CEQA Drainage Study for TM 5406
Hydrology, Hydraulic Calculations
San Diego County Tentative Map

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Hydrology/Hydraulic Calculations Project Summary

San Diego County Tentative Map 5406

Introduction

The attached drainage study represents our analysis of the pre-development and post-development conditions for TM5406. The subject site is an undeveloped 2.08 acre lot located in Rancho Santa Fe in the County of San Diego. The site is bordered by existing residential developments to the west and northwest, an existing residential development to the south, and Via de la Valle to the east. The *CivilDesign* computer program, which is based on the Rational Method per the *San Diego County Hydrology Manual* (June 2003), was used to analyze pre and post-development hydrology conditions. Haestad Methods' Pondpack program was used to analyze detention in proposed conditions. Haestad Methods' Stormcad program was used for hydraulic calculations for the proposed storm drain system. The 100-year storm event was used for all calculations.

Pre-Development

In pre-development conditions, runoff flows to the southeast corner of the site and confluences at an existing pipe culvert that discharges across Via de la Valle. (see node 160, Pre-Development Hydrology Map). Offsite drainage from the east flows through the site to this culvert (Basins A1, A2 A3). The flow from these basins was calculated to be 22.8 CFS, with a time of concentration, T_c of 7.77 minutes. Separate offsite drainage from the northwest (Basins B1 & B2) flows to Via de la Valle and runs through a small section of the site adjacent to the street, before confluencing with the main flow at node 160. The flow from these basins was calculated to be 18.0 CFS, with a T_c of 7.56 minutes. The confluence of these flows at node 160 was calculated to be 40.5 CFS.

Post-Development

Overall flow patterns generally remain the same in pre-development and post-development conditions, with runoff will confluencing at the existing culvert in Via de la Valle. An onsite storm drain system will collect flows from basins B1, C1, C2, D1, D3, and E1. Flows collected by the storm drain system discharges to a bioswale at node 160, and is confluenced with runoff from basin F1 at node 170. The combined flow from these basins was calculated to be 22.2 CFS, with a T_c of 9.62 minutes. The offsite flow from the northwest (Basins G1 & G2) remains the same – 18.0 CFS with a T_c of 7.56 minutes. The confluence of these flows at node 170 was calculated to be 37.6 CFS. Thus there is a net reduction of 2.9 CFS at the culvert crossing Via de la Valle due to detention at the pond in basin D3.

Low flow hydrology calculations were performed for the Basins, using a 0.2" storm (flow based). Basins D1 and C2 discharge into a B1 inlet w/fossil filter and then eventually flow across the bioswale in low flow conditions. Basins B1, B2 and C1 discharge directly into a pipe system which bypasses the fossil filter but is still treated by the bioswale in low flow conditions.

Detention pond calculations were performed using Haestad Methods Pondpack. The existing and proposed pipe system was modeled. The existing 15" pipe draining Paseo Arbolado appears to be undersized, so the driveway was modeled as a weir. The proposed pond was used as a detention facility and a low flow bypass culvert was designed to divert the low flow around the pond, to prevent algae bloom, etc, and a high flow standpipe was modeled to convey runoff to the pond. Hydrographs were developed for each facility using the appropriate Area and C factor and T_c/Intensity for the post-development condition. Rick RatHydro was used for hydrograph calculations. The results of the calculations indicate a post development peak discharge of 37.6 CFS (pre development = 40.5 CFS) with a lag time between the pre and post development conditions of approximately 3 minutes. Based on this, development of the site while using detention will not have an adverse effect on the exiting downstream facilities.

The existing 12" CMP at Via de la Valle has been determined to be inadequate to convey the 100 year storm in pre-development and post-development conditions. The existing pipe has to convey 40.5 cfs during the peak storm. The pipe sits in the bottom of a 5' depression. Using Figure 4-3 of the County Drainage Design Manual - Headwater Depth for Culverts with Inlet Control Chart - it was determined that there is well over 5' of headwater under existing conditions which floods Via del la Valle and sends discharge down the gutter to more adequate facilities downstream.

Conclusion

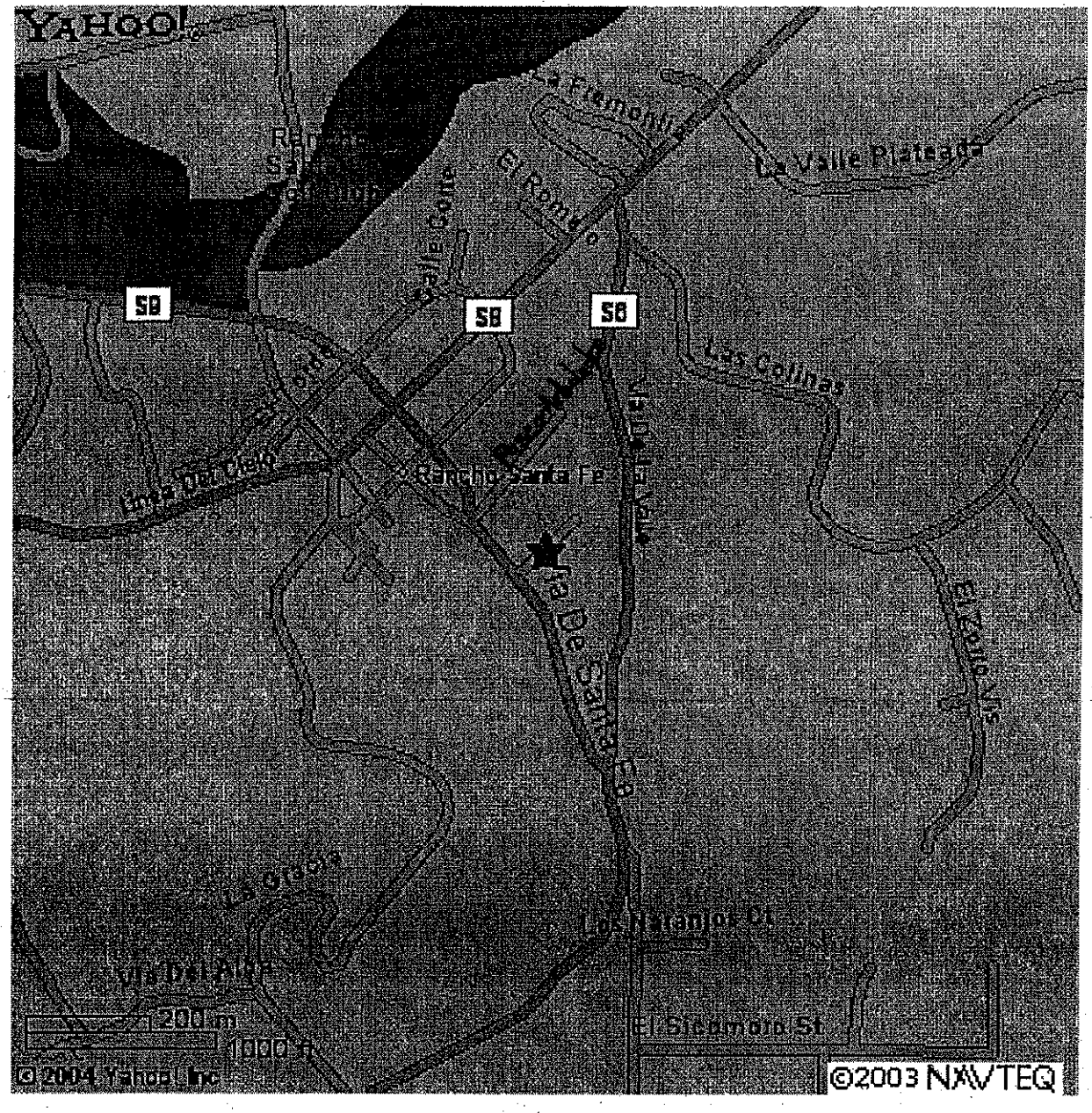
In conclusion, the proposed development does not alter historical drainage patterns. In addition, based on current hydrology methods the existing 12" CMP is undersized for pre-development conditions. There is a net reduction in flow under post development conditions. Thus, the development will not worsen existing drainage conditions.

Table 1 - Pre and Post Development Runoff Comparison

Pre Dev Basin	Area (SF)	Runoff (CFS)	Post Dev Basin	Area (SF)	Runoff (CFS)	Difference
A1,A2,A3	343688	22.8	B1,C1,C2,D1,D3, E1,F1	343,688	22.2	-.6 CFS
B1,B2	247421	18.0	G1,G2	247,421	18.0	0 CFS
CONFLUENCE ALL BASINS	591109	37.6	CONFLUENCE ALL BASINS	591,109	40.5	-2.9CFS

ATTACHMENT A

LOCATION MAP



DECLARATION OF RESPONSIBLE CHARGE

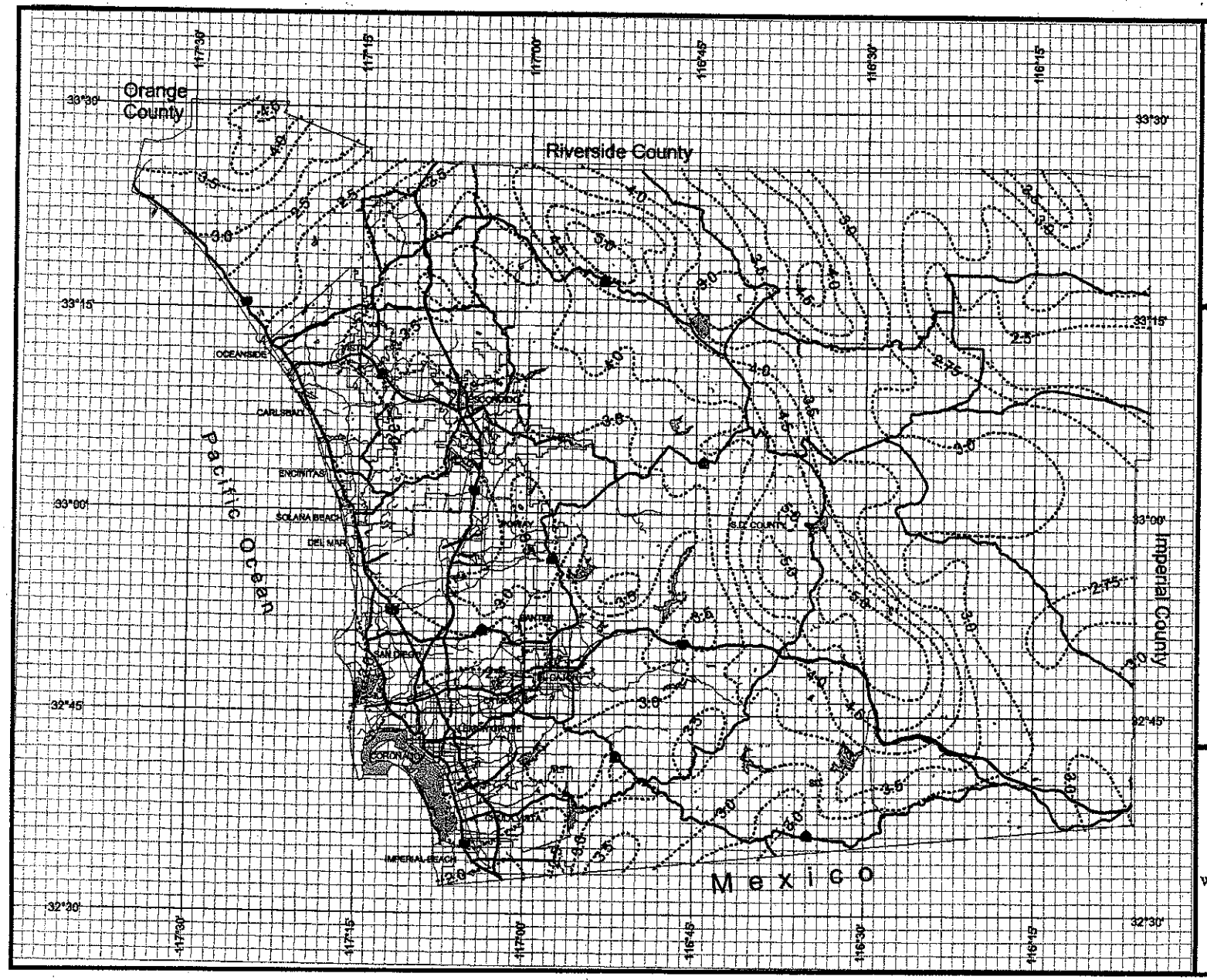
I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 5703 OF THE BUSINESS AND PROFESSIONS CODE, AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS.

I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE COUNTY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

SAN DIEGUITO ENGINEERING, INC. 4407 MANCHESTER AVENUE, SUITE 105
ENCINITAS, CALIFORNIA 92024 (619) 753-5525

BY: _____ DATE _____
RCE _____

HYDROLOGY MANUAL REFERENCES



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS

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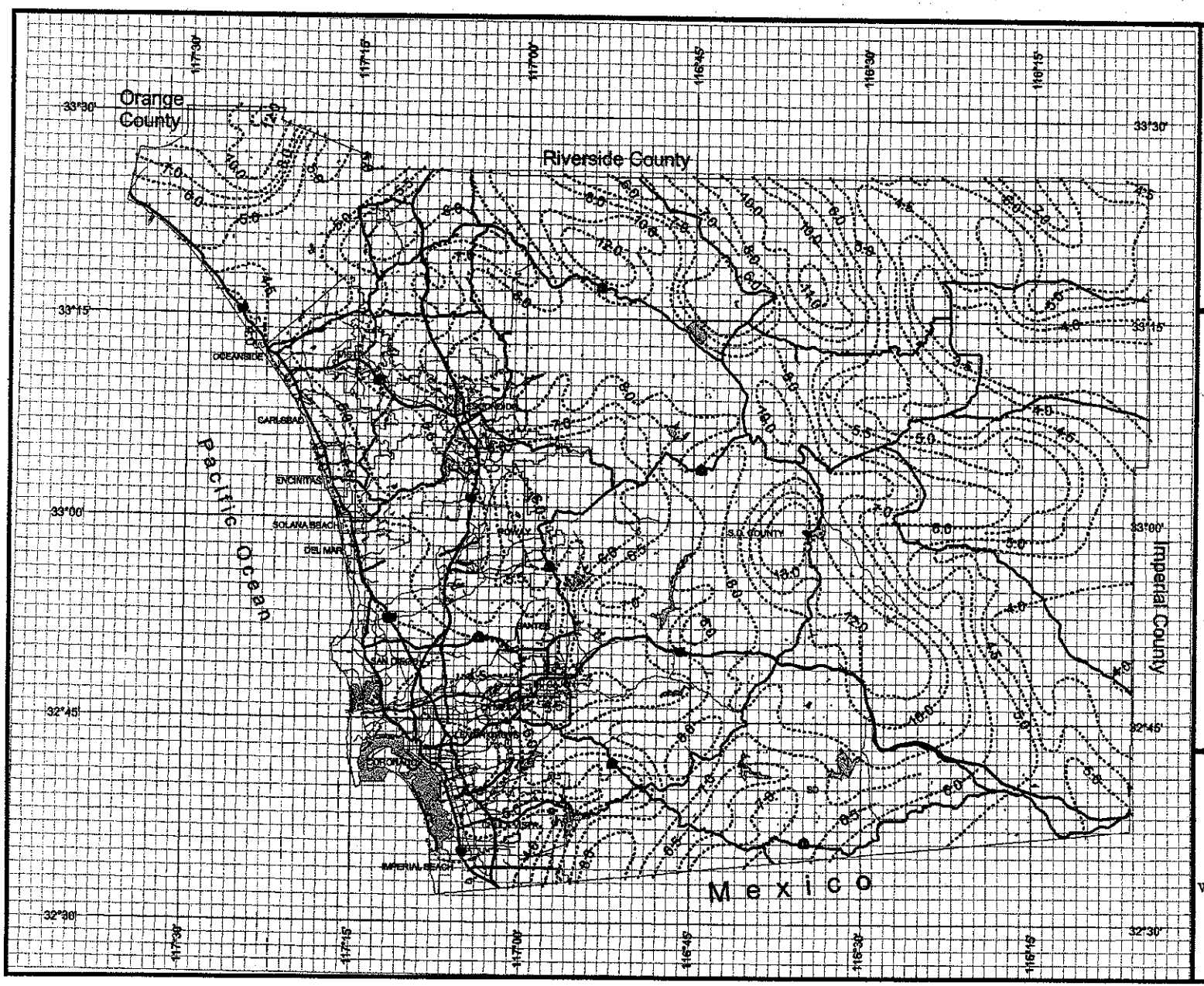

