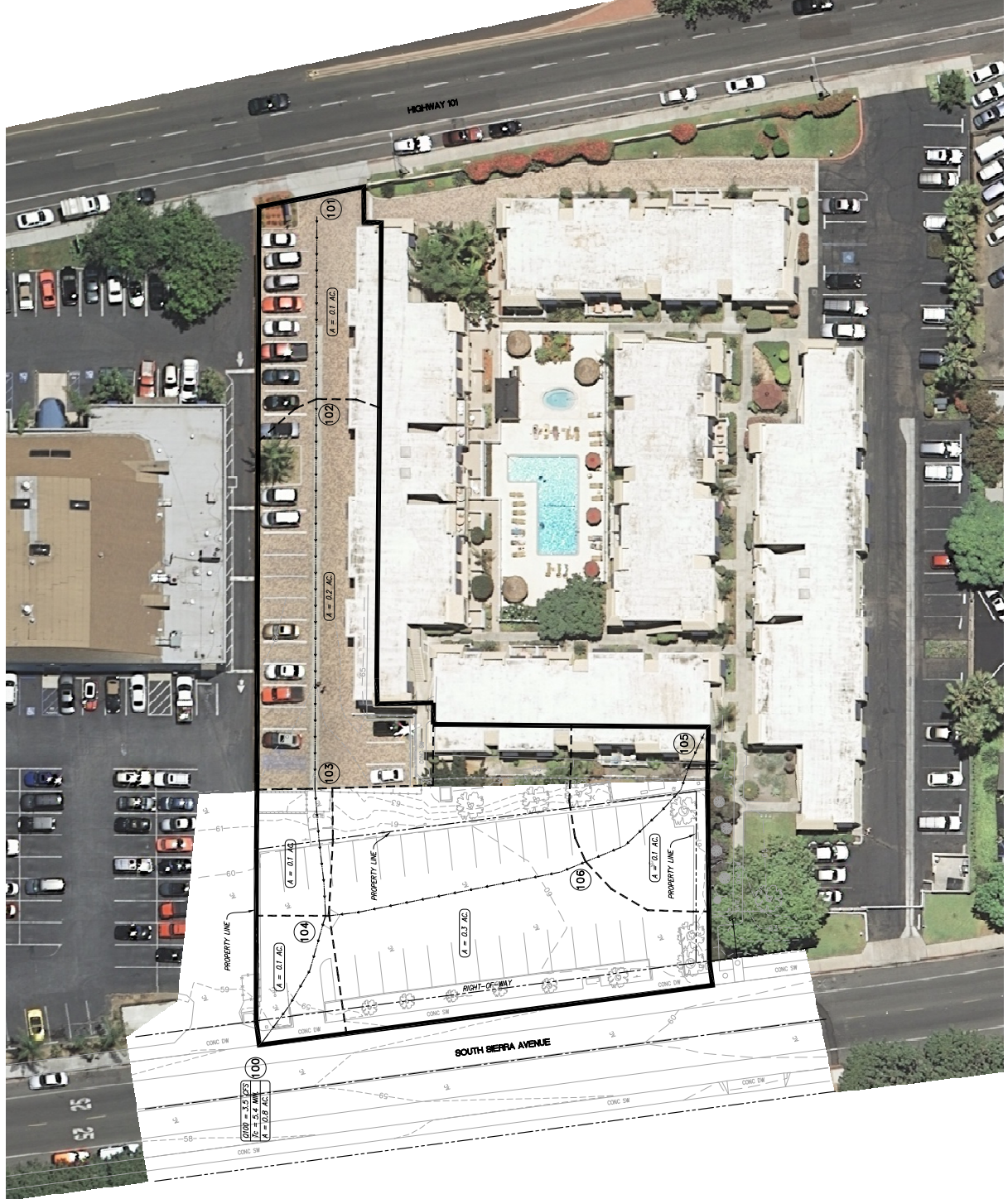
Pre-Development Hydrology Map

LEGEND

NODES

(100)

100-YEAR FREQUENCY DISCHARGE TIME OF CONCENTRATION AREA	100-YEAR FREQUENCY DISCHARGE TIME OF CONCENTRATION AREA
PROPERTY LINE	PROPERTY LINE
MAJOR BASIN BOUNDARY	MAJOR BASIN BOUNDARY
SUBBASIN BOUNDARY	SUBBASIN BOUNDARY
FLOW PATH	FLOW PATH



SCALE IN FEET
GRAPHIC SCALE
20 10 0 20 40 60

THE PEARL EXHIBIT A PRE DEVELOPMENT HYDROLOGY MAP

SWS ENGINEERING, INC.

