DRAINAGE STUDY

FOR

RANCHO VERONA

CASE# P04-050
ER 04-08-041

25695 NORTH CENTER CITY PARKWAY
ESCONDIDO – COUNTY OF SAN DIEGO, CALIFORNIA

Engineer:

MASSON & ASSOCIATES, INC.
200 East Washington Avenue, Suite 200
Escondido, CA 92025
(760) 741-3570

By: _____
Masoomeh Fatini

UNDER THE SUPERVISION OF:

_____
Edilberto F. Sousa, RCE 54633

REGISTERED PROFESSIONAL ENGINEER
EDILBERTO F. SOUSA
C 054633
EXP. 12-31-07
CIVIL
STATE OF CALIFORNIA

P.N. 04022
Date Prepared: April 19, 2005
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SDC DPLU RCVD 1-4-07

P04-050

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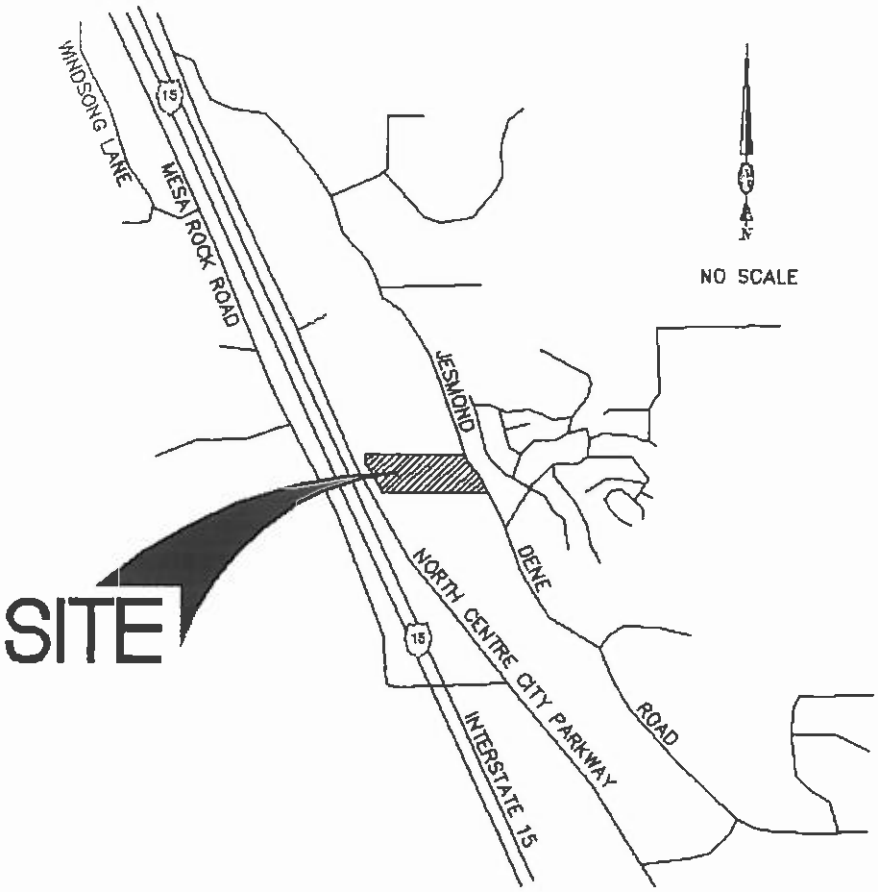
VICINITY MAP



INTRODUCTION:

The project consists of a Major Use Permit for and existing Group Care Facility. No significant grading improvements are proposed for this project. An application has been submitted to the department of health to remodel the existing leach fields. Minor grading will be required to re-align the mid section of the ~~walkway~~ driveway accessing the existing structures. The applicant has agreed to construct half-street improvements along the property frontage at Jesmond Dene Road at a time in the future, as needed by the County of San Diego Department of Public Works. The project is located east of interstate 15 in the Jesmond Dene area, north of the City of Escondido, in San Diego County, California.

The site encompasses 9.75 acres that, topographically, appears to be predominantly in a relatively natural state. The project slopes to the east, south and west away from the hilltop located in the upper middle of the property. The two main structures of the facility sit on the hill top. North Center City Parkway and Interstate 15 border on the west. Vacant parcels border on the south. Jemond Dene Road and single family dwellings border on the east, and vacant parcels and single family dwellings border the property on the north.

The scope of this study is limited since no significant alterations of the existing surface will take place. This study will identify the approximate location of the inundation line for a 100-year storm event so that an easement may be granted to the San Diego County Flood Control District.

METHODOLOGY:

The Rational Method as outlined in the County of San Diego Hydrology Manual dated June 2003 was used to determine the runoff flow rate. The drainage shed for the project site is located in low density residential land and the predominant soil group for the site is soil group D. Utilizing these characteristics and Table 3.2 (located herein) the coefficient of runoff is 0.45. The amount of impervious area within the drainage shed will not significantly increase.

HYDROLOGY:

Pre and post development drainage maps delineating drainage basins, flow paths and concentration points throughout the site are located in the back of this report as Exhibit 'A'. The primary drainage shed (Basin 1) flows north to south through an existing natural drainage course. The hill top in the middle of the site divides the basins, allowing water to drain in to the Centre City Parkway area and the Jesmond Dene road Area. An existing off-site 36 inch pipe carries the western basins under the access driveway to the property. The runoff flows in the pipe under the road. There is plenty of depth within the dam area to create enough head for the entire 100-year runoff to flow through the existing pipes. Several smaller basins flow off of the site in various

directions (see drainage maps). The storm event is the 100 year design storm with a 6 hour total precipitation of 3.5 inches and a 24 hour total precipitation of 6.0 inches.

CONCLUSION:

Since only minor improvements are required and disturbance to the existing overall drainage basins is negligible, the drainage patterns leaving the site remain unchanged there will be no increase in runoff with the implementation of this project.

APPENDIX A

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.