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS

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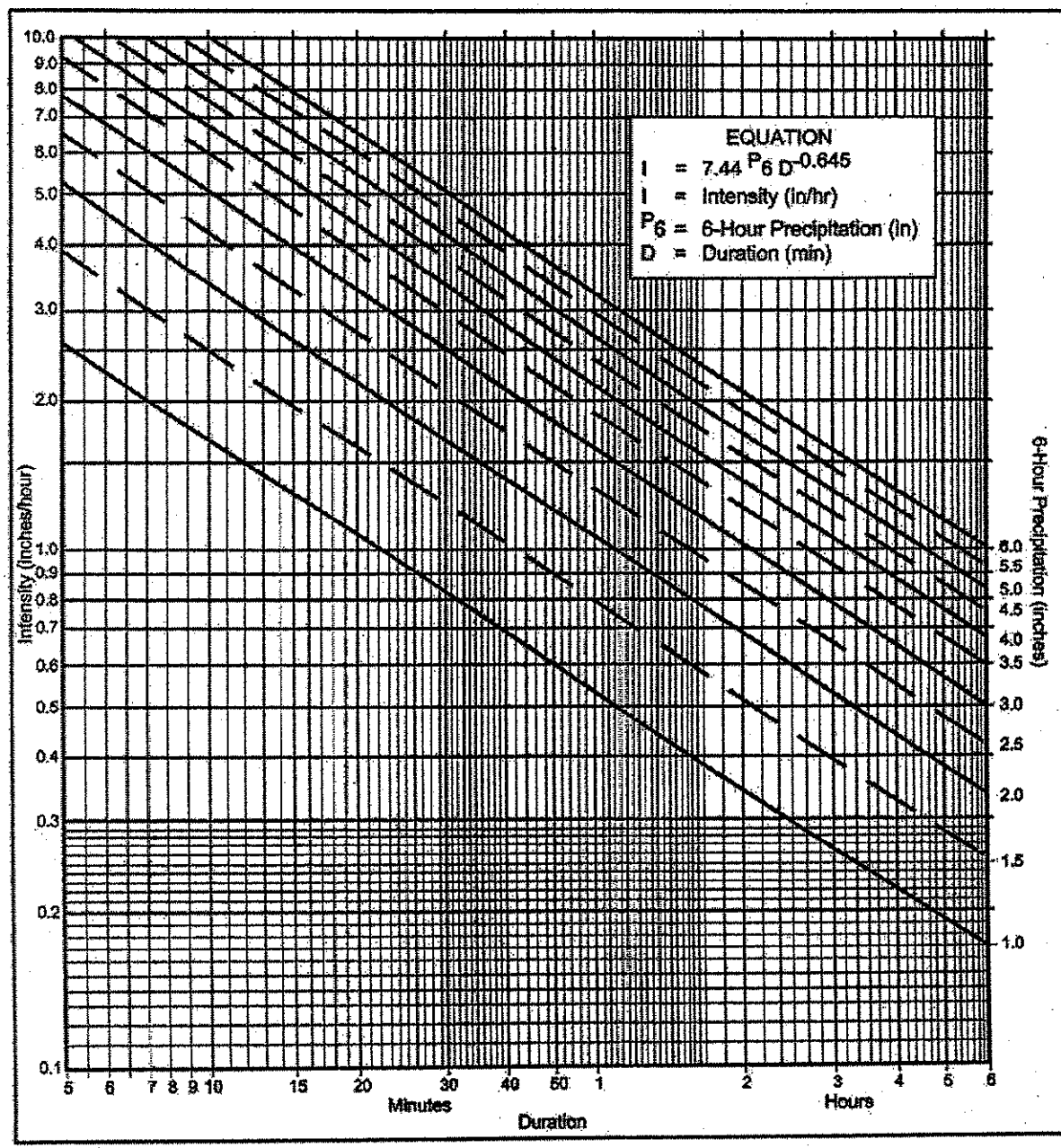
N W E S

3 0 3 Miles



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 = _____ 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.

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	1.06	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

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.

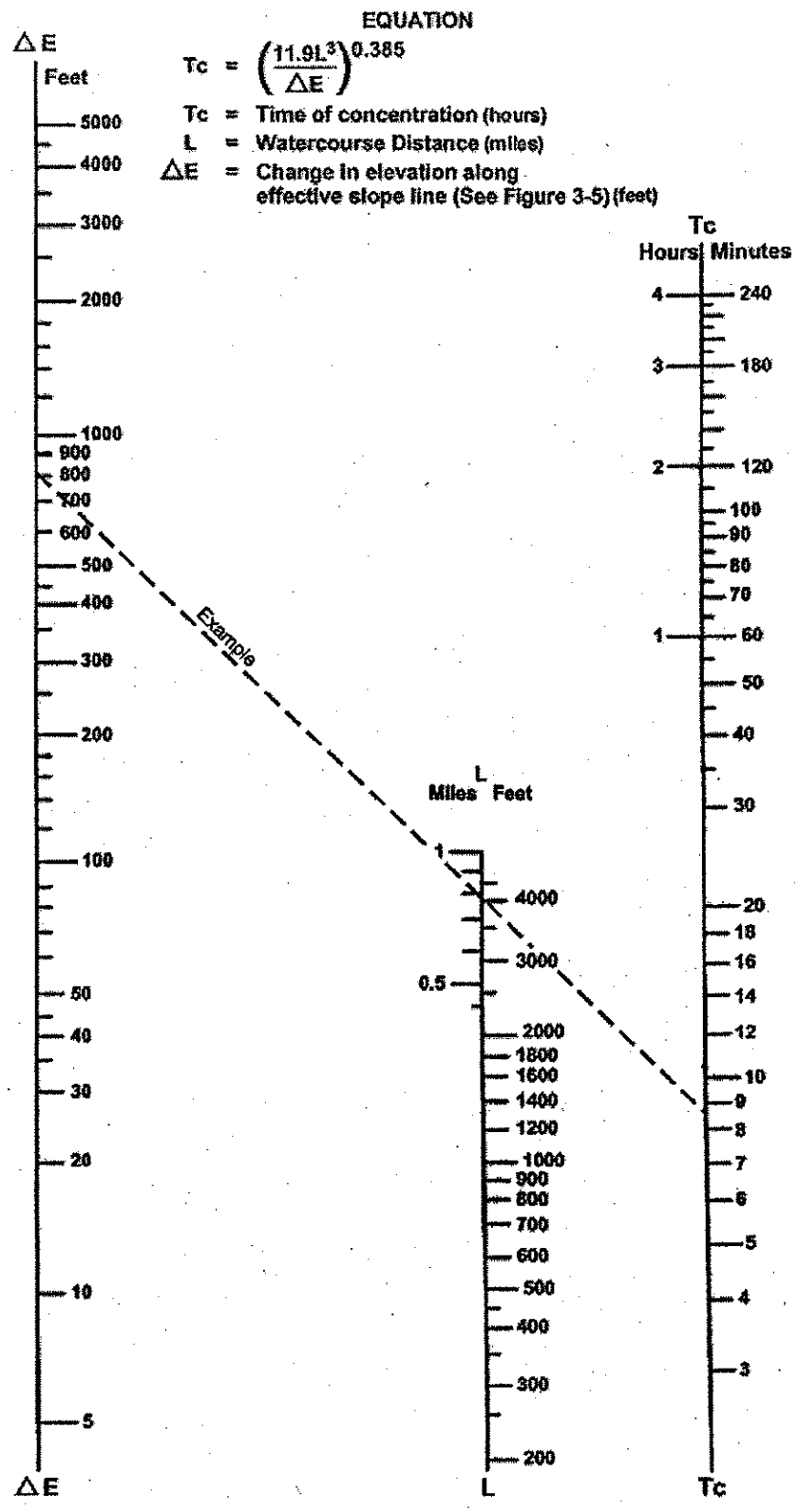
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved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



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

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, 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

Runoff Coefficients for Urban Areas

NRCS	% Imperv	Soil Type A	B	C	D
Natural	0	0.20	0.25	0.30	0.35
	1	0.21	0.26	0.31	0.36
	2	0.21	0.26	0.31	0.36
	3	0.22	0.27	0.32	0.37
	4	0.23	0.28	0.32	0.37
	5	0.24	0.29	0.33	0.38
	6	0.24	0.29	0.34	0.39
	7	0.25	0.30	0.34	0.39
	8	0.26	0.31	0.35	0.40
	9	0.26	0.31	0.35	0.40
LDR	10	0.27	0.32	0.36	0.41
	11	0.28	0.33	0.37	0.42
	12	0.28	0.33	0.37	0.42
	13	0.29	0.34	0.38	0.43
	14	0.30	0.34	0.38	0.43
	15	0.31	0.35	0.39	0.44
	16	0.31	0.36	0.40	0.44
	17	0.32	0.36	0.40	0.45
	18	0.33	0.37	0.41	0.45
	19	0.33	0.37	0.41	0.46
LDR	20	0.34	0.38	0.42	0.46
	21	0.35	0.39	0.43	0.47
	22	0.36	0.39	0.43	0.47
	23	0.36	0.40	0.44	0.48
	24	0.37	0.40	0.44	0.48
LDR	25	0.38	0.41	0.45	0.49
	26	0.39	0.42	0.46	0.50
	27	0.39	0.43	0.46	0.50
	28	0.40	0.43	0.47	0.51
	29	0.40	0.44	0.47	0.51
MDR	30	0.41	0.45	0.48	0.52
	31	0.42	0.46	0.49	0.53
	32	0.42	0.46	0.49	0.53
	33	0.43	0.47	0.50	0.54
	34	0.44	0.47	0.50	0.54
	35	0.45	0.48	0.51	0.55
	36	0.45	0.49	0.52	0.55
	37	0.46	0.49	0.52	0.56
	38	0.47	0.50	0.53	0.56
	39	0.47	0.50	0.53	0.57
MDR	40	0.48	0.51	0.54	0.57
	41	0.49	0.52	0.55	0.58
	42	0.50	0.52	0.55	0.58
	43	0.50	0.53	0.56	0.59
	44	0.51	0.53	0.56	0.59
MDR	45	0.52	0.54	0.57	0.60
	46	0.53	0.55	0.58	0.61
	47	0.53	0.56	0.58	0.61
	48	0.54	0.56	0.59	0.62
	49	0.54	0.57	0.59	0.62
MDR	50	0.55	0.58	0.60	0.63

NRCS	% Imperv	Soil Type A	B	C	D
MDR	50	0.55	0.58	0.60	0.63
	51	0.56	0.59	0.61	0.64
	52	0.56	0.59	0.61	0.64
	53	0.57	0.60	0.62	0.65
	54	0.58	0.60	0.62	0.65
	55	0.59	0.61	0.63	0.66
	56	0.59	0.62	0.64	0.66
	57	0.60	0.62	0.64	0.67
	58	0.61	0.63	0.65	0.67
	59	0.62	0.63	0.65	0.68
	60	0.62	0.64	0.66	0.68
	61	0.63	0.65	0.67	0.69
	62	0.64	0.65	0.67	0.69
	63	0.65	0.66	0.68	0.70
	64	0.65	0.66	0.68	0.70
HDR	65	0.66	0.67	0.69	0.71
	66	0.67	0.68	0.70	0.72
	67	0.67	0.68	0.70	0.72
	68	0.68	0.69	0.71	0.73
	69	0.69	0.70	0.71	0.73
	70	0.69	0.70	0.72	0.74
	71	0.70	0.71	0.73	0.74
	72	0.71	0.72	0.73	0.75
	73	0.71	0.72	0.74	0.75
	74	0.72	0.73	0.74	0.76
	75	0.73	0.74	0.75	0.76
	76	0.73	0.74	0.76	0.77
	77	0.74	0.75	0.76	0.77
	78	0.75	0.76	0.77	0.78
	79	0.75	0.76	0.77	0.78
HDR	80	0.76	0.77	0.78	0.79
	81	0.77	0.78	0.79	0.80
	82	0.78	0.78	0.79	0.80
	83	0.78	0.79	0.80	0.81
	84	0.79	0.79	0.80	0.81
NZ Ob	85	0.80	0.80	0.81	0.82
	86	0.81	0.81	0.82	0.83
	87	0.81	0.82	0.82	0.83
	88	0.82	0.82	0.83	0.84
	89	0.82	0.83	0.83	0.84
OP Cont/	90	0.83	0.84	0.84	0.85
Lim I	91	0.84	0.85	0.85	0.85
	92	0.85	0.85	0.85	0.86
	93	0.85	0.86	0.86	0.86
	94	0.86	0.86	0.86	0.87
Gen I	95	0.87	0.87	0.87	0.87
	96	0.87	0.87	0.87	0.87
	97	0.87	0.87	0.87	0.87
	98	0.87	0.87	0.87	0.87
	99	0.87	0.87	0.87	0.87
	100	0.87	0.87	0.87	0.87

HYDROLOGY CALCULATIONS – PRE DEVELOPMENT

HYDROLOGY SUMMARY
PRE-DEVELOPMENT
100 YEAR STORM

	Paseo Arbolado	
PROJECT NUMBER:	4357	
DATE:	8/10/07	
COMMENT:		
COORD:	N 33°00'	E 117°13'

P6 (in):	2.75	P6/P24:	0.60
P24 (in):	4.60	ADJUSTED P6:	2.75
Soil Group D			

BASIN	AREA (AC)	Q (CFS)	Tc (MIN)	INTENSITY (IN/HR)
BASINS A1, A2, A3 - STREAM 1	7.89	22.8	7.77	5.5
BASIN B1, B2 - STREAM 2	5.68	18.0	7.56	5.6
CONFLUENCE STREAMS 1 & 2	**13.57**	**40.5**	**7.77**	

TOTAL Q = 40.5 CFS

Impervious Calculations

	*Imper Area	Total Area	%Imper	C
Basin A1	60024	168142	**35.7**	**0.55**
Basin A2	22589	74488	**30.3**	**0.52**
Basin A3	26415	101059	**26.1**	**0.50**
Basin B1	74512	209088	**35.6**	**0.55**
Basin B2	17245	38333	**45.0**	**0.60**

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: 08/15/07

4357 PASEO ARBOLADO
100 YEAR STORM
PRE DEVELOPMENT
8-8-2007 TJ

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

Program License Serial Number 6130

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

Map data precipitation entered:
6 hour, precipitation(inches) = 2.750
24 hour precipitation(inches) = 4.600
P6/P24 = 59.8%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 100.000 to Point/Station 110.000
**** 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
[COMMERCIAL area type]
(Neighborhod Commercial)
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance = 85.000(Ft.)
Highest elevation = 253.500(Ft.)
Lowest elevation = 250.950(Ft.)
Elevation difference = 2.550(Ft.) Slope = 3.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of 3.00 %, in a development type of
Neighborhod Commercial
In Accordance With Table 3-2
Initial Area Time of Concentration = 3.80 minutes
(for slope value of 3.00 %)
Calculated TC of 3.800 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 7.246(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff = 0.286(CFS)
Total initial stream area = 0.050(Ac.)

++
Process from Point/Station 110.000 to Point/Station 120.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 250.950(Ft.)
Downstream point elevation = 227.900(Ft.)
Channel length thru subarea = 725.000(Ft.)
Channel base width = 0.000(Ft.)

```
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =      6.328(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      6.328(CFS)
Depth of flow =   0.187(Ft.), Average velocity =   3.634(Ft/s)
Channel flow top width =   18.663(Ft.)
Flow Velocity =    3.63(Ft/s)
Travel time  =    3.33 min.
Time of concentration =    7.13 min.
Critical depth =      0.250(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.766(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.550 given for subarea
Rainfall intensity =      5.766(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.553  CA =      2.135
Subarea runoff =     12.023(CFS) for      3.810(Ac.)
Total runoff =     12.309(CFS)      Total area =       3.860(Ac.)
Depth of flow =   0.240(Ft.), Average velocity =   4.291(Ft/s)
Critical depth =      0.328(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      130.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   227.900(Ft.)
Downstream point/station elevation =   191.400(Ft.)
Pipe length  =   334.20(Ft.) Slope =   0.1092  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    12.309(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =    12.309(CFS)
Normal flow depth in pipe =    8.17(In.)
Flow top width inside pipe =   14.94(In.)
Critical depth could not be calculated.
Pipe flow velocity =     18.01(Ft/s)
Travel time through pipe =    0.31 min.
Time of concentration (TC) =     7.43 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      130.000 to Point/Station      140.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Covered channel
Upstream point elevation =   191.400(Ft.)
Downstream point elevation =   188.000(Ft.)
Channel length thru subarea  =    40.000(Ft.)
Channel base width      =    1.710(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Estimated mean flow rate at midpoint of channel =     14.657(CFS)
Manning's 'N'    = 0.005
Maximum depth of channel  =    0.100(Ft.)
Flow(q) thru subarea =     14.657(CFS)
Pressure flow condition in covered channel:
Wetted perimeter =    3.62(Ft.)  Flow area =    0.17(Sq.Ft)
Hydraulic grade line required at box inlet =   7410.883(Ft.)
Friction loss =   7243.190(Ft.)
Minor Friction loss =    171.094(Ft.)   K-Factor =  1.500
Flow Velocity =   85.71(Ft/s)
Travel time  =    0.01 min.
Time of concentration =    7.44 min.
 Adding area flow to channel
Rainfall intensity (I) =      5.606(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.520 given for subarea
Rainfall intensity =      5.606(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.543  CA =      3.024
```

```
Subarea runoff =       4.644(CFS) for       1.710(Ac.)
Total runoff =      16.953(CFS)       Total area =       5.570(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      140.000 to Point/Station      150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   188.000(Ft.)
Downstream point/station elevation =   186.500(Ft.)
Pipe length  =    30.00(Ft.) Slope =   0.0500  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    16.953(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    16.953(CFS)
Normal flow depth in pipe =   11.32(In.)
Flow top width inside pipe =   17.39(In.)
Critical depth could not be calculated.
Pipe flow velocity =     14.47(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     7.48 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      150.000 to Point/Station      160.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   186.500(Ft.)
Downstream point elevation =   172.560(Ft.)
Channel length thru subarea  =    92.000(Ft.)
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =     19.918(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =     19.918(CFS)
Depth of flow =   0.278(Ft.), Average velocity =   5.168(Ft/s)
Channel flow top width =   27.763(Ft.)
Flow Velocity =    5.17(Ft/s)
Travel time  =    0.30 min.
Time of concentration =    7.77 min.
Critical depth =      0.398(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.451(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.500 given for subarea
Rainfall intensity =      5.451(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.530  CA =      4.184
Subarea runoff =      5.853(CFS) for      2.320(Ac.)
Total runoff =     22.807(CFS)      Total area =      7.890(Ac.)
Depth of flow =   0.292(Ft.), Average velocity =   5.346(Ft/s)
Critical depth =      0.418(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      160.000 to Point/Station      160.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      7.890(Ac.)
Runoff from this stream =     22.807(CFS)
Time of concentration =    7.77 min.
Rainfall intensity =     5.451(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      210.000
**** 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
[COMMERCIAL area type                          ]
(Neighborhod Commercial )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance  =   85.000(Ft.)
Highest elevation =  253.500(Ft.)
Lowest elevation =  250.950(Ft.)
Elevation difference =    2.550(Ft.) Slope =  3.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   3.00 %, in a development type of
 Neighborhod Commercial
In Accordance With Table 3-2
Initial Area Time of Concentration =   3.80 minutes
 (for slope value of   3.00 %)
Calculated TC of    3.800 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      7.246(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff =      0.286(CFS)
Total initial stream area =        0.050(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      220.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   250.950(Ft.)
Downstream point elevation =   220.000(Ft.)
Channel length thru subarea  =   360.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =      9.182(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =      9.182(CFS)
Depth of flow =   0.231(Ft.), Average velocity =   3.443(Ft/s)
Channel flow top width =   23.093(Ft.)
Flow Velocity =    3.44(Ft/s)
Travel time  =    1.74 min.
Time of concentration =    5.54 min.
Critical depth =      0.291(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      6.780(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.550 given for subarea
Rainfall intensity =      6.780(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.553  CA =      2.652
Subarea runoff =     17.694(CFS) for      4.750(Ac.)
Total runoff =     17.980(CFS)      Total area =       4.800(Ac.)
Depth of flow =   0.297(Ft.), Average velocity =   4.073(Ft/s)
Critical depth =      0.381(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      160.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   220.000(Ft.)
Downstream point elevation =   172.560(Ft.)
Channel length thru subarea  =   680.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =     18.006(CFS)
Manning's 'N'    = 0.030
```

```
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =     18.006(CFS)
Depth of flow =   0.566(Ft.), Average velocity =   5.621(Ft/s)
Channel flow top width =   11.320(Ft.)
Flow Velocity =    5.62(Ft/s)
Travel time  =    2.02 min.
Time of concentration =    7.56 min.
Critical depth =      0.727(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.550(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.600 given for subarea
The area added to the existing stream causes a
a lower flow rate of Q =     17.649(CFS)
therefore the upstream flow rate of Q =     17.980(CFS) is being used
Rainfall intensity =      5.550(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.560  CA =      3.180
Subarea runoff =      0.000(CFS) for      0.880(Ac.)
Total runoff =     17.980(CFS)      Total area =       5.680(Ac.)
Depth of flow =   0.566(Ft.), Average velocity =   5.619(Ft/s)
Critical depth =      0.727(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      160.000 to Point/Station      160.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      5.680(Ac.)
Runoff from this stream =     17.980(CFS)
Time of concentration =    7.56 min.
Rainfall intensity =     5.550(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       22.807      7.77                 5.451
2       17.980      7.56                 5.550
Qmax(1) =
         1.000 *    1.000 *    22.807) +
         0.982 *    1.000 *    17.980) + =      40.464
Qmax(2) =
         1.000 *    0.972 *    22.807) +
         1.000 *    1.000 *    17.980) + =      40.156

Total of 2 main streams to confluence:
Flow rates before confluence point:
      22.807      17.980
Maximum flow rates at confluence using above data:
       40.464       40.156
Area of streams before confluence:
        7.890        5.680


Results of confluence:
Total flow rate =     40.464(CFS)
Time of concentration =     7.774 min.
Effective stream area after confluence  =     13.570(Ac.)
End of computations, total study area =          13.570 (Ac.)
```