Civil Engineer No. 44973
31045 Temecula Parkway, Suite 201
Temecula, CA 92592
P: 951-206-5407 F: 951-577-9451
DATE: Jan 19, 12 5:20pm BY: J. L. L. / J. L. L.
FILE: Z:\Projects\2010\10-04\1002\Hydrology\100-04102.dwg

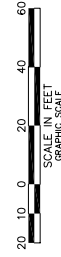
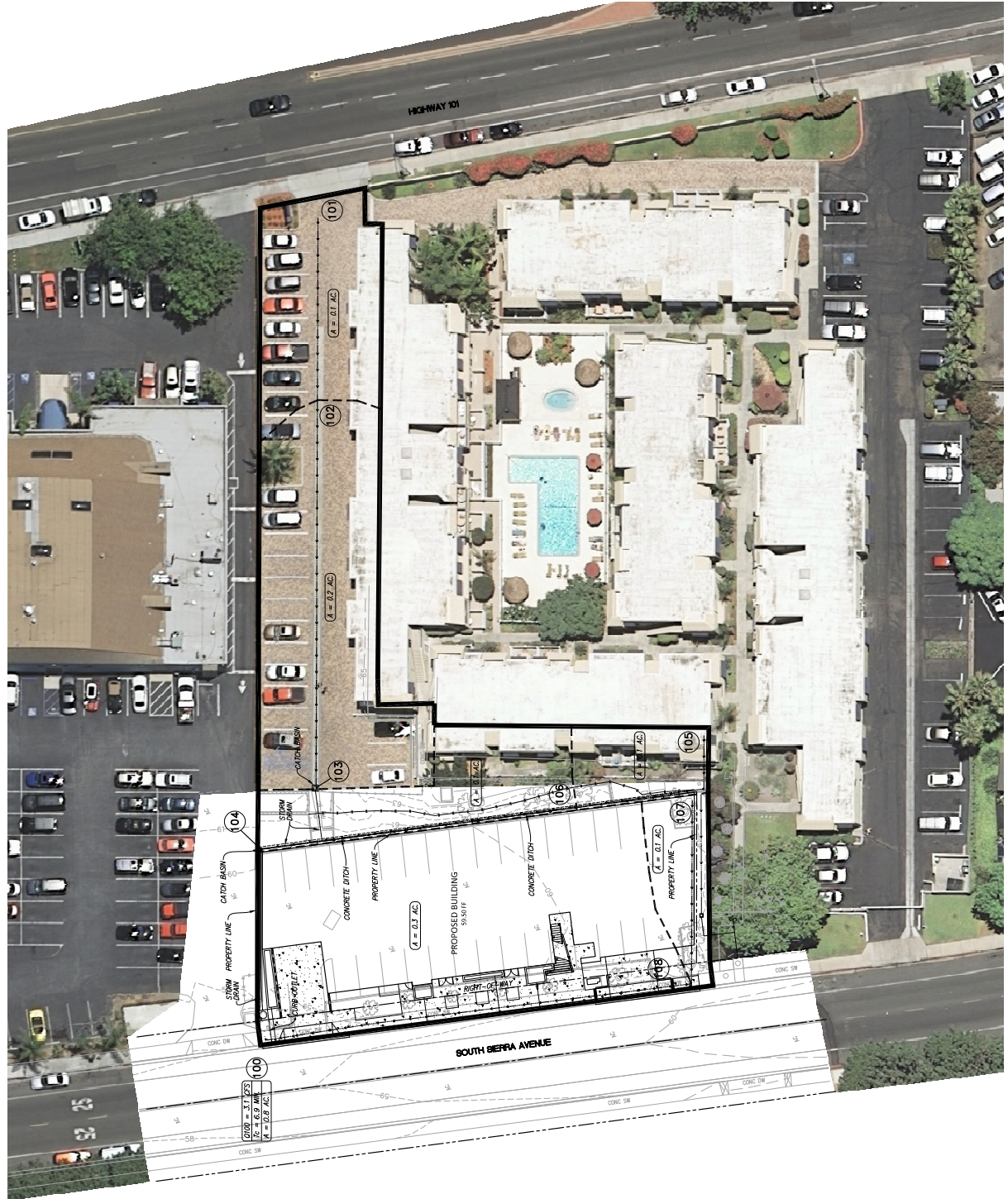


EXHIBIT B

Post-Development Hydrology Map

100

$Q100 = XXY\ Q'S$	100-YEAR FREQUENCY DISCHARGE
$T_c = XXX\ MIN.$	TIME OF CONCENTRATION
$A = XXX\ AC.$	AREA
— — — — —	PROPERTY LINE
—————	MAJOR BASIN BOUNDARY
- - - - -	SUBBASIN BOUNDARY
— • — • — • — • —	FLOW PATH



THE PEARL
EXHIBIT B
POST DEVELOPMENT
HYDROLOGY MAP

SWS ENGINEERING, INC.

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DATE: Jan 20, 12 11:21am by: tationa.friesen
FILE: Z:\Projects\2010\10-041\PROD\Reports\Hydrology\TM\10-041DEV.dwg