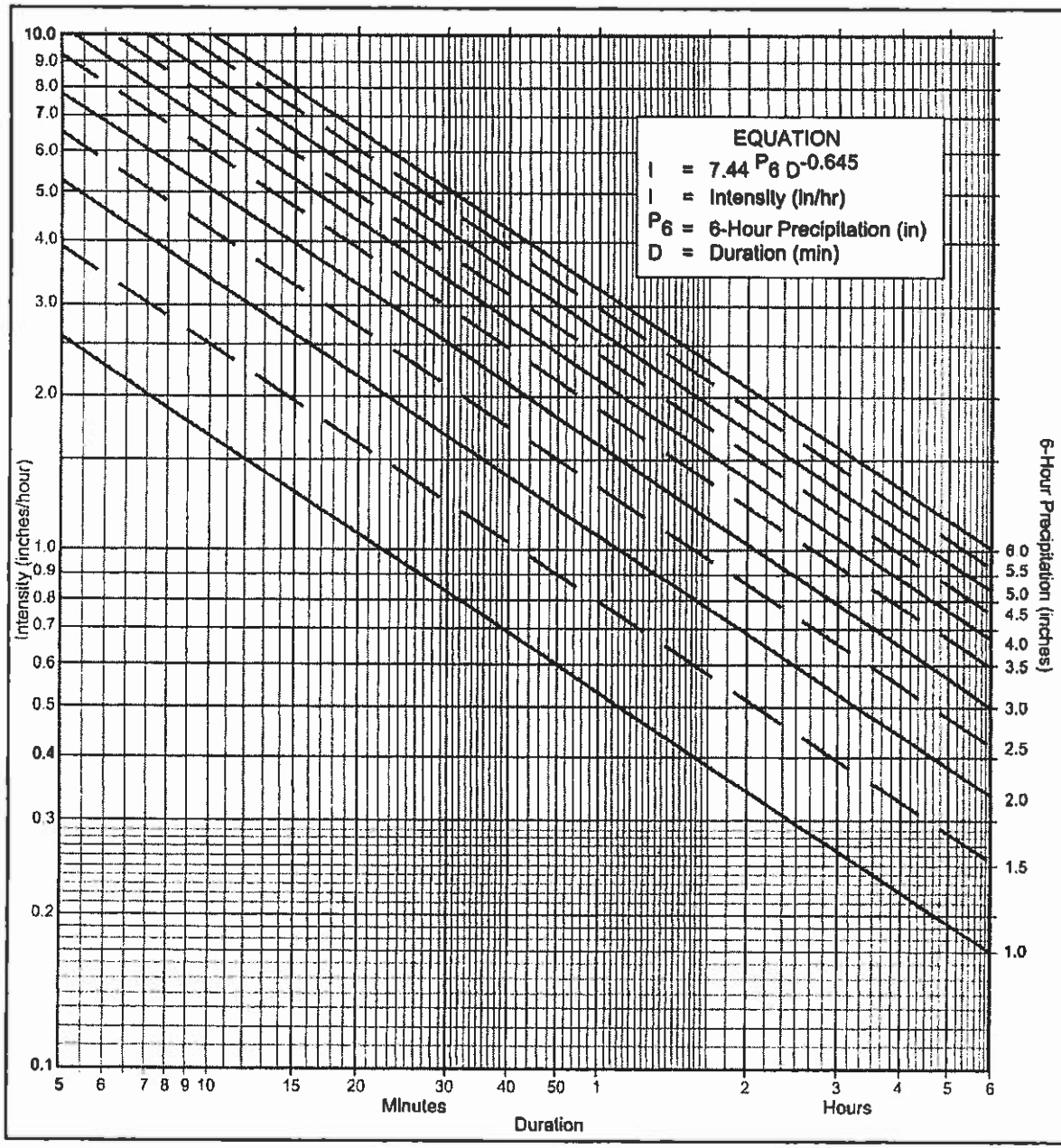
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved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



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 _____ year

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

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

(d) t_x = _____ min.

(e) I = _____ in./hr.

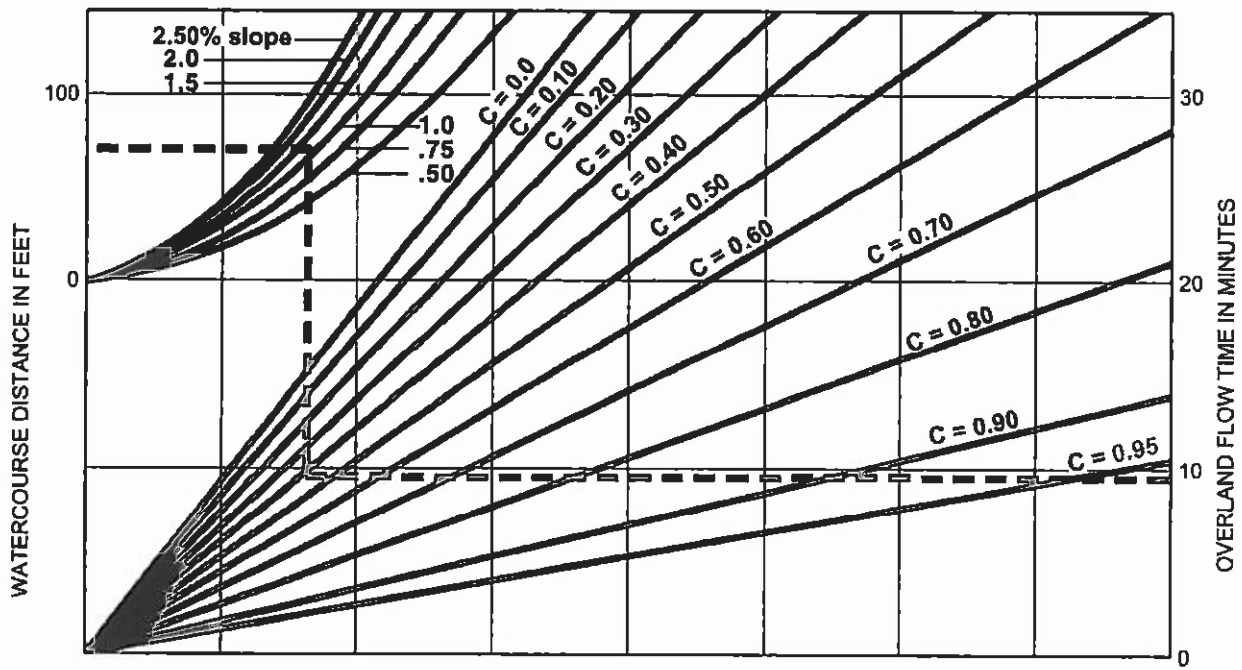
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / 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	1.38	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