HYDROLOGY CALCULATIONS – POST DEVELOPMENT

HYDROLOGY SUMMARY
POST-DEVELOPMENT
100 YEAR STORM

	Paseo Arbolado		
PROJECT NUMBER:	4357		
DATE:	8/10/07		
COMMENT:			
COORD:	N 33°00'		E 117°13'

P6 (in):	2.75	P6/P24:	0.60
P24 (in):	4.60	ADJUSTED P6:	2.75
Soil Group D			

BASIN	AREA (AC)	Q (CFS)	Tc (MIN)	INTENSITY (IN/HR)
B1	3.86	12.3	7.32	5.67
C1	0.93	2.8	6.52	6.11
C2	0.29	1.8	3.31	7.25
D1	0.97	5.2	2.9	7.25
D3	0.28	0.9	6.58	6.07
E1	1.23	4.3	8.24	5.25
F1	0.33	0.9	6.68	6.01
CONFLUENCE - STREAM 1	7.89	22.2	9.62	4.8
BASIN G1, G2 - STREAM 2	5.68	18.0	7.56	5.6
CONFLUENCE STREAMS 1 & 2	**13.57**	**37.6**	**9.62**	

TOTAL Q = 37.6 CFS

Impervious Calculations

	*Imper Area	Total Area	%Imper	C
Basin B1	60024	168142	**35.7**	**0.55**
Basin C1	9241	40613	**22.8**	**0.48**
Basin C2	11415	12745	**89.6**	**0.85**
Basin D1	30018	42323	**70.9**	**0.74**
Basin D3	2975	11989	**24.8**	**0.49**
Basin E1	29558	53555	**55.2**	**0.66**
Basin F1	2310	14387	**16.1**	**0.44**
Basin G1	74512	209088	**35.6**	**0.55**
Basin G2	17245	38333	**45.0**	**0.60**

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: 08/14/07

4357 PASEO ARBOLADO
100 YEAR STORM
POST DEVELOPMENT BASIN B1
8-8-2007 TJ

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

Program License Serial Number 6130

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

Map data precipitation entered:
6 hour, precipitation(inches) = 2.750
24 hour precipitation(inches) = 4.600
P6/P24 = 59.8%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 100.000 to Point/Station 110.000
**** 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
[COMMERCIAL area type]
(Neighborhod Commercial)
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance = 85.000(Ft.)
Highest elevation = 253.500(Ft.)
Lowest elevation = 250.950(Ft.)
Elevation difference = 2.550(Ft.) Slope = 3.000 %
Top of Initial Area Slope adjusted by User to 2.941 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of 2.94 %, in a development type of
Neighborhod Commercial
In Accordance With Table 3-2
Initial Area Time of Concentration = 3.80 minutes
(for slope value of 3.00 %)
Calculated TC of 3.800 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 7.246(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff = 0.286(CFS)
Total initial stream area = 0.050(Ac.)

++
Process from Point/Station 110.000 to Point/Station 120.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 250.950(Ft.)
Downstream point elevation = 227.900(Ft.)
Channel length thru subarea = 725.000(Ft.)

```
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =       6.328(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =       6.328(CFS)
Depth of flow =   0.187(Ft.), Average velocity =   3.634(Ft/s)
Channel flow top width =   18.663(Ft.)
Flow Velocity =    3.63(Ft/s)
Travel time  =    3.33 min.
Time of concentration =    7.13 min.
Critical depth =      0.250(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.766(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.550 given for subarea
Rainfall intensity =      5.766(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.553  CA =      2.135
Subarea runoff =     12.023(CFS) for      3.810(Ac.)
Total runoff =     12.309(CFS)      Total area =       3.860(Ac.)
Depth of flow =   0.240(Ft.), Average velocity =   4.291(Ft/s)
Critical depth =      0.328(Ft.)
End of computations, total study area =           3.860 (Ac.)
```

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: 08/14/07

4357 PASEO ARBOLADO
100 YEAR STORM
POST DEVELOPMENT BASIN C1
8-8-2007 TJ

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

Program License Serial Number 6130

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

Map data precipitation entered:
6 hour, precipitation(inches) = 2.750
24 hour precipitation(inches) = 4.600
P6/P24 = 59.8%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 400.000 to Point/Station 410.000
**** 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
[MEDIUM DENSITY RESIDENTIAL]
(10.9 DU/A or Less)
Impervious value, Ai = 0.450
Sub-Area C Value = 0.600
Initial subarea total flow distance = 60.000(Ft.)
Highest elevation = 233.800(Ft.)
Lowest elevation = 228.500(Ft.)
Elevation difference = 5.300(Ft.) Slope = 8.833 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 8.83 %, in a development type of
10.9 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration = 4.50 minutes
(for slope value of 10.00 %)
Calculated TC of 4.500 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 7.246(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.600
Subarea runoff = 0.174(CFS)
Total initial stream area = 0.040(Ac.)

++
Process from Point/Station 410.000 to Point/Station 140.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 228.500(Ft.)
Downstream point elevation = 194.500(Ft.)
Channel length thru subarea = 296.000(Ft.)
Channel base width = 0.000(Ft.)

```
Total initial stream area =        0.040(Ac.)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      410.000 to Point/Station      140.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   228.500(Ft.)
Downstream point elevation =   194.500(Ft.)
Channel length thru subarea  =   296.000(Ft.)
Channel base width=    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =      1.510(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      1.510(CFS)
Depth of flow =   0.111(Ft.), Average velocity =   2.444(Ft/s)
Channel flow top width =   11.115(Ft.)
Flow Velocity =    2.44(Ft/s)
Travel time  =   2.02 min.
Time of concentration =    6.52 min.
Critical depth =      0.142(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      6.107(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.480 given for subarea
Rainfall intensity =      6.107(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.485  CA =      0.451
Subarea runoff =      2.581(CFS) for      0.890(Ac.)
Total runoff =      2.755(CFS)Total area =      0.930(Ac.)
Depth of flow =   0.139(Ft.), Average velocity -   2.841(Ft/s)
Critical depth =      0.180(Ft.)
End of computations, total study area =          0.930 (Ac.)
```

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: 08/14/07

4357 PASEO ARBOLADO
100 YEAR STORM
POST DEVELOPMENT BASIN C2
8-8-2007 TJ

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

Program License Serial Number 6130

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

Map data precipitation entered:
6 hour, precipitation(inches) = 2.750
24 hour precipitation(inches) = 4.600
P6/P24 = 59.8%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 500.000 to Point/Station 510.000
**** 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
[COMMERCIAL area type]
(Neighborhod Commercial)
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 212.000(Ft.)
Lowest elevation = 204.000(Ft.)
Elevation difference = 8.000(Ft.) Slope = 8.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft.)
for the top area slope value of 8.00 %, in a development type of
Neighborhod Commercial
In Accordance With Table 3-2
Initial Area Time of Concentration = 2.70 minutes
(for slope value of 10.00 %)
Calculated TC of 2.700 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 7.246(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff = 0.401(CFS)
Total initial stream area = 0.070(Ac.)

++
Process from Point/Station 510.000 to Point/Station 150.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 204.000(Ft.)
Downstream point elevation = 195.000(Ft.)
Channel length thru subarea = 118.000(Ft.)
Channel base width = 0.000(Ft.)

```
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =      1.030(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      1.030(CFS)
Depth of flow =   0.080(Ft.), Average velocity =   3.204(Ft/s)
Channel flow top width =    8.019(Ft.)
Flow Velocity =    3.20(Ft/s)
Travel time  =    0.61 min.
Time of concentration =    3.31 min.
Critical depth =      0.121(Ft.)
 Adding area flow to channel
Calculated TC of    3.314 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      7.246(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.850 given for subarea
Rainfall intensity =      7.246(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.836  CA =      0.242
Subarea runoff =      1.355(CFS) for      0.220(Ac.)
Total runoff =      1.756(CFS)      Total area =      0.290(Ac.)
Depth of flow =   0.098(Ft.), Average velocity =   3.661(Ft/s)
Critical depth =      0.150(Ft.)
End of computations, total study area =          0.290 (Ac.)
```

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: 08/14/07

4357 PASEO ARBOLADO
100 YEAR STORM
POST DEVELOPMENT BASIN D1
8-8-2007 TJ

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

Program License Serial Number 6130

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

Map data precipitation entered:
6 hour, precipitation(inches) = 2.750
24 hour precipitation(inches) = 4.600
P6/P24 = 59.8%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 200.000 to Point/Station 210.000
**** 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
[COMMERCIAL area type]
(Neighborhod Commercial)
Impervious value, Ai = 0.800
Sub-Area C Value = 0.790
Initial subarea total flow distance = 40.000(Ft.)
Highest elevation = 230.500(Ft.)
Lowest elevation = 224.000(Ft.)
Elevation difference = 6.500(Ft.) Slope = 16.250 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 16.25 %, in a development type of
Neighborhod Commercial
In Accordance With Table 3-2
Initial Area Time of Concentration = 2.70 minutes
(for slope value of 10.00 %)
Calculated TC of 2.700 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 7.246(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.790
Subarea runoff = 0.286(CFS)
Total initial stream area = 0.050(Ac.)

++
Process from Point/Station 210.000 to Point/Station 220.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Covered channel
Upstream point elevation = 224.000(Ft.)
Downstream point elevation = 211.000(Ft.)
Channel length thru subarea = 150.000(Ft.)

```
Channel base width       =    0.970(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Estimated mean flow rate at midpoint of channel =      2.794(CFS)
Manning's 'N'    = 0.005
Maximum depth of channel  =    0.100(Ft.)
Flow(q) thru subarea =      2.794(CFS)
Pressure flow condition in covered channel:
Wetted perimeter =    2.14(Ft.)  Flow area =    0.10(Sq.Ft)
Hydraulic grade line required at box inlet =   1217.342(Ft.)
Friction loss =   1230.342(Ft.)
Minor Friction loss =      0.000(Ft.)   K-Factor =  0.000
Flow Velocity =   28.80(Ft/s)
Travel time  =    0.09 min.
Time of concentration =    2.79 min.
 Adding area flow to channel
Calculated TC of    2.787 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      7.246(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.740 given for subarea
Rainfall intensity =      7.246(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.743  CA =      0.720
Subarea runoff =      4.933(CFS) for      0.920(Ac.)
Total runoff =      5.219(CFS)      Total area =       0.970(Ac.)
End of computations, total study area =           0.970 (Ac.)
```

```
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =      2.269(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      2.269(CFS)
Depth of flow =   0.117(Ft.), Average velocity =   3.320(Ft/s)
Channel flow top width =   11.692(Ft.)
Flow Velocity =    3.32(Ft/s)
Travel time  =    2.54 min.
Time of concentration =    8.24 min.
Critical depth =      0.166(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.252(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.660 given for subarea
Rainfall intensity =      5.252(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.658  CA =      0.809
Subarea runoff =      4.048(CFS) for      1.180(Ac.)
Total runoff =      4.247(CFS)      Total area =       1.230(Ac.)
Depth of flow =   0.148(Ft.), Average velocity =   3.883(Ft/s)
Critical depth =      0.214(Ft.)
End of computations, total study area =           1.230 (Ac.)
```

```
Time of concentration =    9.62 min.
Critical depth =      0.410(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      170.000 to Point/Station      170.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      7.560(Ac.)
Runoff from this stream =     21.460(CFS)
Time of concentration =    9.62 min.
Rainfall intensity =     4.751(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      700.000 to Point/Station      710.000
**** 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
[MEDIUM DENSITY RESIDENTIAL                    ]
(4.3 DU/A or Less        )
Impervious value, Ai = 0.300
Sub-Area C Value = 0.520
Initial subarea total flow distance  =   55.000(Ft.)
Highest elevation =  211.200(Ft.)
Lowest elevation =  205.000(Ft.)
Elevation difference =    6.200(Ft.) Slope = 11.273 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  11.27 %, in a development type of
 4.3 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration =   5.30 minutes
 (for slope value of  10.00 %)
Rainfall intensity (I) =      6.978(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.520
Subarea runoff =      0.145(CFS)
Total initial stream area =        0.040(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      710.000 to Point/Station      170.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   205.000(Ft.)
Downstream point elevation =   172.560(Ft.)
Channel length thru subarea  =   185.000(Ft.)
Channel base width=    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel -      0.558(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =      0.558(CFS)
```

```
Time of concentration =     5.54 min.
Critical depth =       0.291(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =       6.780(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.550 given for subarea
Rainfall intensity =       6.780(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.553  CA =       2.652
Subarea runoff =      17.694(CFS) for       4.750(Ac.)
Total runoff =      17.980(CFS)Total area =       4.800(Ac.)
Depth of flow =   0.297(Ft.), Average velocity =   4.073(Ft/s)
Critical depth =       0.381(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      820.000 to Point/Station      170.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   220.000(Ft.)
Downstream point elevation =   172.560(Ft.)
Channel length thru subarea  =   680.000(Ft.)
Channel base width=  .  0.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =     18.006(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    5.000(Ft.)
Flow(q) thru subarea =     18.006(CFS)
Depth of flow =   0.566(Ft.), Average velocity =   5.621(Ft/s)
Channel flow top width =   11.320(Ft.)
Flow Velocity =    5.62(Ft/s)
Travel time  =    2.02 min.
Time of concentration =    7.56 min.
Critical depth =       0.727(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =       5.550(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.600 given for subarea
The area added to the existing stream causes a
a lower flow rate of Q =     17.649(CFS)
therefore the upstream flow rate of Q =     17.980(CFS) is being used
Rainfall intensity =       5.550(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.560  CA =       3.180
Subarea runoff =       0.000(CFS) for       0.880(Ac.)
Total runoff =      17.980(CFS)Total area =       5.680(Ac.)
Depth of flow =   0.566(Ft.), Average velocity =   5.619(Ft/s)
Critical depth =       0.727(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      170.000 to Point/Station      170.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =       5.680(Ac.)
Runoff from this stream =      17.980(CFS)
Time of concentration =    7.56 min.
Rainfall intensity =     5.550(In/Hr)
Summary of stream data:
```