EXAMPLE:

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

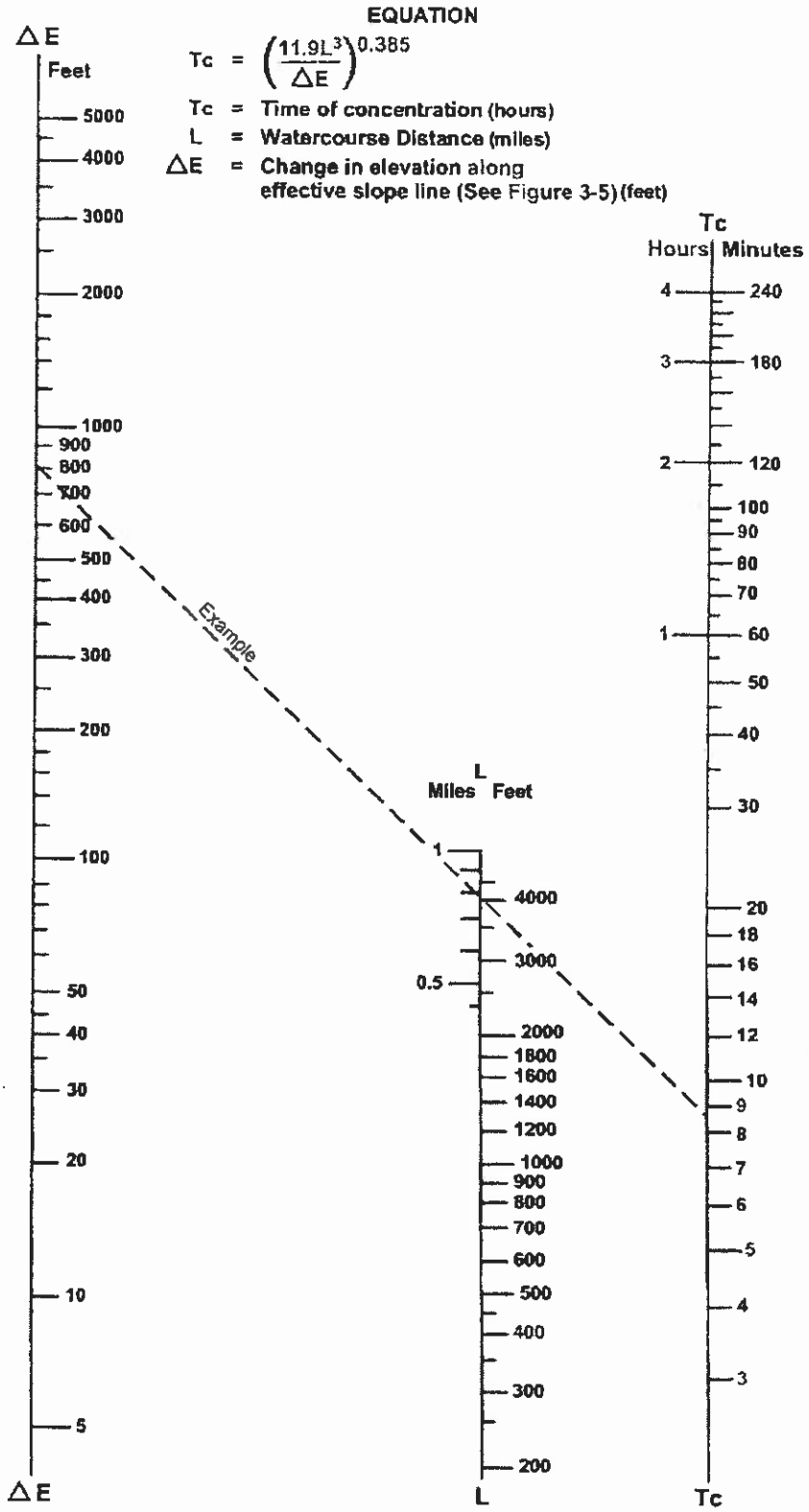
$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