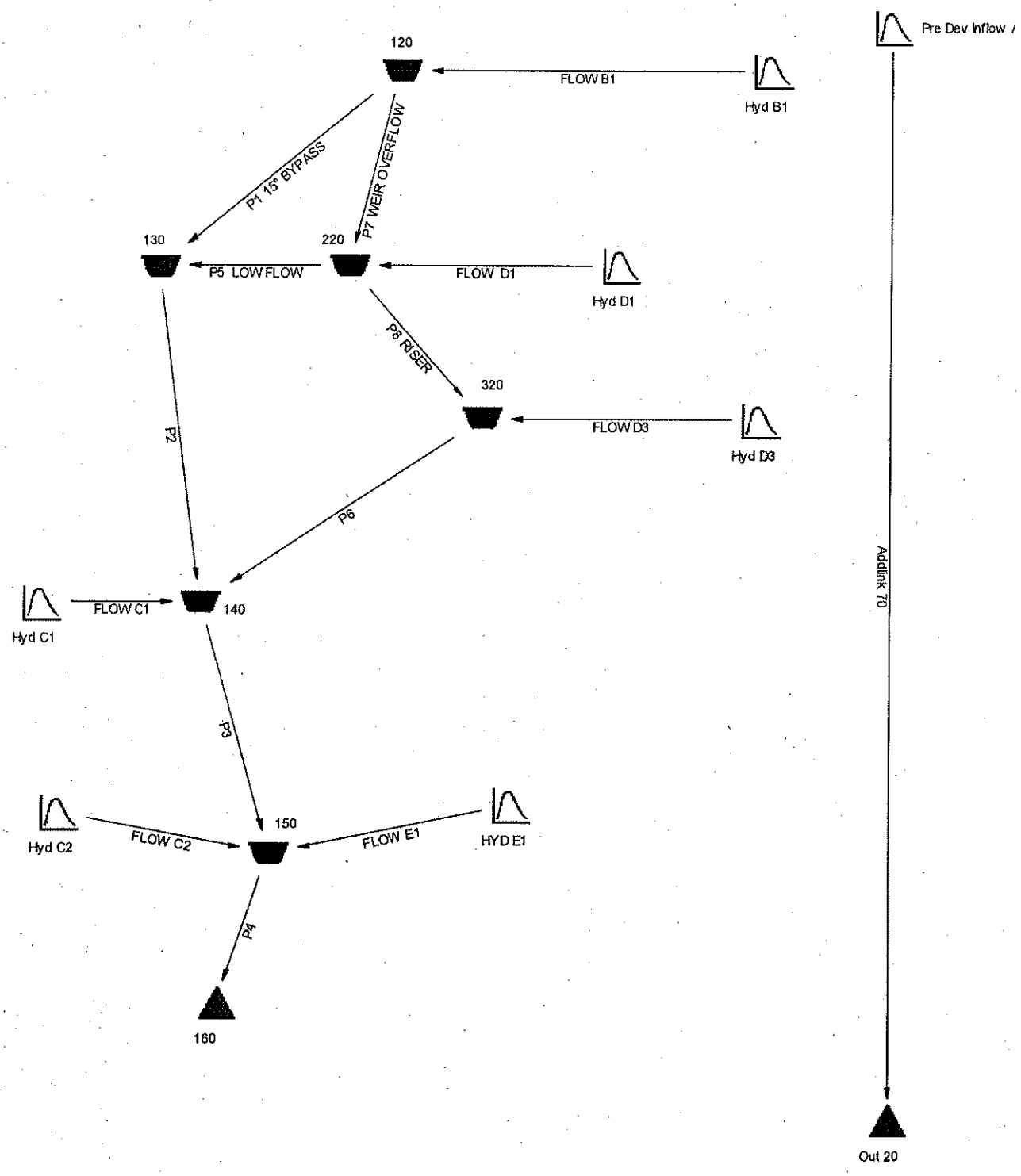
Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	22.165	9.62	4.751
2	17.980	7.56	5.550

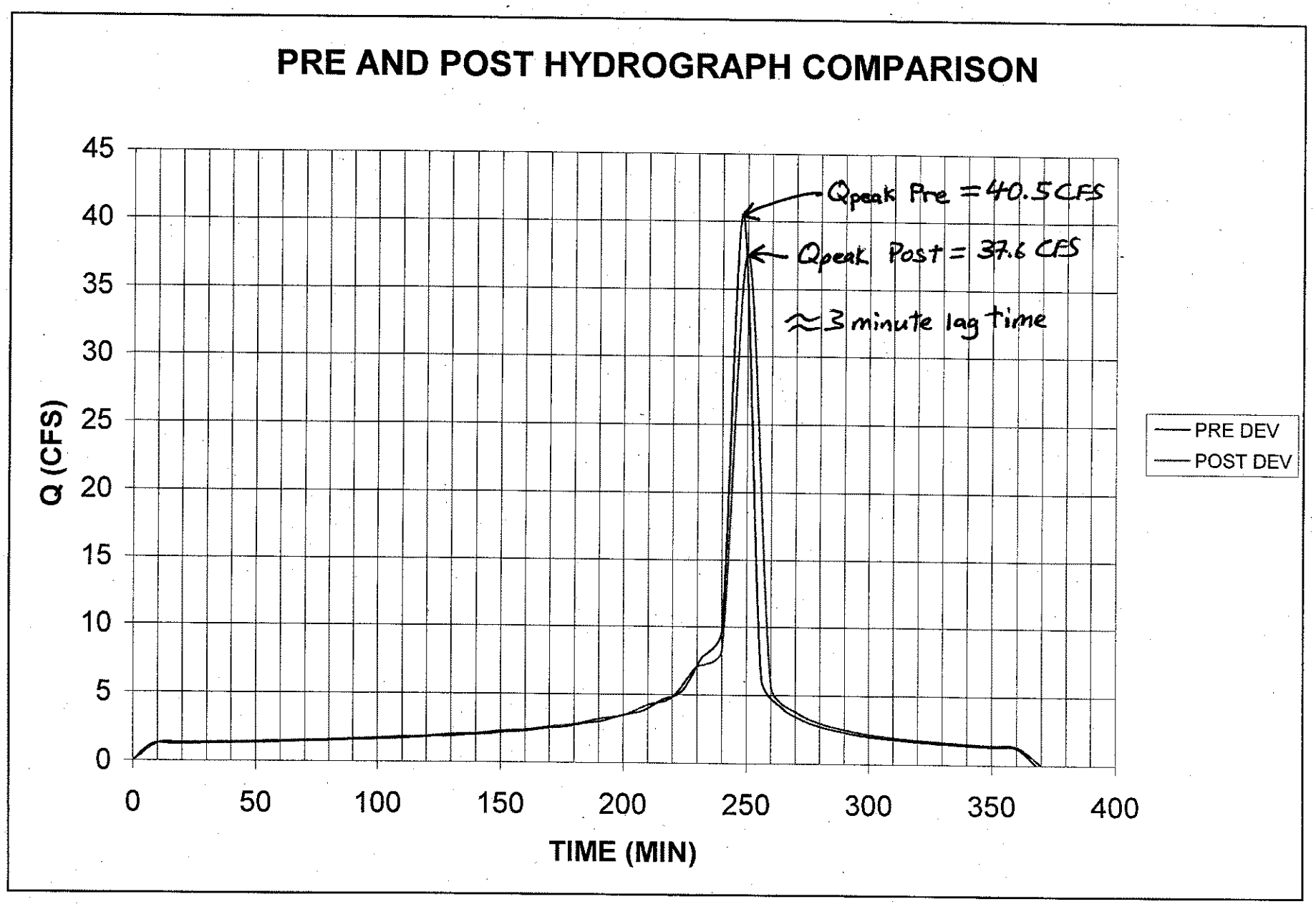
```
Qmax(1) =
          1.000 *    1.000 *    22.165) +
          0.856 *    1.000 *    17.980) + =      37.556
Qmax(2) =
          1.000 *    0.786 *    22.165) +
          1.000 *    1.000 *    17.980) + =      35.397
```

Total of 2 main streams to confluence:
Flow rates before confluence point:
22.165 17.980
Maximum flow rates at confluence using above data:
37.556 35.397
Area of streams before confluence:
7.890 5.680

Results of confluence:
Total flow rate = 37.556(CFS)
Time of concentration = 9.619 min.
Effective stream area after confluence = 13.570(Ac.)
End of computations, total study area = 13.570 (Ac.)

DETENTION CALCULATIONS


120
FLOW B1
Hyd B1
P1 15" BYPASS
P7 WEIR OVERFLOW
130
220
P5 LOW FLOW
FLOW D1
Hyd D1
P8 RISER
320
FLOW D3
Hyd D3
P2
P6
FLOW C1
140
Hyd C1
P3
150
Hyd C2
FLOW C2
FLOW E1
HYD E1
P4
160
Pre Dev Inflow /
Addlink 70
Out 20


PRE AND POST HYDROGRAPH COMPARISON
Q (CFS)
45
40
35
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
TIME (MIN)
Qpeak Pre = 40.5 CFS
Qpeak Post = 37.6 CFS
≈3 minute lag time
PRE DEV
POST DEV

PASEO ARBOLADO - HYDROGRAPH DATA
TM 5406 8-10-2007

RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 2001 RICK ENGINEERING COMPANY
RUN DATE 8/16/2007
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 7.77 MIN.
6 HOUR RAINFALL 2.75 INCHES
BASIN AREA 13.57 ACRES
RUNOFF COEFFICIENT 0.54
PEAK DISCHARGE 40.46 CFS

PRE DEVELOPMENT

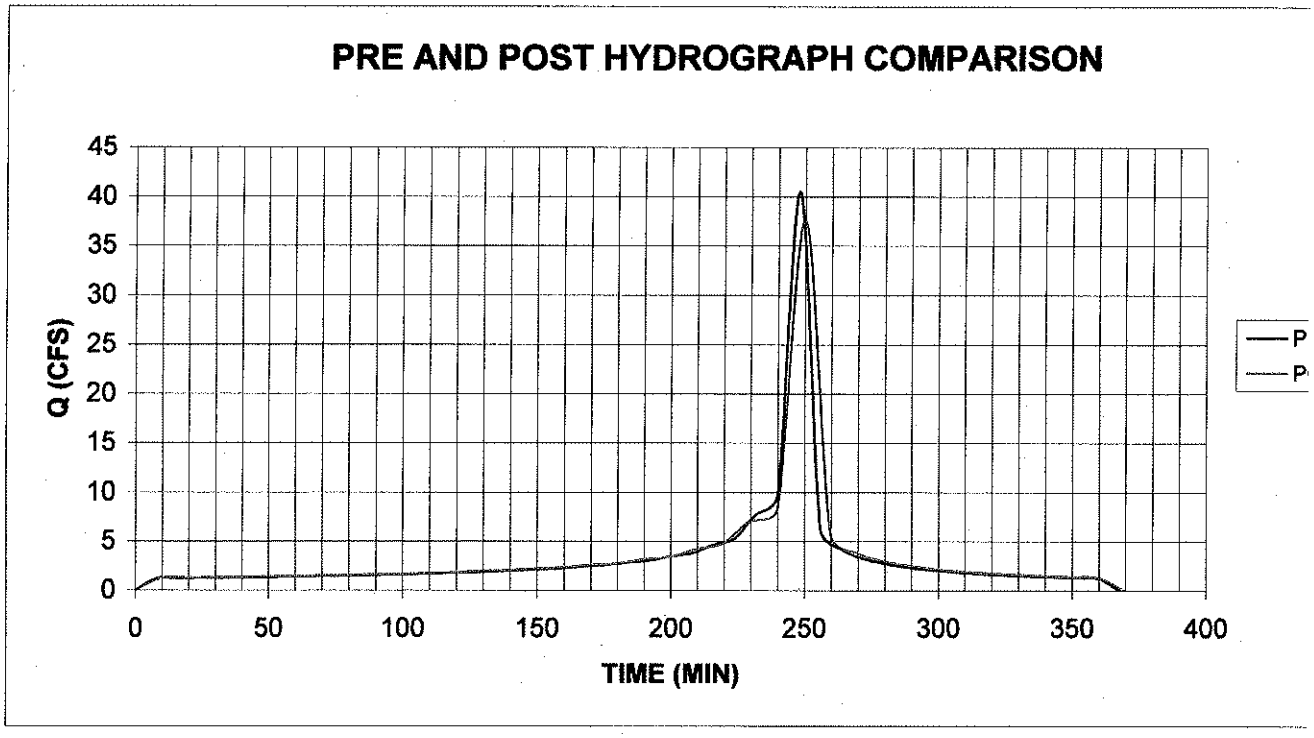
TIME (MIN)	Q_{100} (CFS)
0	0
8	1.2
16	1.22
24	1.26
32	1.28
40	1.32
48	1.34
56	1.39
64	1.42
72	1.47
80	1.5
88	1.57
96	1.6
104	1.68
112	1.72
120	1.82
128	1.87
136	1.98
144	2.05
152	2.2
160	2.28
168	2.48
176	2.6
184	2.88
192	3.06
200	3.5
208	3.8
216	4.64
224	5.29
232	7.76
240	9.69
248	40.46
256	6.23
264	4.17
272	3.26
280	2.73
288	2.38
296	2.12
304	1.92
312	1.77
320	1.64
328	1.54
336	1.45
344	1.37
352	1.3
360	1.24
368	0

RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 2001 RICK ENGINEERING COMPANY
RUN DATE 8/16/2007
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9.62 MIN.
6 HOUR RAINFALL 27.5 INCHES
BASIN AREA 13.57 ACRES
RUNOFF COEFFICIENT 0.57
PEAK DISCHARGE 37.56 CFS

POST DEVELOPMENT

TIME (MIN)	Q_{100} (CFS)
0	0
10	1.27
20	1.3
30	1.35
40	1.37
50	1.43
60	1.47
70	1.54
80	1.58
90	1.66
100	1.71
110	1.81
120	1.87
130	2.01
140	2.09
150	2.27
160	2.37
170	2.63
180	2.79
190	3.2
200	3.47
210	4.24
220	4.83
230	7.1
240	8.28
250	37.56
260	5.69
270	3.81
280	2.98
290	2.5
300	2.17
310	1.94
320	1.76
330	1.62
340	1.5
350	1.4
360	1.32
370	0

PASEO ARBOLADO - HYDROGRAPH DATA
TM 5406 8-10-2007



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130 OUT 100
Pond Routing Summary 10.78
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MASTER DESIGN STORM SUMMARY

Hydrograph Queue Only Network

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method
Hydrograph File Import Option Used For 7 node(s)

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak min	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
120	IN	POND	100	.482		245.00	12.31		
+120	OUT	POND	100	.482		245.00	11.68	230.79	.000
130	IN	POND	100	.617		246.00	11.53		
130	OUT	POND	100	.617		246.00	11.51	205.99	.001
140	IN	POND	100	.778		247.00	16.44		
140	OUT	POND	100	.783	L	247.00	16.42	191.20	.001
150	IN	POND	100	1.024	L	247.00	21.46		
150	OUT	POND	100	1.021	L	247.00	21.46	186.80	.000
*160		JCT	100	1.021	L	247.00	21.46		
220	IN	POND	100	.175		245.00	7.94		
+220	OUT	POND	100	.175		246.00	7.44	207.94	.001
320	IN	POND	100	.059		246.00	5.75		
320	OUT	POND	100	.059		248.00	3.01	196.47	.019
HYD B1		HYG	100	.482		245.00	12.31		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method
Hydrograph File Import Option Used For 7 node(s)

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak min	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
HYD C1	HYG	100	.101		245.00	2.76		
HYD C2	HYG	100	.056		245.00	1.76		
HYD D1	HYG	100	.163		245.00	5.22		
HYD D3	HYG	100	.031		246.00	.88		
HYD E1	HYG	100	.185		248.00	4.25		
*OUT 20	JCT	100	.982		245.00	24.58		
PRE DEV INFLOW A	HYG	100	.982		245.00	24.58		

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

	Node ID		Type	HYG Vol ac-ft	Trun.	Qpeak min	Qpeak cfs	Max WSEL ft
	120	IN	POND	.482		245.00	12.31	
Divert	120	OUT	POND	.482		245.00	11.68	230.79
	130	IN	POND	.617		246.00	11.53	
	130	OUT	POND	.617		246.00	11.51	205.99
	140	IN	POND	.778		247.00	16.44	
	140	OUT	POND	.783	L	247.00	16.42	191.20
	150	IN	POND	1.024	L	247.00	21.46	
	150	OUT	POND	1.021	L	247.00	21.46	186.80
Outfall	160		JCT	1.021	L	247.00	21.46	
	220	IN	POND	.175		245.00	7.94	
	220	OUT	POND	.175		246.00	7.44	207.94
	320	IN	POND	.059		246.00	5.75	
	320	OUT	POND	.059		248.00	3.01	196.47
	HYD B1		HYG	.482		245.00	12.31	
	HYD C1		HYG	.101		245.00	2.76	
	HYD C2		HYG	.056		245.00	1.76	
	HYD D1		HYG	.163		245.00	5.22	
	HYD D3		HYG	.031		246.00	.88	
	HYD E1		HYG	.185		248.00	4.25	
Outfall	OUT 20		JCT	.982		245.00	24.58	
	PRE DEV INFLOW A		HYG	.982		245.00	24.58	

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time min	Peak Q cfs	End Points	
ADDLINK 70	ADD	UN	.982		245.00	24.58	PRE DEV INFLOW A	
		DL	.982		245.00	24.58		
		DN	.982		245.00	24.58	OUT 20	
FLOW D1	ADD	UN	.163		245.00	5.22	HYD D1	
		DL	.163		245.00	5.22		
		DN	.175		245.00	7.94	220	IN
FLOW B1	ADD	UN	.482		245.00	12.31	HYD B1	
		DL	.482		245.00	12.31		
		DN	.482		245.00	12.31	120	IN
FLOW C1	ADD	UN	.101		245.00	2.76	HYD C1	
		DL	.101		245.00	2.76		
		DN	.778		247.00	16.44	140	IN
FLOW C2	ADD	UN	.056		245.00	1.76	HYD C2	
		DL	.056		245.00	1.76		
		DN	1.024	L	247.00	21.46	150	IN
FLOW D3	ADD	UN	.031		246.00	.88	HYD D3	
		DL	.031		246.00	.88		
		DN	.059		246.00	5.75	320	IN
FLOW E1	ADD	UN	.185		248.00	4.25	HYD E1	
		DL	.185		248.00	4.25		
		DN	1.024	L	247.00	21.46	150	IN
P1 15" BYPASS	PONDrt	UN	.482		245.00	12.31	120	IN
P1 15" BYPASS			.482		245.00	11.68	120	OUT
	DIVERT	DL	.471		245.00	8.97		
		DN	.617		246.00	11.53	130	IN
P2	PONDrt	UN	.617		246.00	11.53	130	IN
P2			.617		246.00	11.51	130	OUT
		DL	.617		246.00	11.51		
		DN	.778		247.00	16.44	140	IN

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time min	Peak Q cfs	End Points	
P3	PONDrt	UN	.778		247.00	16.44	140	IN
P3			.783	L	247.00	16.42	140	OUT
		DL	.783	L	247.00	16.42		
		DN	1.024	L	247.00	21.46	150	IN
P4	PONDrt	UN	1.024	L	247.00	21.46	150	IN
P4			1.021	L	247.00	21.46	150	OUT
		DL	1.021	L	247.00	21.46		
		DN	1.021	L	247.00	21.46	160	
P5 LOW FLOW	PONDrt	UN	.175		245.00	7.94	220	IN
P5 LOW FLOW			.175		246.00	7.44	220	OUT
	DIVERT	DL	.147		246.00	2.57		
		DN	.617		246.00	11.53	130	IN
P6	PONDrt	UN	.059		246.00	5.75	320	IN
P6			.059		248.00	3.01	320	OUT
		DL	.059		248.00	3.01		
		DN	.778		247.00	16.44	140	IN
P7 WEIR OVERFLOW	PONDrt	UN	.482		245.00	12.31	120	IN
P7 WEIR OVERFLOW			.482		245.00	11.68	120	OUT
	DIVERT	DL	.012		245.00	2.72		
		DN	.175		245.00	7.94	220	IN
P8 RISER	PONDrt	UN	.175		245.00	7.94	220	IN
P8 RISER			.175		246.00	7.44	220	OUT
	DIVERT	DL	.028		246.00	4.87		
		DN	.059		246.00	5.75	320	IN

HYG file =
HYG ID = Hyg B1
HYG Tag =

Peak Discharge	=	12.31 cfs
Time to Peak	=	245.00 min
HYG Volume	=	.482 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 7.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	.35	.35	.36	.37
35.00	.38	.39	.40	.40	.42
70.00	.42	.44	.45	.47	.47
105.00	.50	.51	.53	.54	.57
140.00	.59	.63	.65	.69	.72
175.00	.78	.82	.91	.96	1.11
210.00	1.20	1.47	1.67	2.45	3.53
245.00	12.31	1.97	1.32	1.03	.86
280.00	.75	.67	.61	.56	.52
315.00	.48	.46	.43	.41	.39
350.00	.37	.36	.00		

HYG file =
HYG ID = HYG C1
HYG Tag =

Peak Discharge	=	2.76 cfs
Time to Peak	=	245.00 min
HYG Volume	=	.101 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 7.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	.07	.07	.08	.08
35.00	.08	.08	.08	.08	.09
70.00	.09	.09	.09	.10	.10
105.00	.10	.11	.11	.11	.12
140.00	.12	.13	.14	.15	.15
175.00	.16	.17	.19	.20	.23
210.00	.25	.31	.35	.52	.57
245.00	2.76	.41	.28	.22	.18
280.00	.16	.14	.13	.12	.11
315.00	.10	.10	.09	.09	.08
350.00	.08	.08	.00		

HYG file =
HYG ID = HYD C2
HYG Tag =

Peak Discharge = 1.76 cfs
Time to Peak = 245.00 min
HYG Volume = .056 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 5.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	.04	.04	.04	.04
25.00	.04	.04	.04	.04	.05
50.00	.05	.05	.05	.05	.05
75.00	.05	.05	.05	.05	.05
100.00	.06	.06	.06	.06	.06
125.00	.06	.06	.07	.07	.07
150.00	.07	.08	.08	.08	.09
175.00	.09	.09	.10	.10	.11
200.00	.12	.13	.14	.16	.17
225.00	.21	.24	.35	.53	1.76
250.00	.28	.19	.15	.12	.11
275.00	.10	.09	.08	.07	.07
300.00	.07	.06	.06	.06	.05
325.00	.05	.05	.05	.05	.04
350.00	.04	.04	.04	.00	

HYG file =
HYG ID = Hyg D1
HYG Tag =

Peak Discharge = 5.22 cfs
Time to Peak = 245.00 min
HYG Volume = .163 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 5.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	.12	.12	.12	.12
25.00	.12	.13	.13	.13	.13
50.00	.13	.14	.14	.14	.14
75.00	.15	.15	.15	.16	.16
100.00	.16	.17	.17	.18	.18
125.00	.18	.19	.20	.20	.21
150.00	.21	.22	.23	.24	.25
175.00	.26	.27	.29	.30	.33
200.00	.34	.38	.41	.46	.50
225.00	.62	.70	1.03	1.43	5.22
250.00	.83	.55	.43	.36	.32
275.00	.28	.26	.23	.22	.20
300.00	.19	.18	.17	.16	.16
325.00	.15	.15	.14	.14	.13
350.00	.13	.12	.12	.00	

HYG file =
HYG ID = HYG D3
HYG Tag =

Peak Discharge	=	.88 cfs
Time to Peak	=	246.00 min
HYG Volume	=	.031 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 6.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	.02	.02	.02	.02
30.00	.02	.02	.03	.03	.03
60.00	.03	.03	.03	.03	.03
90.00	.03	.03	.03	.03	.03
120.00	.03	.04	.04	.04	.04
150.00	.04	.04	.04	.05	.05
180.00	.05	.06	.06	.06	.07
210.00	.08	.09	.10	.12	.17
240.00	.25	.88	.14	.09	.07
270.00	.06	.05	.05	.04	.04
300.00	.04	.03	.03	.03	.03
330.00	.03	.03	.03	.02	.02
360.00	.02	.00			

HYG file =
HYG ID = HYD E1
HYG Tag =

Peak Discharge =	4.25	cfs
Time to Peak =	248.00	min
HYG Volume =	.185	ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 8.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	.13	.14	.14	.14
40.00	.15	.15	.15	.16	.16
80.00	.17	.17	.18	.19	.19
120.00	.20	.21	.22	.23	.24
160.00	.25	.27	.29	.32	.34
200.00	.39	.42	.51	.59	.86
240.00	1.31	4.25	.69	.46	.36
280.00	.30	.26	.23	.21	.20
320.00	.18	.17	.16	.15	.14
360.00	.14	.00			

SUMMARY FOR HYDROGRAPH ADDITION
at Node: 160

HYG Directory: U:\1data\engineering\4357_R\HYDROLOGY\detention\

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
P4	150	IN	P4	100

INFLOWS TO: 160

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	P4	100	1.021	247.00	21.46

TOTAL FLOW INTO: 160

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time min	Peak Flow cfs
	160	100	1.021	247.00	21.46

TOTAL NODE INFLOW...
HYG file =
HYG ID = 160
HYG Tag = 100

Peak Discharge	=	21.46 cfs
Time to Peak	=	247.00 min
HYG Volume	=	1.021 ac-ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	3.25	.03	.11	.21	.32
5.00	.44	.53	.62	.69	.72
10.00	.73	.73	.73	.73	.74
15.00	.74	.74	.74	.75	.75
20.00	.75	.76	.76	.76	.76
25.00	.76	.77	.77	.77	.77
30.00	.78	.78	.78	.79	.79
35.00	.79	.79	.80	.80	.80
40.00	.81	.81	.82	.82	.82
45.00	.83	.83	.83	.83	.84
50.00	.84	.84	.84	.84	.84
55.00	.85	.85	.85	.86	.86
60.00	.87	.87	.88	.88	.89
65.00	.89	.89	.89	.89	.89
70.00	.89	.89	.89	.90	.90
75.00	.91	.92	.92	.93	.93
80.00	.93	.93	.93	.94	.94
85.00	.94	.94	.95	.96	.96
90.00	.97	.98	.98	.99	.99
95.00	.99	.99	1.00	1.00	1.00
100.00	1.01	1.01	1.02	1.03	1.03
105.00	1.04	1.05	1.05	1.06	1.06
110.00	1.06	1.06	1.07	1.07	1.08
115.00	1.09	1.09	1.10	1.10	1.10
120.00	1.11	1.11	1.12	1.12	1.12
125.00	1.13	1.13	1.14	1.14	1.15
130.00	1.16	1.17	1.19	1.20	1.21
135.00	1.22	1.22	1.23	1.23	1.24
140.00	1.24	1.25	1.25	1.26	1.27
145.00	1.28	1.29	1.30	1.31	1.32
150.00	1.33	1.33	1.34	1.35	1.36

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
155.00	1.37	1.38	1.39	1.40	1.41
160.00	1.42	1.43	1.44	1.45	1.46
165.00	1.47	1.48	1.49	1.51	1.52
170.00	1.53	1.55	1.56	1.58	1.59
175.00	1.61	1.62	1.64	1.65	1.66
180.00	1.68	1.69	1.71	1.73	1.75
185.00	1.78	1.80	1.82	1.84	1.86
190.00	1.88	1.90	1.92	1.94	1.97
195.00	1.99	2.01	2.04	2.06	2.10
200.00	2.14	2.17	2.21	2.25	2.29
205.00	2.32	2.35	2.38	2.41	2.45
210.00	2.48	2.53	2.59	2.66	2.73
215.00	2.81	2.88	2.95	3.02	3.08
220.00	3.13	3.20	3.27	3.34	3.42
225.00	3.54	3.70	3.89	4.09	4.28
230.00	4.48	4.69	4.93	5.21	5.52
235.00	5.83	6.16	6.50	6.84	7.47
240.00	8.65	10.80	13.24	15.75	18.05
245.00	20.06	21.07	21.46	21.19	19.15
250.00	16.19	13.12	10.15	7.74	6.15
255.00	5.14	4.35	4.02	3.73	3.47
260.00	3.23	3.04	2.88	2.74	2.60
265.00	2.50	2.40	2.31	2.23	2.16
270.00	2.10	2.04	1.98	1.93	1.87
275.00	1.83	1.79	1.75	1.72	1.68
280.00	1.65	1.62	1.59	1.56	1.53
285.00	1.50	1.47	1.45	1.42	1.40
290.00	1.38	1.37	1.35	1.33	1.31
295.00	1.30	1.28	1.26	1.25	1.24
300.00	1.22	1.21	1.19	1.18	1.16
305.00	1.15	1.14	1.13	1.12	1.10
310.00	1.09	1.08	1.07	1.06	1.05
315.00	1.04	1.02	1.01	1.01	1.00
320.00	.99	.99	.98	.97	.97
325.00	.96	.95	.94	.93	.93
330.00	.92	.91	.91	.90	.90
335.00	.89	.89	.88	.87	.87
340.00	.86	.86	.85	.84	.83
345.00	.82	.81	.81	.80	.80
350.00	.79	.79	.78	.78	.77
355.00	.77	.77	.76	.75	.71
360.00	.65	.56	.46	.35	.23
365.00	.13	.06	.03	.01	.01
370.00	.01	.00	.00	.00	.00

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 227.90 ft
Increment = .02 ft
Max. Elev.= 231.50 ft

```
*********************************************
                OUTLET CONNECTIVITY
*********************************************

 ---> Forward Flow Only (UpStream to DnStream)
<---  Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed
```

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	C0	--->	TW	227.900	231.500
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =         1
Barrel Diameter    =    1.2500 ft
Upstream Invert    =    227.90 ft
Dnstream Invert    =    204.00 ft
Horiz. Length      =    210.00 ft
Barrel Length      =    211.36 ft
Barrel Slope       =    .11381 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0150
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .030922  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0098
Inlet Control M    =    2.0000
Inlet Control c    =    .03980
Inlet Control Y    =     .6700
T1 ratio (HW/D)    =     1.103
T2 ratio (HW/D)    =     1.250
Slope Factor       =     -.500
Calc inlet only    = Yes
```

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev = 229.28 ft ---> Flow = 4.80 cfs
At T2 Elev = 229.46 ft ---> Flow = 5.49 cfs

OUTLET STRUCTURE INPUT DATA

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 204.00 ft
Increment = .01 ft
Max. Elev.= 210.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular TW SETUP, DS Channel	C0	--->	TW	204.000	210.000

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =        1
Barrel Diameter    =   2.0000 ft
Upstream Invert    =   204.00 ft
Dnstream Invert    =   190.00 ft
Horiz. Length      =   104.88 ft
Barrel Length      =   105.81 ft
Barrel Slope       =   .13349 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0130
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .012411  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =        1
Inlet Control K    =     .0098
Inlet Control M    =    2.0000
Inlet Control c    =    .03980
Inlet Control Y    =     .6700
T1 ratio (HW/D)    =     1.093
T2 ratio (HW/D)    =     1.240
Slope Factor       =     -.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =    206.19 ft  --->  Flow =     15.55 cfs
At T2 Elev =    206.48 ft  --->  Flow =     17.77 cfs
```

OUTLET STRUCTURE INPUT DATA

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 189.00 ft
Increment = .01 ft
Max. Elev.= 195.50 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	C0	--->	TW	189.000	195.500
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =         1
Barrel Diameter    =    2.5000 ft
Upstream Invert    =    189.00 ft
Dnstream Invert    =    184.00 ft
Horiz. Length      =     49.09 ft
Barrel Length      =     49.34 ft
Barrel Slope       =    .10185 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0130
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .009217  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0098
Inlet Control M    =    2.0000
Inlet Control c    =    .03980
Inlet Control Y    =     .6700
T1 ratio (HW/D)    =     1.109
T2 ratio (HW/D)    =     1.256
Slope Factor       =     -.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =    191.77 ft  --->  Flow =     27.16 cfs
At T2 Elev =    192.14 ft  --->  Flow =     31.05 cfs
```

OUTLET STRUCTURE INPUT DATA

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 196.00 ft
Increment = 1.00 ft
Max. Elev.= 196.50 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	C0	--->	TW	183.500	196.500
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =         1
Barrel Diameter    =    2.5000 ft
Upstream Invert    =    183.50 ft
Dnstream Invert    =    182.00 ft
Horiz. Length      =     24.00 ft
Barrel Length      =     24.05 ft
Barrel Slope       =    .06250 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0130
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .009217  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0098
Inlet Control M    =    2.0000
Inlet Control c    =    .03980
Inlet Control Y    =     .6700
T1 ratio (HW/D)    =     1.129
T2 ratio (HW/D)    =     1.276
Slope Factor       =     -.500
```

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev = 186.32 ft ---> Flow = 27.16 cfs
At T2 Elev = 186.69 ft ---> Flow = 31.05 cfs

OUTLET STRUCTURE INPUT DATA

```
Structure ID      = TW
Structure Type    = TW SETUP, DS Channel
-------------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    30
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .10 cfs
Max.  Q tolerance =    .10 cfs
```

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 196.00 ft
Increment = 1.00 ft
Max. Elev.= 196.50 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	C0	--->	TW	183.500	196.500
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =         1
Barrel Diameter    =    2.5000 ft
Upstream Invert    =    183.50 ft
Dnstream Invert    =    182.00 ft
Horiz. Length      =     24.00 ft
Barrel Length      =     24.05 ft
Barrel Slope       =    .06250 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0130
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .009217  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0098
Inlet Control M    =    2.0000
Inlet Control c    =    .03980
Inlet Control Y    =     .6700
T1 ratio (HW/D)    =     1.129
T2 ratio (HW/D)    =     1.276
Slope Factor       =     -.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =    186.32 ft  --->  Flow =     27.16 cfs
At T2 Elev =    186.69 ft  --->  Flow =     31.05 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID      = TW
Structure Type    = TW SETUP, DS Channel
-----------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    30
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .10 cfs
Max.  Q tolerance =    .10 cfs
```

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 206.50 ft
Increment = .02 ft
Max. Elev.= 211.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	C0	--->	TW	206.500	211.000
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =        1
Barrel Diameter    =    .8300 ft
Upstream Invert    =   206.50 ft
Dnstream Invert    =   204.00 ft
Horiz. Length      =    93.00 ft
Barrel Length      =    93.03 ft
Barrel Slope       =   .02688 ft/ft

OUTLET CONTROL DATA...
Mannings n         =    .0110
Ke                 =    .5000  (forward entrance loss)
Kb                 =  .028706  (per ft of full flow)
Kr                 =    .5000  (reverse entrance loss)
HW Convergence     =     .001  +/- ft

INLET CONTROL DATA...
Equation form      =        1
Inlet Control K    =    .0098
Inlet Control M    =   2.0000
Inlet Control c    =   .03980
Inlet Control Y    =    .6700
T1 ratio (HW/D)    =    1.147
T2 ratio (HW/D)    =    1.293
Slope Factor       =    -.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =    207.45 ft  --->  Flow =      1.73 cfs
At T2 Elev =    207.57 ft  --->  Flow =      1.97 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID      = TW
Structure Type    = TW SETUP, DS Channel
-----------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    40
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .00 cfs
Max.  Q tolerance =    .00 cfs
```