FIGURE

3-3

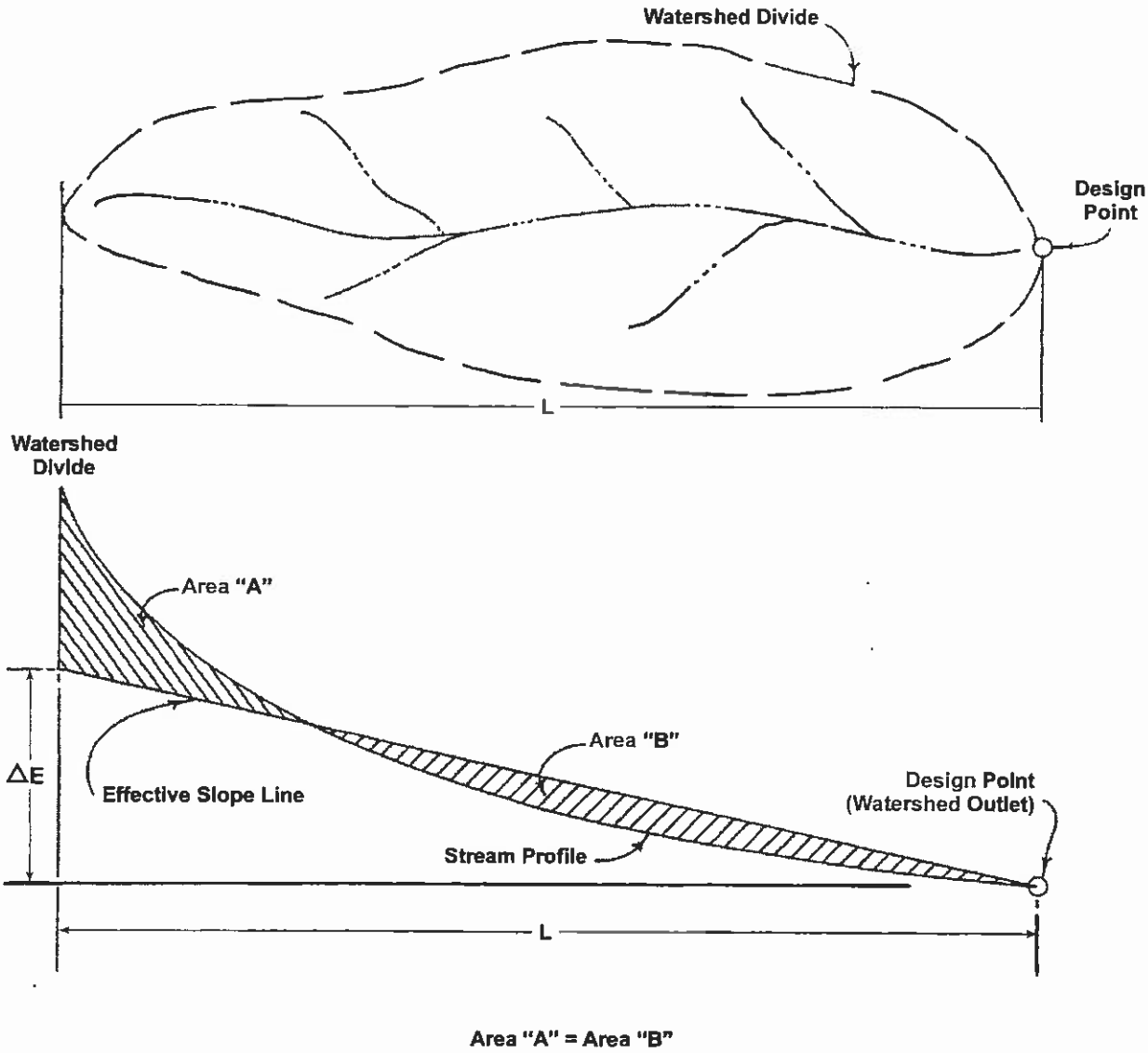


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

3-4

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



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

FIGURE

Computation of Effective Slope for Natural Watersheds

3-5

APPENDIX B

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study        Date: 12/22/06
----------------------------------------------------------------------
HYDROLOGY ANALYSIS FOR PRE AND POST-DEVELOPMENT CONDITION
BASIN 2
100 YEAR EVENT

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

----------------------------------------------------------------------


Program License Serial Number 4065

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

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.011 to Point/Station        2.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
User specified 'C' value of 0.450 given for subarea
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       9.22(In/Hr)
Total area =        0.010(Ac.)  Total runoff =     0.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.011 to Point/Station        2.012
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.094(CFS)
Depth of flow =   0.362(Ft.), Average velocity =   2.780(Ft/s)
      ******* Irregular Channel Data ***********
--------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              3.00              0.00
      3              6.00              1.00
Manning's 'N' friction factor =   0.045
```

```
----------------------------------------------------------------
Sub-Channel flow  =      1.094(CFS)
  '      '    flow top width =      2.173(Ft.)
  '      '    velocity=    2.780(Ft/s)
  '      '    area =      0.393(Sq.Ft)
  '      '    Froude number =     1.152

Upstream point elevation =   941.000(Ft.)
Downstream point elevation =   926.000(Ft.)
Flow length =   202.000(Ft.)
Travel time  =    1.21 min.
Time of concentration =    6.21 min.
Depth of flow =   0.362(Ft.)
Average velocity =   2.780(Ft/s)
Total irregular channel flow =     1.094(CFS)
Irregular channel normal depth above invert elev. =   0.362(Ft.)
Average velocity of channel(s) =   2.780(Ft/s)
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      8.018(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.450  CA =      0.279
Subarea runoff =      2.227(CFS) for      0.610(Ac.)
Total runoff =      2.237(CFS)      Total area =       0.620(Ac.)
Depth of flow =   0.474(Ft.), Average velocity =   3.325(Ft/s)
End of computations, total study area =           0.620 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 12/22/06

HYDROLOGY ANALYSIS FOR PRE AND POST-DEVELOPMENT CONDITION
BASIN 3
100 YEAR EVENT

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

Program License Serial Number 4065

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 3.011 to Point/Station 3.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****

User specified 'C' value of 0.450 given for subarea
Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 9.22(In/Hr)
Total area = 0.010(Ac.) Total runoff = 0.010(CFS)

++
Process from Point/Station 3.011 to Point/Station 3.012
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 2.925(CFS)
Depth of flow = 0.505(Ft.), Average velocity = 3.822(Ft/s)
******* Irregular Channel Data ***********

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	1.00
2	3.00	0.00
3	6.00	1.00

Manning's 'N' friction factor = 0.045

```
----------------------------------------------------------------
Sub-Channel flow  =      2.925(CFS)
  '      '    flow top width =      3.031(Ft.)
  '      '    velocity=    3.822(Ft/s)
  '      '    area =      0.765(Sq.Ft)
  '      '    Froude number =     1.340

Upstream point elevation =   957.000(Ft.)
Downstream point elevation =   920.000(Ft.)
Flow length =   411.000(Ft.)
Travel time  =    1.79 min.
Time of concentration =    6.79 min.
Depth of flow =   0.505(Ft.)
Average velocity =   3.822(Ft/s)
Total irregular channel flow =     2.925(CFS)
Irregular channel normal depth above invert elev. =   0.505(Ft.)
Average velocity of channel(s) =   3.822(Ft/s)
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      7.568(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.450  CA =      0.783
Subarea runoff =      5.916(CFS) for      1.730(Ac.)
Total runoff =      5.926(CFS)      Total area =       1.740(Ac.)
Depth of flow =   0.658(Ft.), Average velocity =   4.560(Ft/s)
End of computations, total study area =           1.740 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 12/22/06

HYDROLOGY ANALYSIS FOR PRE AND POST-DEVELOPMENT CONDITION
BASIN 4
100 YEAR EVENT

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

Program License Serial Number 4065

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 4.011 to Point/Station 4.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****

User specified 'C' value of 0.450 given for subarea
Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 9.22(In/Hr)
Total area = 0.010(Ac.) Total runoff = 0.010(CFS)

++
Process from Point/Station 4.011 to Point/Station 4.011
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 0.806(CFS)
Depth of flow = 0.284(Ft.), Average velocity = 3.333(Ft/s)
******* Irregular Channel Data ***********

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	1.00
2	3.00	0.00
3	6.00	1.00

Manning's 'N' friction factor = 0.045

```
------------------------------------------------------------------
Sub-Channel flow  =      0.806(CFS)
  '      '    flow top width =      1.703(Ft.)
  '      '    velocity=    3.333(Ft/s)
  '      '    area =      0.242(Sq.Ft)
  '      '    Froude number =     1.559

Upstream point elevation =   957.000(Ft.)
Downstream point elevation =   926.000(Ft.)
Flow length =   210.000(Ft.)
Travel time  =    1.05 min.
Time of concentration =    6.05 min.
Depth of flow =   0.284(Ft.)
Average velocity =   3.333(Ft/s)
Total irregular channel flow =     0.806(CFS)
Irregular channel normal depth above invert elev. =   0.284(Ft.)
Average velocity of channel(s) =   3.333(Ft/s)
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      8.155(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.450  CA =      0.207
Subarea runoff =      1.678(CFS) for      0.450(Ac.)
Total runoff =      1.688(CFS)      Total area =       0.460(Ac.)
Depth of flow =   0.375(Ft.), Average velocity =   4.010(Ft/s)
End of computations, total study area =           0.460 (Ac.)
```

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study        Date: 12/22/06
----------------------------------------------------------------------
YDROLOGY ANALYSIS FOR PRE AND POST-DEVELOPMENT CONDITION
BASIN 5
100 YEAR EVENT

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

----------------------------------------------------------------------


Program License Serial Number 4065

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

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.011 to Point/Station        5.012
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
User specified 'C' value of 0.450 given for subarea
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       9.22(In/Hr)
Total area =        0.010(Ac.)  Total runoff =     0.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.011 to Point/Station        5.012
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.302(CFS)
Depth of flow =   0.362(Ft.), Average velocity =   5.863(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              3.00              0.00
      3              6.00              1.00
Manning's 'N' friction factor =   0.045
```

```
----------------------------------------------------------------
Sub-Channel flow  =      2.302(CFS)
  '      '    flow top width =      2.171(Ft.)
  '      '    velocity=    5.863(Ft/s)
  '      '    area =      0.393(Sq.Ft)
  '      '    Froude number =     2.429

Upstream point elevation =  1055.000(Ft.)
Downstream point elevation =   898.000(Ft.)
Flow length =   475.000(Ft.)
Travel time  =    1.35 min.
Time of concentration =    6.35 min.
Depth of flow =   0.362(Ft.)
Average velocity =   5.863(Ft/s)
Total irregular channel flow =     2.302(CFS)
Irregular channel normal depth above invert elev. =   0.362(Ft.)
Average velocity of channel(s) =   5.863(Ft/s)
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      7.904(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.450  CA =      0.590
Subarea runoff =      4.649(CFS) for      1.300(Ac.)
Total runoff =      4.659(CFS)      Total area =       1.310(Ac.)
Depth of flow =   0.471(Ft.), Average velocity =   6.993(Ft/s)
End of computations, total study area =           1.310 (Ac.)
```

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study        Date: 12/22/06
----------------------------------------------------------------------
HYDROLOGY ANALYSIS FOR PRE AND POST-DEVELOPMENT CONDITION
BASIN 6
100 YEAR EVENT

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

----------------------------------------------------------------------


Program License Serial Number 4065

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

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.011 to Point/Station        6.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
User specified 'C' value of 0.450 given for subarea
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       9.22(In/Hr)
Total area =        0.010(Ac.)  Total runoff =     0.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.011 to Point/Station        6.012
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      3.725(CFS)
Depth of flow =   0.491(Ft.), Average velocity =   5.149(Ft/s)
      ******* Irregular Channel Data ***********
-------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              3.00              0.00
      3              6.00              1.00
Manning's 'N' friction factor =   0.045
```

```
----------------------------------------------------------------
Sub-Channel flow  =      3.725(CFS)
  '      '    flow top width =      2.946(Ft.)
  '      '    velocity=    5.149(Ft/s)
  '      '    area =      0.723(Sq.Ft)
  '      '    Froude number =     1.831

Upstream point elevation =   957.000(Ft.)
Downstream point elevation =   900.000(Ft.)
Flow length =   336.000(Ft.)
Travel time  =    1.09 min.
Time of concentration =    6.09 min.
Depth of flow =   0.491(Ft.)
Average velocity =   5.149(Ft/s)
Total irregular channel flow =     3.725(CFS)
Irregular channel normal depth above invert elev. =   0.491(Ft.)
Average velocity of channel(s) =   5.149(Ft/s)
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      8.122(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.450  CA =      0.922
Subarea runoff =      7.483(CFS) for      2.040(Ac.)
Total runoff =      7.493(CFS)      Total area =       2.050(Ac.)
Depth of flow =   0.638(Ft.), Average velocity =   6.132(Ft/s)
End of computations, total study area =           2.050 (Ac.)
```

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study        Date: 12/22/06
----------------------------------------------------------------------
HYDROLOGY ANALYSIS FOR PRE AND POST-DEVELOPMENT CONDITION
BASIN 7
100 YEAR EVENT

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

----------------------------------------------------------------------


Program License Serial Number 4065

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

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.500
24 hour precipitation(inches) =  6.000
P6/P24 =    58.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.011 to Point/Station        7.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
User specified 'C' value of 0.450 given for subarea
Rainfall intensity (I) =      9.222(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       9.22(In/Hr)
Total area =        0.010(Ac.)  Total runoff =     0.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.011 to Point/Station        7.012
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.602(CFS)
Depth of flow =   0.244(Ft.), Average velocity =   3.370(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              3.00              0.00
      3              6.00              1.00
Manning's 'N' friction factor =   0.045
```

```
----------------------------------------------------------------
Sub-Channel flow  =      0.602(CFS)
  '      '    flow top width =      1.464(Ft.)
  '      '    velocity=    3.371(Ft/s)
  '      '    area =      0.178(Sq.Ft)
  '      '    Froude number =     1.701

Upstream point elevation =   957.000(Ft.)
Downstream point elevation =   940.000(Ft.)
Flow length =    92.000(Ft.)
Travel time  =    0.45 min.
Time of concentration =    5.45 min.
Depth of flow =   0.244(Ft.)
Average velocity =   3.370(Ft/s)
Total irregular channel flow =     0.602(CFS)
Irregular channel normal depth above invert elev. =   0.244(Ft.)
Average velocity of channel(s) =   3.370(Ft/s)
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      8.718(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.450  CA =      0.144
Subarea runoff =      1.245(CFS) for      0.310(Ac.)
Total runoff =      1.255(CFS)      Total area =       0.320(Ac.)
Depth of flow =   0.321(Ft.), Average velocity =   4.051(Ft/s)
End of computations, total study area =           0.320 (Ac.)
```