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 196.00 ft
Increment = 1.00 ft
Max. Elev.= 196.50 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
User Defined Table	U0	--->	TW	.000	196.500
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

Structure ID = U0
Structure Type = User Defined Table

ELEV-FLOW RATING TABLE

Elev, ft	Flow, cfs
196.00	.00
196.10	.28
196.20	.80
196.30	1.48
196.40	2.28
196.50	3.18

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 227.90 ft
Increment = .01 ft
Max. Elev.= 231.50 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Weir-Rectangular	W0	--->	TW	230.700	231.500
TW SETUP, DS Channel					

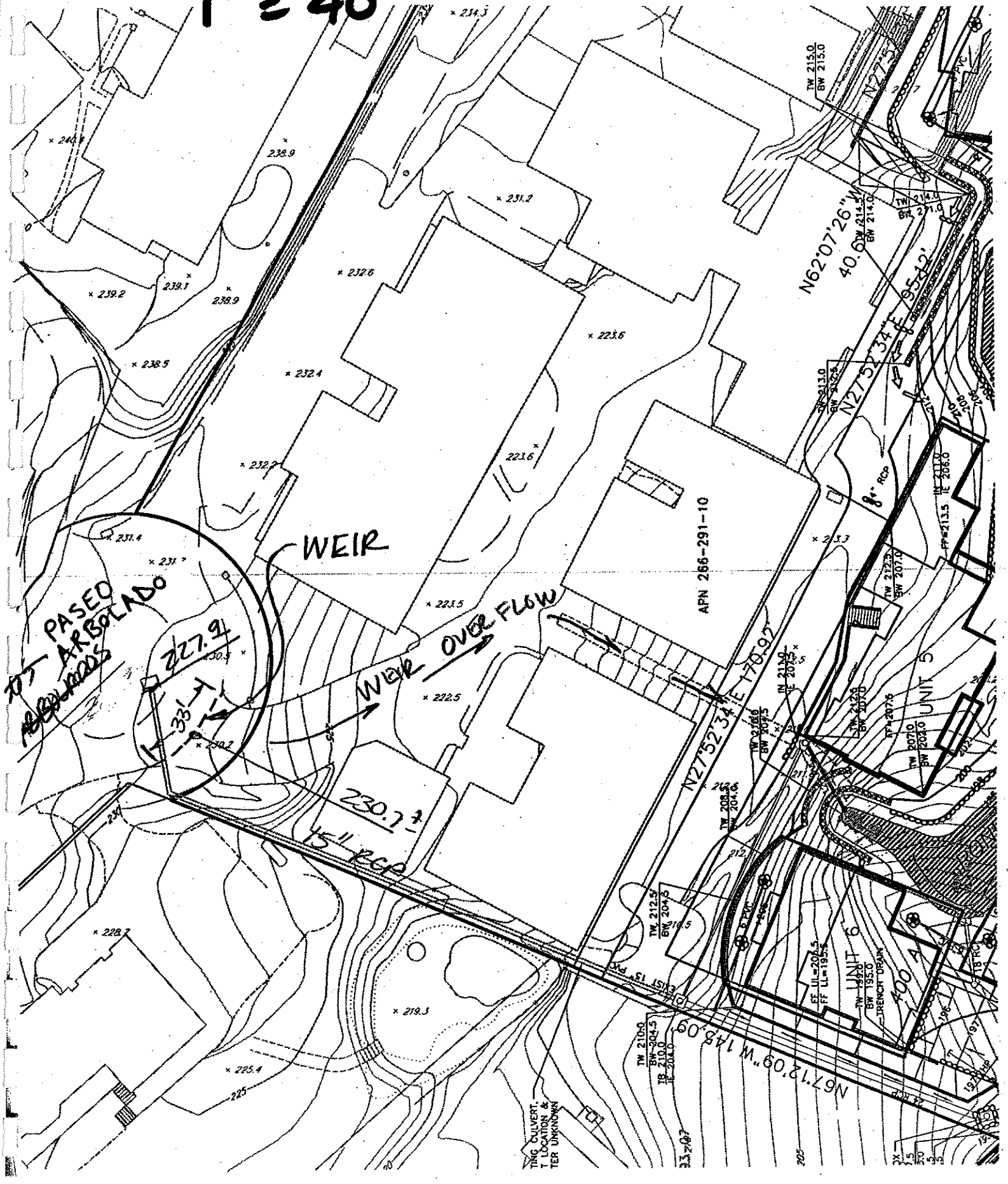
OUTLET STRUCTURE INPUT DATA

```
Structure ID       = W0
Structure Type     = Weir-Rectangular
-----------------------------------
# of Openings      =         1
Crest Elev.        =    230.70 ft
Weir Length        =     33.00 ft
Weir Coeff.        =  3.000000

Weir TW effects      (Use adjustment equation)
```

```
Structure ID       = TW
Structure Type     = TW SETUP, DS Channel
-----------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    30
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .10 cfs
Max.  Q tolerance =    .10 cfs
```

WEIR LOCATION

1" = 40'



REQUESTED POND WS ELEVATIONS:

Min. Elev.= 206.50 ft
Increment = .01 ft
Max. Elev.= 211.00 ft

```
*********************************************
                OUTLET CONNECTIVITY
*********************************************

 ---> Forward Flow Only (UpStream to DnStream)
<---  Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed
```

Structure	No.		Outfall	E1, ft	E2, ft
Stand Pipe	R0	--->	TW	207.300	211.000
TW SETUP, DS Channel					

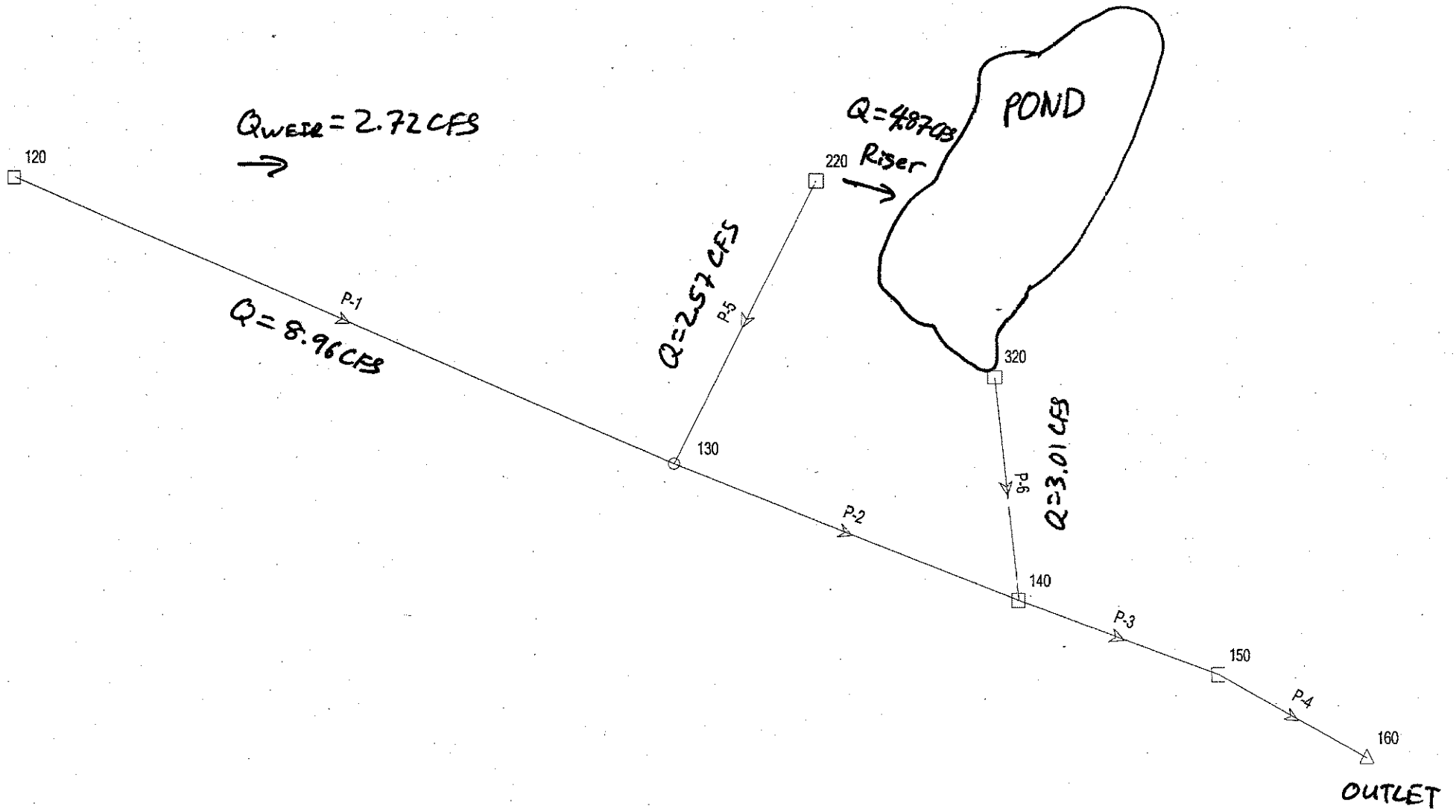
OUTLET STRUCTURE INPUT DATA

```
Structure ID       = R0
Structure Type     = Stand Pipe
------------------------------------
# of Openings      =         1
Invert Elev.       =    207.30 ft
Diameter           =    1.0000 ft
Orifice Area       =     .7854 sq.ft
Orifice Coeff.     =     5.370
Weir Length        =      3.14 ft
Weir Coeff.        =     3.000
K, Reverse         =     1.000
Mannings n         =     .0000
Kev,Charged Riser  =      .000
Weir Submergence   = No
Orifice H to crest= Yes
```

```
Structure ID       = TW
Structure Type     = TW SETUP, DS Channel
------------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    30
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .10 cfs
Max.  Q tolerance =    .10 cfs
```

HYDRAULIC CALCULATIONS

Scenario: Base



Scenario: Base

Node Report

Label	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
120	0.00	0.00	0.00	8.96	0.00	8.96	231.50	231.50	229.50	229.05	
130	0.21	0.00	0.00			11.53	210.00	210.00	205.63	205.22	
140	0.31	0.00	0.00	2.76	14.54	17.30	194.80	194.80	191.75	191.41	
150	0.35	0.00	0.00	6.01	17.30	23.31	195.00	195.00	186.22	185.64	
160	0.45	0.00	0.00			23.31	186.00	186.00	183.50	183.50	
220	0.00	0.00	0.00	2.57	0.00	2.57	211.00	211.00	207.42	207.21	
320	0.00	0.00	0.00	3.01	0.00	3.01	196.00	196.00	194.71	194.61	

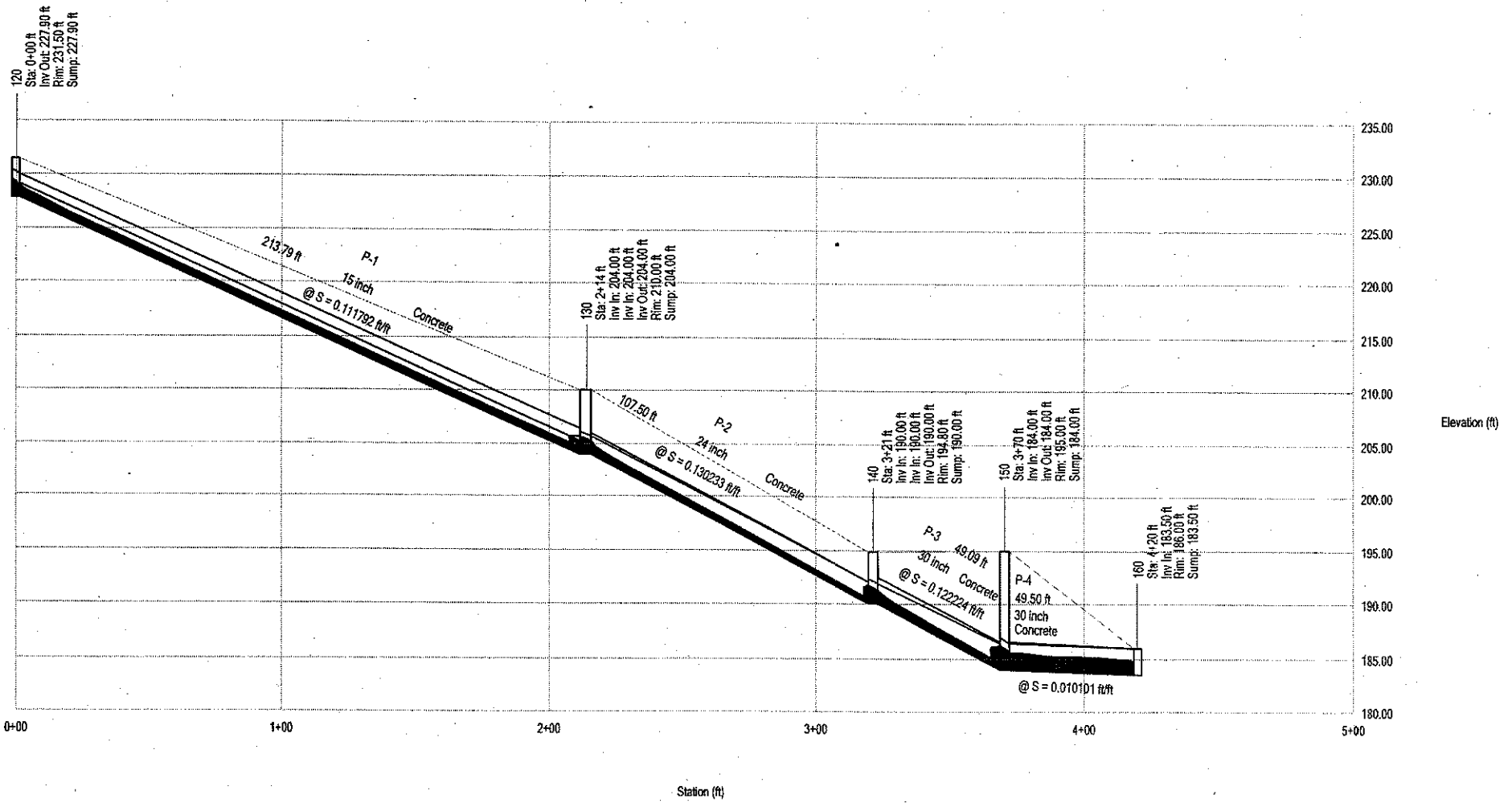
Scenario: Base

Pipe Report

Label	Upstream Node	Down-stream Node	Total System Flow (cfs)	Length (ft)	Slope (ft/ft)	Section Size	Mannings n	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Velocity Out (ft/s)	Description
P-1	120	130	8.96	213.79	0.111792	15 inch	0.013	227.90	204.00	231.50	210.00	229.05	205.63	7.30	
P-5	220	130	2.57	88.19	0.028348	10 inch	0.011	206.50	204.00	211.00	210.00	207.21	205.63	4.71	
P-2	130	140	11.53	107.50	0.130233	24 inch	0.013	204.00	190.00	210.00	194.80	205.22	191.75	3.95	
P-6	320	140	3.01	62.55	0.063949	24 inch	0.010	194.00	190.00	196.00	194.80	194.61	191.75	1.03	
P-3	140	150	17.30	49.09	0.122224	30 inch	0.013	190.00	184.00	194.80	195.00	191.41	186.22	3.75	
P-4	150	160	23.31	49.50	0.010101	30 inch	0.013	184.00	183.50	195.00	186.00	185.64	184.89	8.33	