APPENDIX C

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2001 Version 6.2

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 04/19/05

RANCH VERONA
FLOW AJACENT TO CENTER CITY PARKWAY
100 YEAR STORM UNDEVELOPED
FILE: 4022XSWALE

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

Masson & Associates, Inc., Escondido, California - S/N 889

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.500
24 hour precipitation(inches) = 6.000
Adjusted 6 hour precipitation (inches) = 3.500
P6/P24 = 58.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.011 to Point/Station 1.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****

User specified 'C' value of 0.450 given for subarea
Rainfall intensity (I) = 9.222(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 9.22(In/Hr)
Total area = 0.010(Ac.) Total runoff = 0.010(CFS)

++
Process from Point/Station 1.011 to Point/Station 1.012
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 3.710(CFS)
Depth of flow = 0.353(Ft.), Average velocity = 2.983(Ft/s)
******* Irregular Channel Data **********

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	2.00
2	20.00	0.00
3	40.00	2.00

Manning's 'N' friction factor = 0.045

```
-----------------------------------------------------------------
Sub-Channel flow  =      3.710(CFS)
  '      '    flow top width =      7.054(Ft.)
  '      '    velocity=    2.983(Ft/s)
  '      '    area =      1.244(Sq.Ft)
  '      '    Froude number =     1.252

Upstream point elevation =  1055.000(Ft.)
Downstream point elevation =  1006.000(Ft.)
Flow length =   590.000(Ft.)
Travel time  =    3.30 min.
Time of concentration =    8.30 min.
Depth of flow =   0.353(Ft.)
Average velocity =   2.983(Ft/s)
Total irregular channel flow =     3.710(CFS)
Irregular channel normal depth above invert elev. =   0.353(Ft.)
Average velocity of channel(s) =   2.983(Ft/s)

Sub-Channel No. 1 Critical depth =      0.387(Ft.)
  '      '        '     Critical flow top width =      7.734(Ft.)
  '      '        '     Critical flow velocity=    2.481(Ft/s)
  '      '        '     Critical flow area =      1.496(Sq.Ft)

 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      6.652(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =     22.151(CFS) for    7.400(Ac.)
Total runoff =     22.161(CFS)      Total area =        7.41(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.012 to Point/Station        1.022
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Estimated mean flow rate at midpoint of channel =     25.421(CFS)
Depth of flow =   0.572(Ft.), Average velocity =   3.887(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             20.00              0.00
      3             40.00              1.00
Manning's 'N' friction factor =   0.045
-----------------------------------------------------------------
Sub-Channel flow  =     25.421(CFS)
  '      '    flow top width =     22.873(Ft.)
  '      '    velocity=    3.887(Ft/s)
  '      '    area =      6.540(Sq.Ft)
  '      '    Froude number =     1.281

Upstream point elevation =  1006.000(Ft.)
Downstream point elevation =   992.000(Ft.)
Flow length =   190.000(Ft.)
Travel time  =    0.81 min.
Time of concentration =    9.11 min.
```

```
Depth of flow =   0.572(Ft.)
Average velocity =   3.887(Ft/s)
Total irregular channel flow =    25.421(CFS)
Irregular channel normal depth above invert elev. =   0.572(Ft.)
Average velocity of channel(s) =   3.887(Ft/s)

Sub-Channel No. 1 Critical depth =      0.633(Ft.)
  '      '       '     Critical flow top width =     25.313(Ft.)
  '      '       '     Critical flow velocity=    3.174(Ft/s)
  '      '       '     Critical flow area =      8.009(Sq.Ft)

 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      6.262(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      6.143(CFS) for    2.180(Ac.)
Total runoff =     28.304(CFS)      Total area =        9.59(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.022 to Point/Station        1.032
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     34.634(CFS)
Depth of flow =   0.474(Ft.), Average velocity =   4.105(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              2.00
      2            100.00              0.00
      3            150.00              2.00
Manning's 'N' friction factor =   0.045
----------------------------------------------------------------
Sub-Channel flow  =     34.634(CFS)
  '      '    flow top width =     35.574(Ft.)
  '      '    velocity=    4.105(Ft/s)
  '      '    area =      8.437(Sq.Ft)
  '      '    Froude number =     1.486

Upstream point elevation =   992.000(Ft.)
Downstream point elevation =   913.000(Ft.)
Flow length =   750.000(Ft.)
Travel time  =    3.04 min.
Time of concentration =   12.16 min.
Depth of flow =   0.474(Ft.)
Average velocity =   4.105(Ft/s)
Total irregular channel flow =    34.634(CFS)
Irregular channel normal depth above invert elev. =   0.474(Ft.)
Average velocity of channel(s) =   4.105(Ft/s)

Sub-Channel No. 1 Critical depth =      0.555(Ft.)
  '      '       '     Critical flow top width =     41.602(Ft.)
  '      '       '     Critical flow velocity=    3.002(Ft/s)
  '      '       '     Critical flow area =     11.538(Sq.Ft)

 Adding area flow to channel
```

```
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      5.199(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =     10.037(CFS) for    4.290(Ac.)
Total runoff =     38.341(CFS)      Total area =       13.88(Ac.)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.032 to Point/Station        1.032
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.045 given for subarea
Time of concentration =    12.16 min.
Rainfall intensity =      5.199(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.045
Subarea runoff =      1.240(CFS) for    5.300(Ac.)
Total runoff =     39.581(CFS)      Total area =       19.18(Ac.)
End of computations, total study area =          19.180 (Ac.)
```