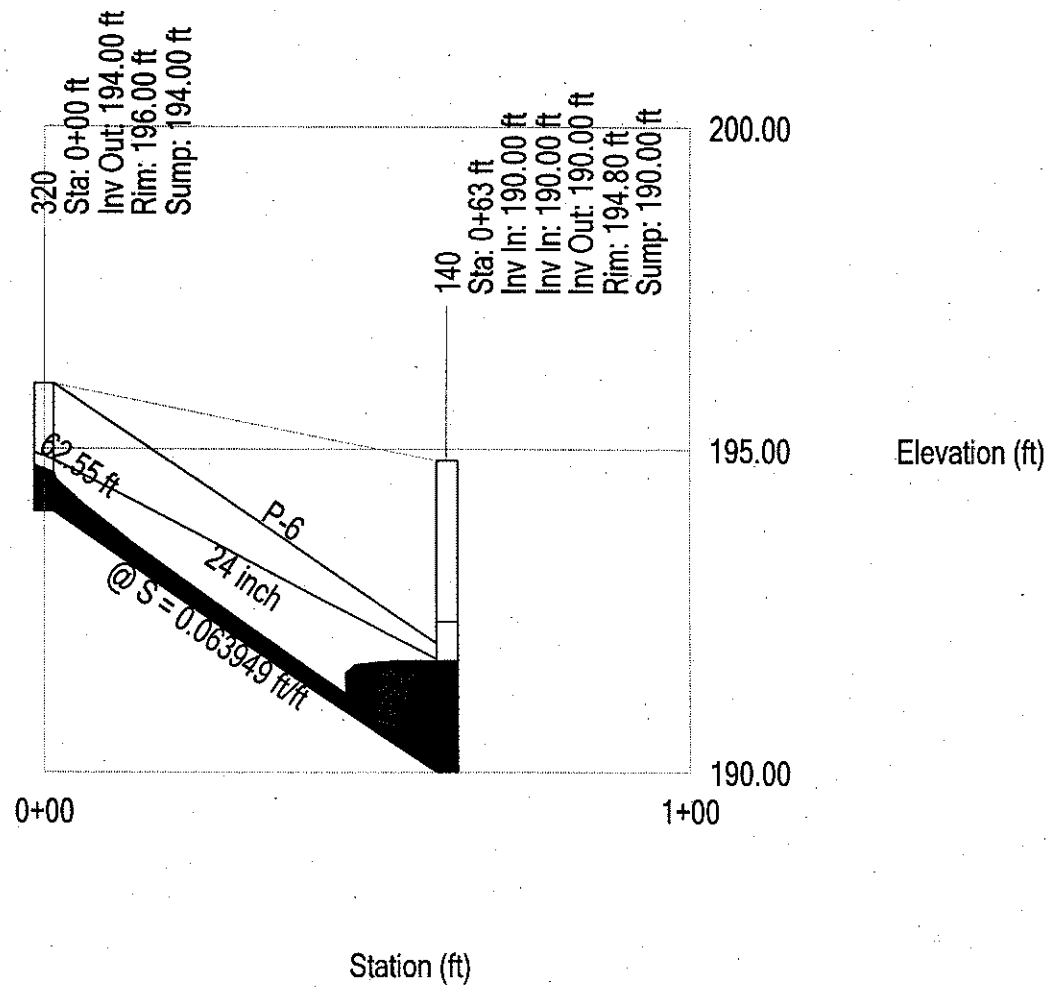
Profile
Scenario: Base

NODE 120 - NODE 160



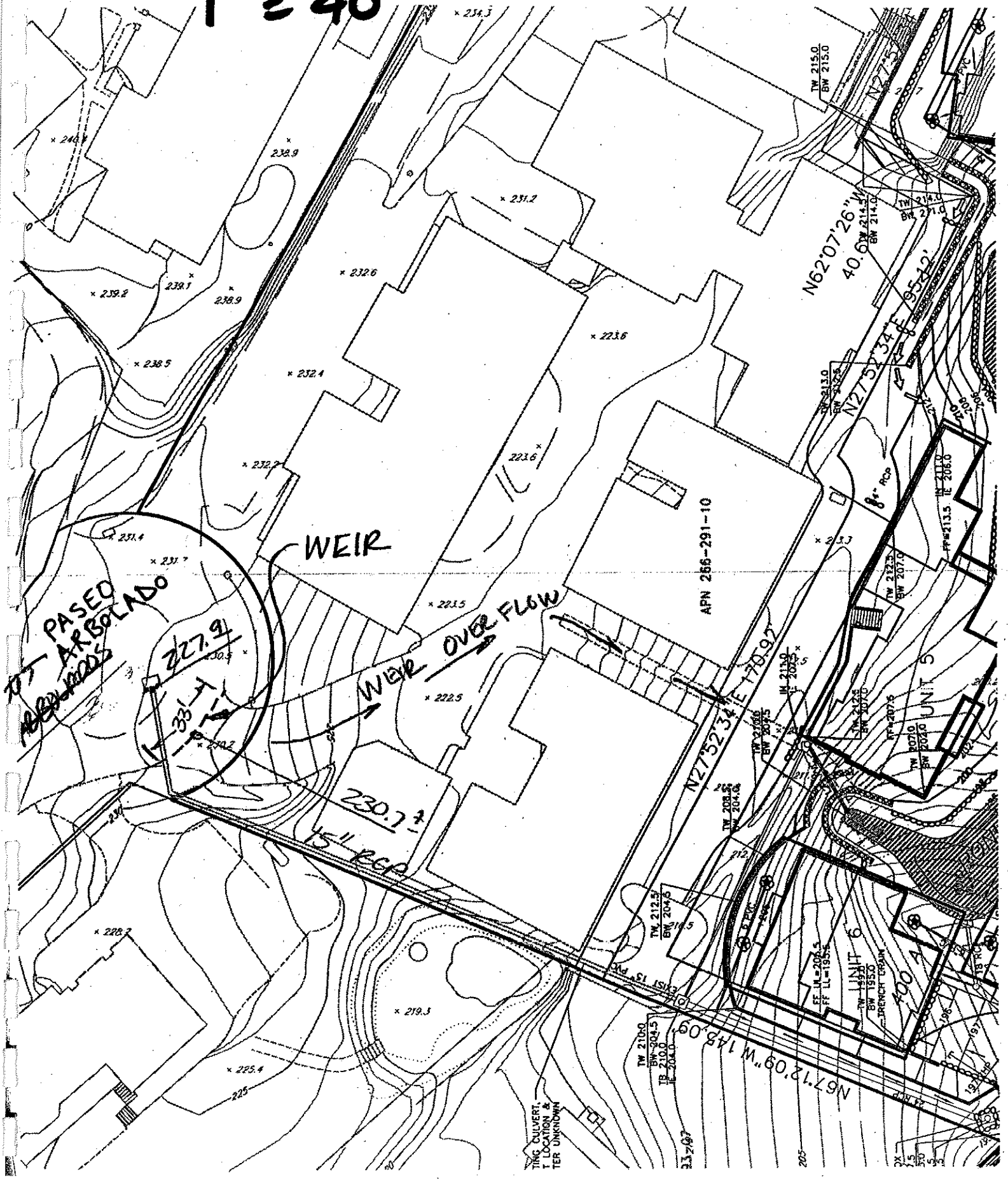
Profile
Scenario: Base

NODE 320 - NODE 140



WEIR LOCATION

1" = 40'



REQUESTED POND WS ELEVATIONS:

Min. Elev.= 206.50 ft
Increment = .01 ft
Max. Elev.= 211.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Stand Pipe TW SETUP, DS Channel	R0	--->	TW	207.300	211.000

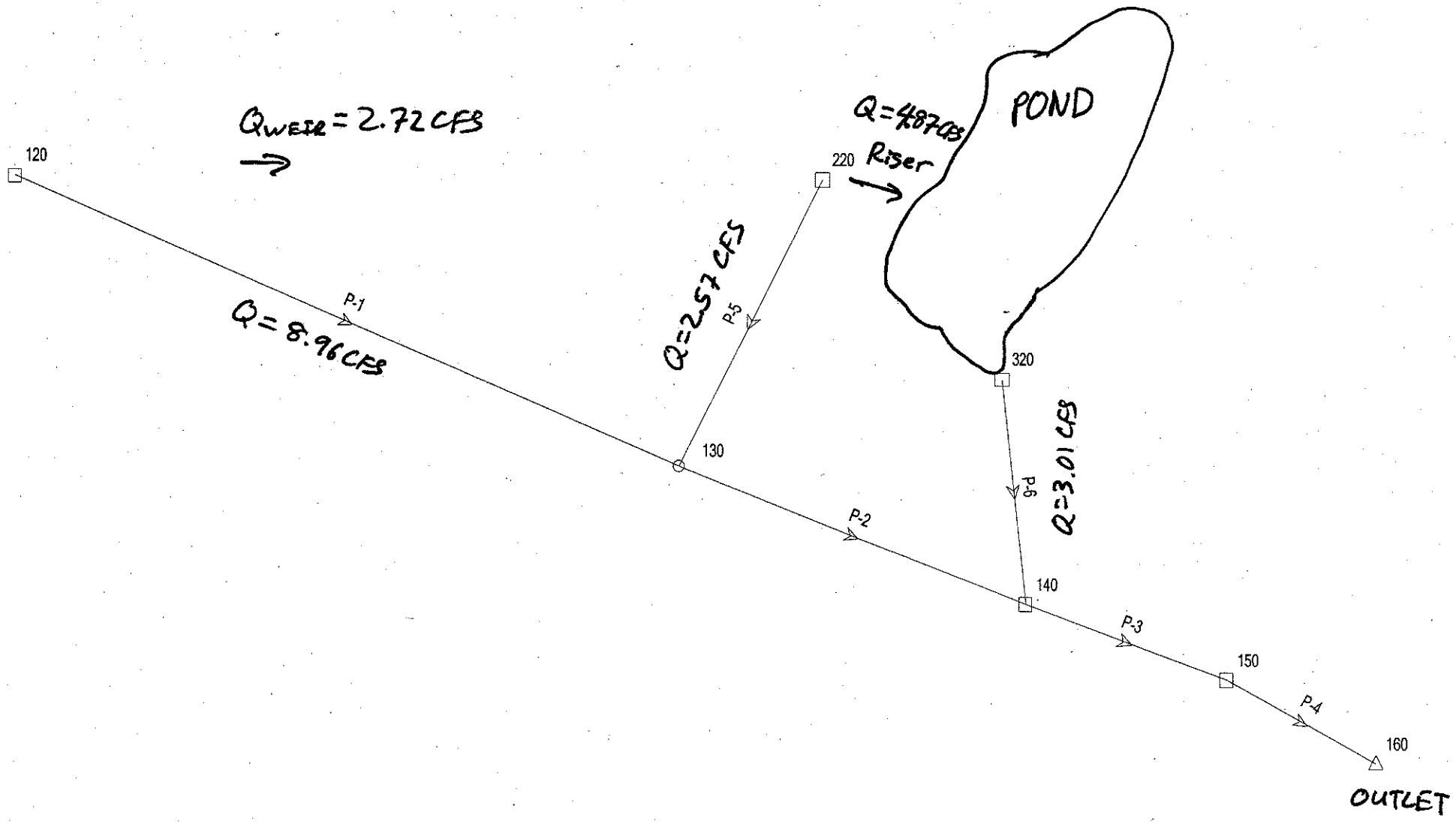
OUTLET STRUCTURE INPUT DATA

```
Structure ID       = R0
Structure Type     = Stand Pipe
-----------------------------------
# of Openings      =         1
Invert Elev.       =    207.30 ft
Diameter           =    1.0000 ft
Orifice Area       =     .7854 sq.ft
Orifice Coeff.     =     5.370
Weir Length        =      3.14 ft
Weir Coeff.        =     3.000
K, Reverse         =     1.000
Mannings n         =     .0000
Kev,Charged Riser  =      .000
Weir Submergence   = No
Orifice H to crest= Yes
```

```
Structure ID       = TW
Structure Type     = TW SETUP, DS Channel
-----------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    30
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .10 cfs
Max.  Q tolerance =    .10 cfs
```

HYDRAULIC CALCULATIONS

Scenario: Base



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Scenario: Base

Node Report

Label	System Flow Time (min)	System Intensity (in/hr)	System Rational Flow (cfs)	Additional Flow (cfs)	Upstream Additional Flow (cfs)	Total System Flow (cfs)	Ground Elevation (ft)	Rim Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
120	0.00	0.00	0.00	8.96	0.00	8.96	231.50	231.50	229.50	229.05	
130	0.21	0.00	0.00			11.53	210.00	210.00	205.63	205.22	
140	0.31	0.00	0.00	2.76	14.54	17.30	194.80	194.80	191.75	191.41	
150	0.35	0.00	0.00	6.01	17.30	23.31	195.00	195.00	186.22	185.64	
160	0.45	0.00	0.00			23.31	186.00	186.00	183.50	183.50	
220	0.00	0.00	0.00	2.57	0.00	2.57	211.00	211.00	207.42	207.21	
320	0.00	0.00	0.00	3.01	0.00	3.01	196.00	196.00	194.71	194.61	

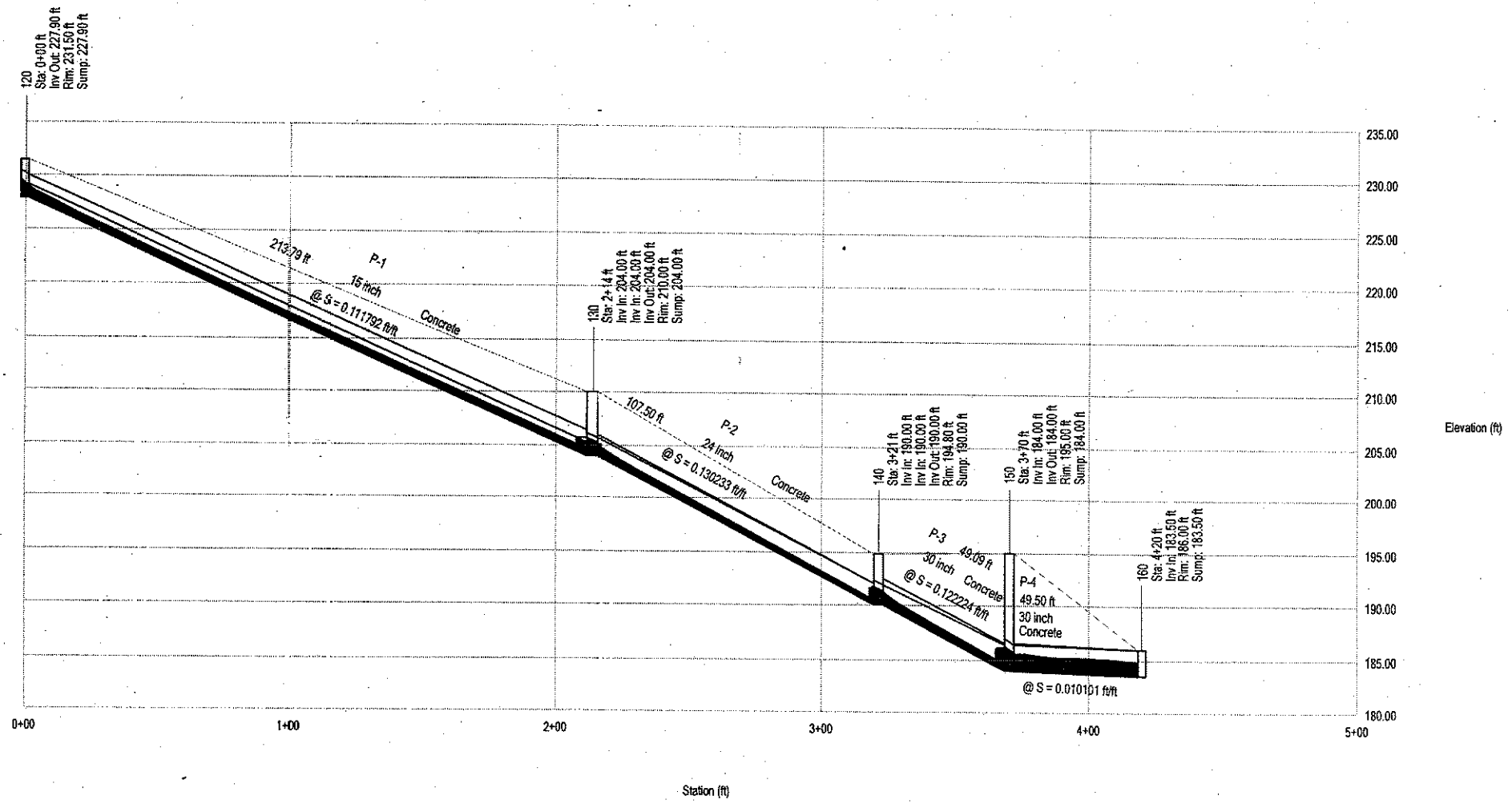
Scenario: Base

Pipe Report

Label	Upstream Node	Down-stream Node	Total System Flow (cfs)	Length (ft)	Slope (ft/ft)	Section Size	Mannings n	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Velocity Out (ft/s)	Description
P-1	120	130	8.96	213.79	0.111792	15 inch	0.013	227.90	204.00	231.50	210.00	229.05	205.63	7.30	
P-5	220	130	2.57	88.19	0.028348	10 inch	0.011	206.50	204.00	211.00	210.00	207.21	205.63	4.71	
P-2	130	140	11.53	107.50	0.130233	24 inch	0.013	204.00	190.00	210.00	194.80	205.22	191.75	3.95	
P-6	320	140	3.01	62.55	0.063949	24 inch	0.010	194.00	190.00	196.00	194.80	194.61	191.75	1.03	
P-3	140	150	17.30	49.09	0.122224	30 inch	0.013	190.00	184.00	194.80	195.00	191.41	186.22	3.75	
P-4	150	160	23.31	49.50	0.010101	30 inch	0.013	184.00	183.50	195.00	186.00	185.64	184.89	8.33	

Profile
Scenario: Base

NODE 120 - NODE 160



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SDE
Haestad Methods Solution Center Watertown, CT 06795 USA +1-203-755-1666

Project Engineer: B L Munson
StormCAD v5.6 [05.06.005.00]

TOTAL POND OUTFLOW CURVE FOR MULTIPLE OUTFALLS

Contributing Outfalls:
Outfall 1: P5 LOW FLOW 100 (P5 LOW FLOW)
Outfall 2: P8 RISER 100 (P8 Riser)

POND HW Elev, ft	OUTFALL 1 Flow, cfs	OUTFALL 2 Flow, cfs	TOTAL Flow, cfs
207.88	2.48	4.16	6.64
207.89	2.49	4.27	6.76
207.90	2.51	4.38	6.89
207.91	2.52	4.49	7.01
207.92	2.54	4.60	7.14
207.93	2.55	4.71	7.26
207.94	2.57	4.83	7.39
207.95	2.58	4.94	7.52
207.96	2.59	5.05	7.65
207.97	2.61	5.17	7.78
207.98	2.62	5.28	7.91
207.99	2.64	5.40	8.04
208.00	2.65	5.52	8.17
208.01	2.66	5.64	8.30
208.02	2.68	5.76	8.44
208.03	2.69	5.88	8.57
208.04	2.71	6.00	8.71
208.05	2.72	6.12	8.84
208.06	2.73	6.24	8.98
208.07	2.75	6.37	9.11
208.08	2.76	6.49	9.25
208.09	2.77	6.62	9.39
208.10	2.79	6.74	9.53
208.11	2.80	6.87	9.67
208.12	2.81	7.00	9.81
208.13	2.82	7.13	9.95
208.14	2.84	7.26	10.09
208.15	2.85	7.39	10.24
208.16	2.86	7.52	10.38
208.17	2.88	7.65	10.52
208.18	2.89	7.78	10.67
208.19	2.90	7.91	10.82
208.20	2.91	8.05	10.96
208.21	2.93	8.18	11.11
208.22	2.94	8.32	11.26
208.23	2.95	8.45	11.41
208.24	2.97	8.59	11.55
208.25	2.98	8.73	11.70
208.26	2.99	8.86	11.85
208.27	3.00	9.00	12.00
208.28	3.01	9.14	12.16
208.29	3.03	9.28	12.31
208.30	3.04	9.42	12.46
208.31	3.05	9.57	12.62
208.32	3.06	9.71	12.77
208.33	3.07	9.85	12.93

$Q_{OUT} = 7.44$ CFS

$\Rightarrow Q_{P5} = 2.57$ CFS

$Q_{P8} = 4.87$ CFS

PASEO ARBOLADO
CURB INLET CALCULATIONS
TM 5406 8-10-2007

BASIN	Q_{100} (CFS)	L_W (FEET)	d (FEET)
I_2 (220) = D_1+B_1 BYPASS	7.44	11	0.49
I_3 (320) = D_3+D_1 BYPASS	3.01	9	0.5
I_5 (150) = C2+E_1	6.01	7	0.49

Headwater depth overtops road at existing 12" CMP Culvert Crossing Via De La Valle

Figure 4-3

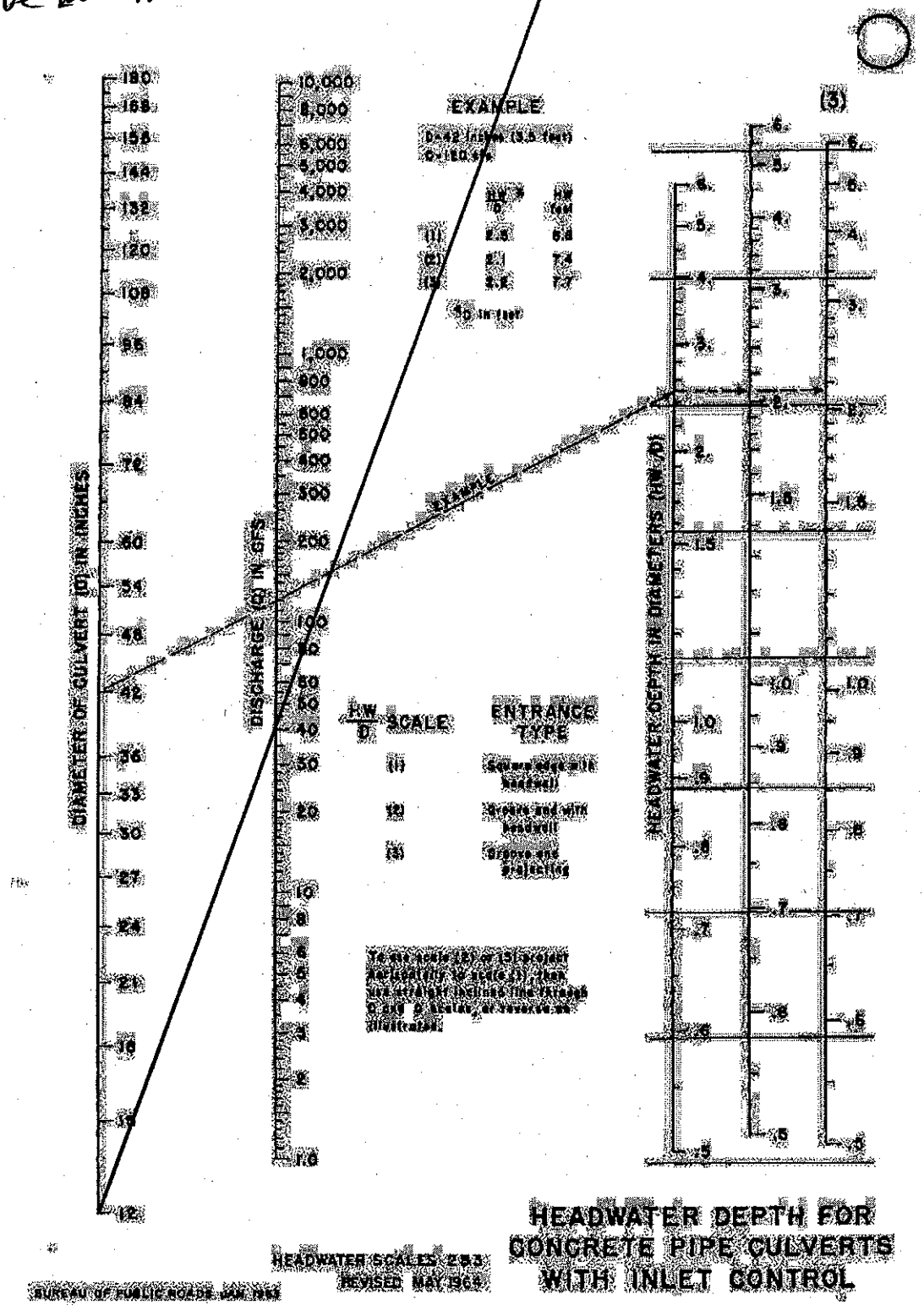

Figure 4-3 Sample Inlet Control Nomograph

velocities to non-erosive or pre-project levels. In these cases, the engineer shall apply a reasonable design procedure to determine an appropriate riprap design.

7.3.1.1 San Diego Regional Standard Drawing

Apron Length and Width. Riprap apron length and width are a function of the diameter or vertical dimension of the outlet pipe or culvert. The apron length shall be determined using the following equation, with a minimum length of 10 feet:

$$L_a = 4D_O \qquad (7\text{-}1)$$

where ...

L_a = minimum riprap apron length (ft); and
D_o = diameter or width of culvert or storm drain (ft).

Where there is a well-defined channel downstream of the apron, the bottom width of the riprap apron shall be at least equal to the bottom width of the channel. The riprap apron shall extend at least one foot above the maximum tailwater elevation or the computed water surface elevation, whichever is greater. The side slopes of the riprap apron shall be 3H:1V whenever practical, but in no case be steeper than 1.5H:1V.

Where there is no well-defined channel downstream of the apron, the upstream width of the riprap apron shall be equal to twice the width of conduit or the width of the headwall, whichever is greater. The downstream width of the riprap apron shall be at least the width of the upstream end of the apron, plus one conduit diameter (D_o) on each side. Figure 7-1 illustrates the layout of the San Diego regional standard riprap apron.

Riprap Size and Thickness. Flow energy governs the size of the riprap used for energy dissipation. The San Diego Regional Standard Drawings use exit velocity as a surrogate for flow energy (Table 7-1). Riprap apron thickness shall be at least 1.5 times the nominal d_{50} of the specified riprap. Riprap shall be placed over a geotextile filter fabric, and a filter blanket material shall be placed under the fabric as appropriate. The equivalent diameter of stone (d_{50}) shall not exceed the diameter or vertical dimension of the outlet pipe, and the dimensions of the riprap apron shall be adjusted to accommodate the required stone size.

Table 7-1 Rock Size for Riprap Aprons at Storm Drain Outlets

Outlet Velocity (ft/s)	Rock Classification	Size of Stone, d_{50} (ft) [a]
6-10	No. 2 Backing	0.7
OUTLET → 10-12	¼ Ton	1.8
12-14	½ Ton	2.3
14-16	1 Ton	2.9
16-18	2 Ton	3.6

[a] *Assumes specific weight of 165 lb/ft³. The designer shall take care to apply a unit weight that is applicable to the type of riprap specified for the project, and adjust their calculations if necessary.*

7.3.2 Stilling Basins

There are a number of additional types of stilling basins, and it is beyond the scope of this Manual to provide detailed information on each of them. Information about their proper application and design can be obtained from a number of sources, including the FHWA *Hydraulic Design of Energy Dissipaters for Culverts and Channels* (HEC-14), the U.S. Army Corps of Engineers' *Hydraulic Design Criteria* and *Engineer Manuals*, the Bureau of

SOIL MAP

TM 5406
PRE DEVELOPMENT HYDROLOGY MAP

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FILE NO.4357_R

LEGEND

CIVIL D NODE	100
BASIN BOUNDARY	
PROPERTY LINE	

SCALE 1" = 40'

NOTE:

(1) DETENTION BASIN SYSTEM TO BE MAINTAINED BY TM 5406RPL2 HOMEOWNERS ASSOCIATION IN PERPETUITY.

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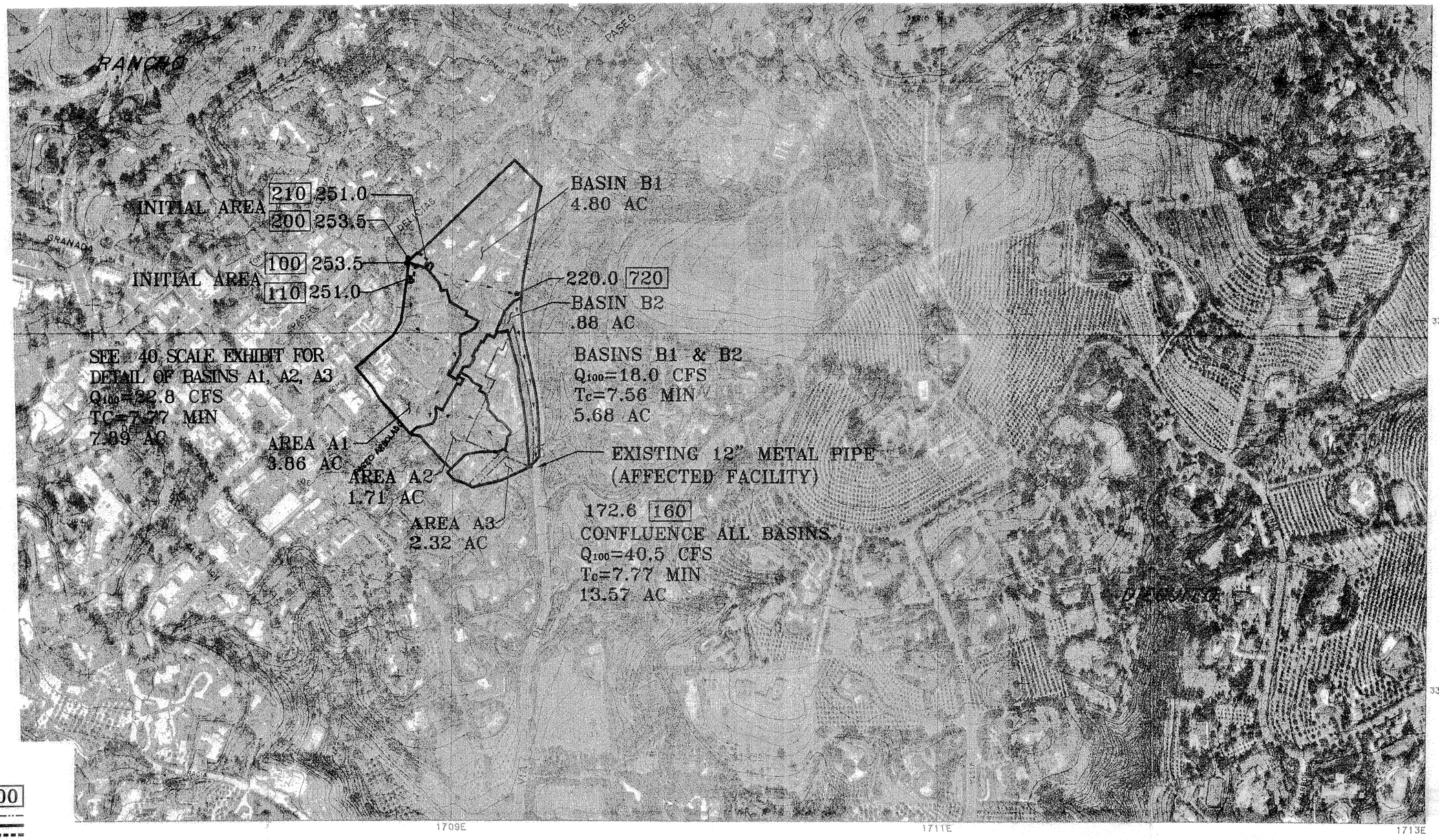
TM 5406
POST DEVELOPMENT HYDROLOGY MAP

ENGINEER'S NAME: SAN DIEGUITO ENGINEERING PHONE NO. (760) 753-5525



LEGEND

CIVIL D NODE **100**

PROPERTY BOUNDARY

BASIN BOUNDARY

INITIAL AREA

Map Complies with ACCURACY STANDARDS

400 600 800 1000 (Feet)
00 200 300 (Meters)

SCALE 1: 2400 (1"= 200')

INDEX CONTOUR INTERVAL: 25 FEET

CONTOUR INTERVAL: 5 FEET

TWO THOUSAND FOOT CALIFORNIA RECTANGULAR GRID (ZONE VI)

THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

THE RECTANGULAR COORDINATE VALUES ARE SHOWN ON THE SOUTH AND WEST MARGINS

THE GEOGRAPHIC VALUES ARE SHOWN ON THE NORTH AND EAST MARGINS

INDEX TO ADJOINING SHEETS

314-1701	314-1707	314-1713
310-1701	310-1707	310-1713
306-1701	306-1707	306-1713

SAN DIEGO COUNTY
CALIFORNIA

SHEET NO. 310-1707

SCALE 1" = 200'

PRE DEVELOPMENT HYDROLOGY MAP

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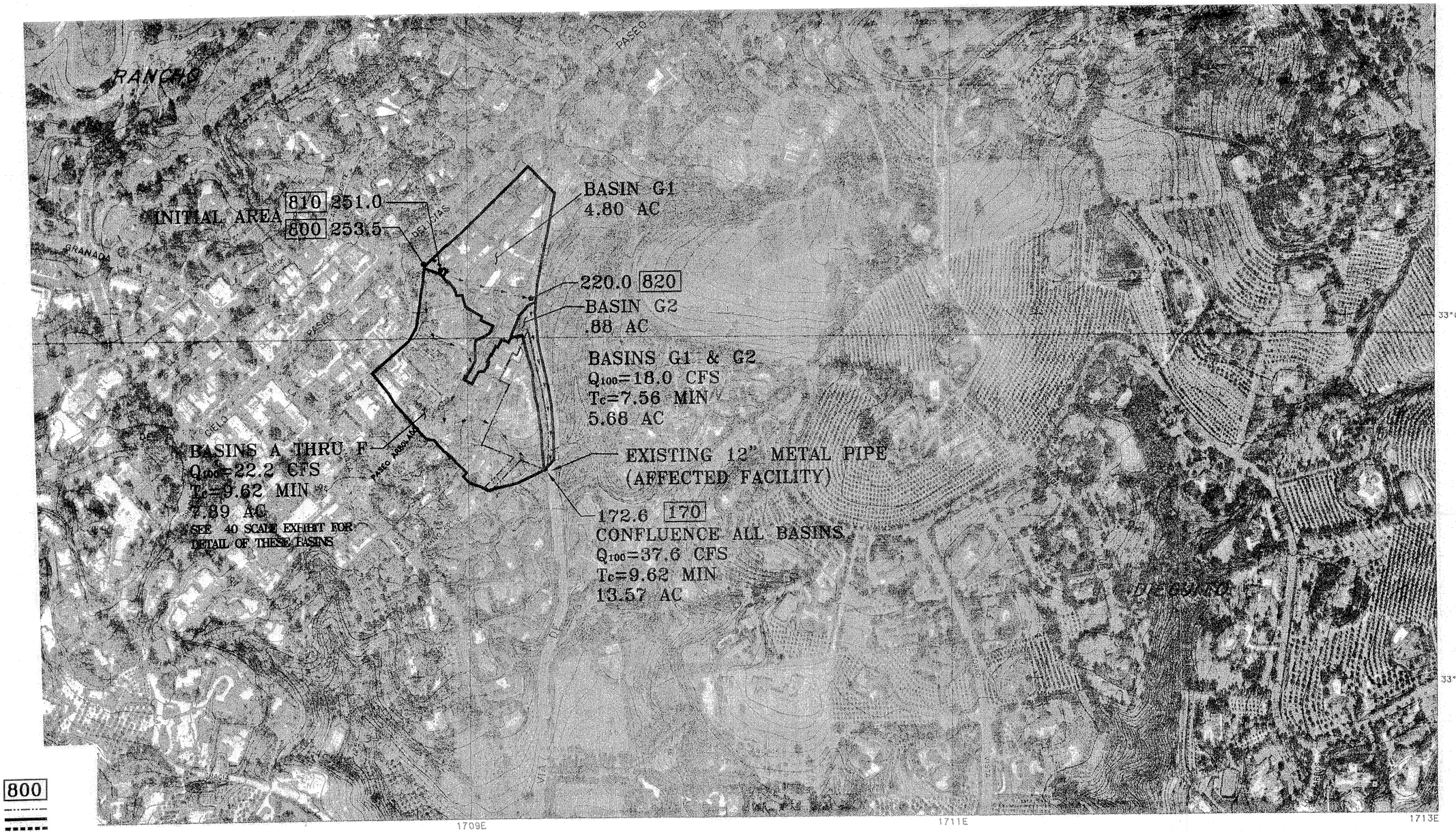

LEGEND

CIVIL D NODE	800
PROPERTY BOUNDARY	
BASIN BOUNDARY	
INITIAL AREA	

Map Complies with
ACCURACY STANDARDS

400 600 800 1000 (Feet)
0 200 300 (Meters)

SCALE 1: 2400 (1"= 200')
INDEX CONTOUR INTERVAL: 25 FEET
CONTOUR INTERVAL: 5 FEET
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SAN DIEGO COUNTY
CALIFORNIA

SHEET NO. 310-1707

SCALE 1" = 200'

POST DEVELOPMENT HYDROLOGY MAP

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