Program Package Serial Number: 1770

WATER SURFACE PROFILE LISTING Date: 4-20-2005 Time:10:29: 6

RANCHO VERONA

FLOW ADJACENT TO CENTER CITY PARKWAY

100 YEAR FLOW

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1079.380	904.000	1.237	905.237	39.58	9.53	1.41	906.65	.00	1.68	6.71		1	0 .0
TRANS STR	.1744						.1397	6.90	1.24	2.14	.045	IR-OPEN	
1128.810	912.620	.643	913.263	39.58	5.04	.39	913.66	.75	.77	24.41		2	0 .0
TRANS STR	.1184						.0773	.90	1.39	1.57	.045	IR-OPEN	
1140.470	914.000	.471	914.471	39.58	2.75	.12	914.59	.12	.47	61.01		3	0 .0
TRANS STR	.0145						.0240	2.86	.59	1.00	.045	IR-OPEN	
1259.690	915.730	1.729	917.459	39.58	.36	.00	917.46	.00	.41	92.21		4	0 .0
TRANS STR	.0569							1.729	.058		.045	IR-OPEN	
1440.330	926.000	.278	926.278	39.58	3.75	.22	926.50	.02	.34	49.66		5	0 .0
TRANS STR	.0686						.0708	17.07	.30	1.44	.045	IR-OPEN	
1681.500	942.540	.863	943.403	39.58	3.74	.22	943.62	.01	.86	24.58		6	0 .0

Program Package Serial Number: 1770

WATER SURFACE PROFILE LISTING Date: 4-20-2005 Time:10:29: 6

RANCHO VERONA

FLOW ADJACENT TO CENTER CITY PARKWAY

100 YEAR FLOW

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip	L/Elem	Ch Slope	SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1079.380	904.000	1.237	905.237	39.58	9.53	1.41	906.65	.00	1.68	6.71		1	0	.0										
TRANS STR															.1744	.1397	6.90	1.24	2.14	.045	IR-OPEN			
1128.810	912.620	.643	913.263	39.58	5.04	.39	913.66	.75	.77	24.41		2	0	.0										
TRANS STR															.1184	.0773	.90	1.39	1.57	.045	IR-OPEN			
1140.470	914.000	.471	914.471	39.58	2.75	.12	914.59	.12	.47	61.01		3	0	.0										
TRANS STR															.0145	.0240	2.86	.59	1.00	.045	IR-OPEN			
1259.690	915.730	1.729	917.459	39.58	.36	.00	917.46	.00	.41	92.21		4	0	.0										
TRANS STR															.0569		1.729	.058		.045	IR-OPEN			
1440.330	926.000	.278	926.278	39.58	3.75	.22	926.50	.02	.34	49.66		5	0	.0										
TRANS STR															.0686	.0708	17.07	.30	1.44	.045	IR-OPEN			
1681.500	942.540	.863	943.403	39.58	3.74	.22	943.62	.01	.86	24.58		6	0	.0										

Program Package Serial Number: 1770

WATER SURFACE PROFILE LISTING Date: 4-20-2005 Time:10:29: 6

RANCHO VERONA

FLOW ADJACENT TO CENTER CITY PARKWAY

100 YEAR FLOW

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1079.380	904.000	1.237	905.237	39.58	9.53	1.41	906.65	.00	1.68	6.71		1	0 .0
TRANS STR	.1744					.1397	6.90	1.24	2.14		.045	IR-OPEN	
1128.810	912.620	.643	913.263	39.58	5.04	.39	913.66	.75	.77	24.41		2	0 .0
TRANS STR	.1184					.0773	.90	1.39	1.57		.045	IR-OPEN	
1140.470	914.000	.471	914.471	39.58	2.75	.12	914.59	.12	.47	61.01		3	0 .0
TRANS STR	.0145					.0240	2.86	.59	1.00		.045	IR-OPEN	
1259.690	915.730	1.729	917.459	39.58	.36	.00	917.46	.00	.41	92.21		4	0 .0
TRANS STR	.0569						1.729	.058			.045	IR-OPEN	
1440.330	926.000	.278	926.278	39.58	3.75	.22	926.50	.02	.34	49.66		5	0 .0
TRANS STR	.0686					.0708	17.07	.30	1.44		.045	IR-OPEN	
1681.500	942.540	.863	943.403	39.58	3.74	.22	943.62	.01	.86	24.58		6	0 .0

Program Package Serial Number: 1770

WATER SURFACE PROFILE LISTING Date: 4-20-2005 Time:10:29: 6

RANCHO VERONA

FLOW ADJACENT TO CENTER CITY PARKWAY

100 YEAR FLOW

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip	L/Elem	Ch Slope	SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1079.380	904.000	1.237	905.237	39.58	9.53	1.41	906.65	.00	1.68	6.71		1	0	.0										
TRANS STR															.1744	.1397	6.90	1.24	2.14		.045			IR-OPEN
1128.810	912.620	.643	913.263	39.58	5.04	.39	913.66	.75	.77	24.41		2	0	.0										
TRANS STR															.1184	.0773	.90	1.39	1.57		.045			IR-OPEN
1140.470	914.000	.471	914.471	39.58	2.75	.12	914.59	.12	.47	61.01		3	0	.0										
TRANS STR															.0145	.0240	2.86	.59	1.00		.045			IR-OPEN
1259.690	915.730	1.729	917.459	39.58	.36	.00	917.46	.00	.41	92.21		4	0	.0										
TRANS STR															.0569		1.729	.058			.045			IR-OPEN
1440.330	926.000	.278	926.278	39.58	3.75	.22	926.50	.02	.34	49.66		5	0	.0										
TRANS STR															.0686	.0708	17.07	.30	1.44		.045			IR-OPEN
1681.500	942.540	.863	943.403	39.58	3.74	.22	943.62	.01	.86	24.58		6	0	.0										

Program Package Serial Number: 1770

WATER SURFACE PROFILE LISTING Date: 4-20-2005 Time:10:29: 6

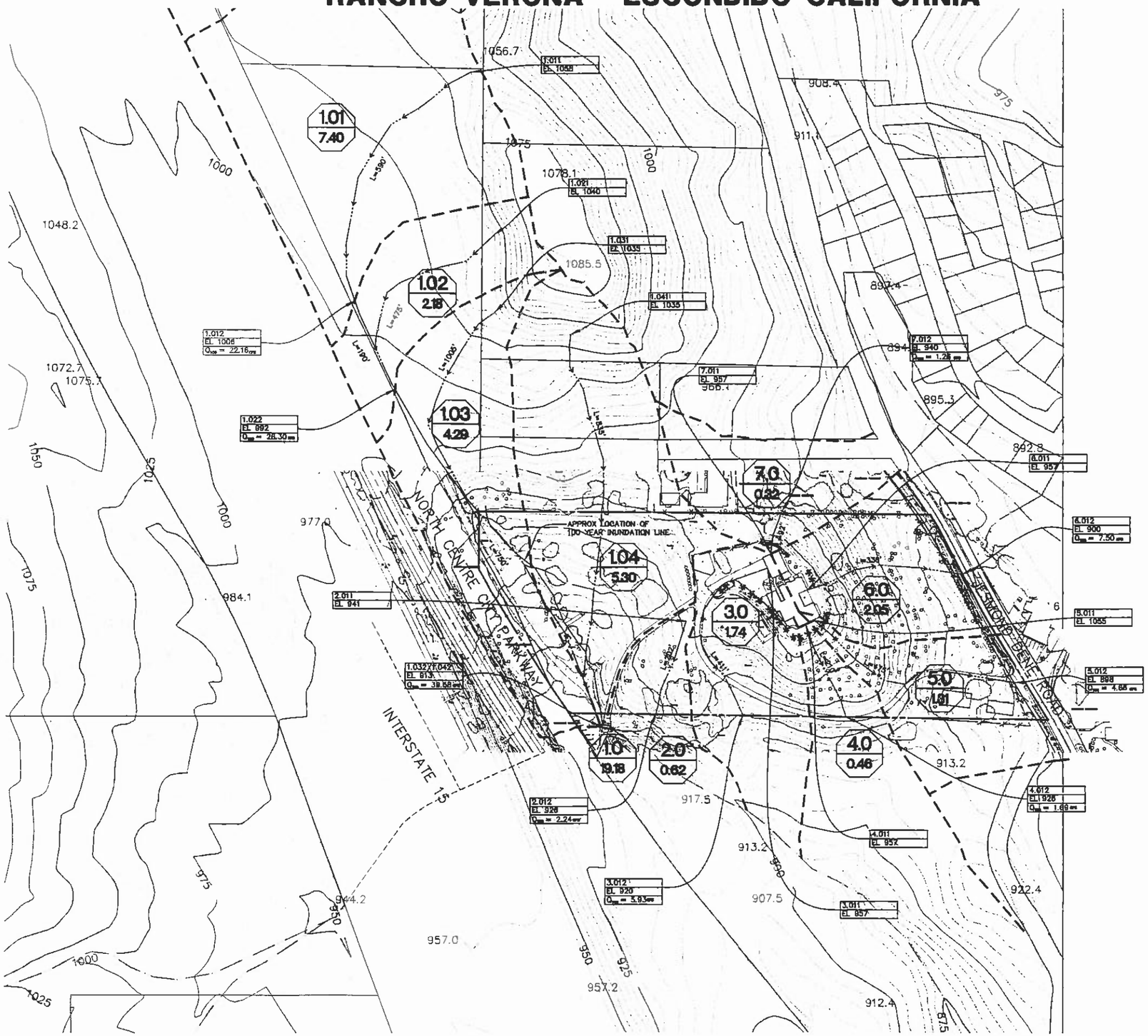
RANCHO VERONA

FLOW ADJACENT TO CENTER CITY PARKWAY

100 YEAR FLOW

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip	L/Elem	Ch Slope	SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1079.380	904.000	1.237	905.237	39.58	9.53	1.41	906.65	.00	1.68	6.71		1	0	.0										
TRANS STR															.1744	.1397	6.90	1.24	2.14	.045	IR-OPEN			
1128.810	912.620	.643	913.263	39.58	5.04	.39	913.66	.75	.77	24.41		2	0	.0										
TRANS STR															.1184	.0773	.90	1.39	1.57	.045	IR-OPEN			
1140.470	914.000	.471	914.471	39.58	2.75	.12	914.59	.12	.47	61.01		3	0	.0										
TRANS STR															.0145	.0240	2.86	.59	1.00	.045	IR-OPEN			
1259.690	915.730	1.729	917.459	39.58	.36	.00	917.46	.00	.41	92.21		4	0	.0										
TRANS STR															.0569		1.729	.058		.045	IR-OPEN			
1440.330	926.000	.278	926.278	39.58	3.75	.22	926.50	.02	.34	49.66		5	0	.0										
TRANS STR															.0686	.0708	17.07	.30	1.44	.045	IR-OPEN			
1681.500	942.540	.863	943.403	39.58	3.74	.22	943.62	.01	.86	24.58		6	0	.0										

RANCHO VERONA - ESCONDIDO CALIFORNIA



LEGEND

7.012 / Q_{100} = 0.32 cfs	CONCENTRATION POINT NUMBER FLOWRATE (CFS) 100 = PER 100 YEAR STORM EVENT
5.0	BASIN DESIGNATION
1.31	BASIN AREA (AC)
	BASIN BOUNDARY
	FLOW PATH
	PROJECT BOUNDARY

N

100 50 0 100 200 300

SCALE IN FEET
GRAPHIC SCALE
1"=100'

EXHIBIT 'A'
PRE & POST - DEVELOPMENT DRAINAGE MAP

DATE: Jan 04, 07 8:44am by:mfatini
FILE: I:\DWG\04\4022\Hydrology\4022-Hdy-Dev.dwg

MASSON & ASSOCIATES, INC.
PLANNING • ENGINEERING • SURVEYING
200 E. WASHINGTON AVE. • SUITE 200 • ESCONDIDO • CA 92025-1516
TEL (760) 741-3570 • FAX (760) 741-1788 • www.masson-assoc.com