PRELIMINARY DRAINAGE STUDY

ALTERNATE 1

FOR

The Salvation Army Divisional Camp, Ramona
14488 Mussey Grade Road
Ramona, CA

MUP NO. 70-379W2

REGISTERED PROFESSIONAL ENGINEER
LAWRENCE PAUL THORNBURGH
No. 49795
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Prepared by:

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SUMMARY

The proposed expansion at the Salvation Army Regional Campground in Ramona only encompasses a small portion of the overall site. Based on future phasing the project development has been noted as sub-areas (Area 5 and 6 have been combined in Alternate 1). The existing topography consists of three natural drainage courses (A, B, and C) that cross the site. This drainage study fist addresses the existing drainage courses, than discusses each of the five proposed sub-areas.

1. Exhibits

The following exhibits are included with this report:

Exhibit 1 – Existing Basins: a composite topographic map created from County of San Diego (200 scale) Maps and SANGIS 25' Contour Maps, with the 3 major drainage basins delineated.

Exhibit 2 – Proposed Basins: a topographic map of the property (scale 1" = 200') showing the location of various drainage basins, including the on-site tributary basins and proposed flows associated with each individual Sub-Areas (1,2,3,4,6).

Exhibits 3-6 are various charts and rainfall data taken from the County Hydrology manual.

Exhibit 7 contains both sections/calculations for normal depth of the 100-year peak flow at specific points along the natural drainage courses over 25 Acres (Basins A,B,C). These calculations were used in determining the limits of inundation shown on the Exhibit. Data for west branch of the San Vicente Creek taken from San Diego County Flood Control comprehensive plan is included.

Exhibit 8 contains peak flow calculations for the before and after condition for each of the on-site building Areas (1,2,3,4,6).

Exhibit 9 contains peak flow calculations for the natural drainage courses A, B, and C.

Exhibit 10 contains a map of the existing Soils Groups for this project.

Exhibit 11 contains a map of the Disturbed Areas for this project.

2. Existing Natural Drainage Courses

All data was acquired using the County of San Diego Drainage Manual.

- The runoff coefficient C is determined using table 3-1 (Exhibit 3).
- The time of concentration is determined using the chart and equation on figure 3-3 (Exhibit 5).
- The intensity (I) is calculated as a function of time of concentration and is determined by using the Intensity Duration Design Chart figure 3-2 (Exhibit 6).
- The runoff discharge (Q) is calculated using the Modified Rational Method Q=CIA

  Q= 50 year and 100 year storm discharge (cfs)
  C= the runoff coefficient
  I= the intensity
  A= the area in acres

Please see the attached Drainage Map (Exhibit 2) for the Salvation Army Campground Project for location of the basins. A summary of the Site Map is explained below.

For basins this size, the Rational Method will provide a very conservative (high) value for peak runoff.

Approximate hydrology calculations for each of the major drainage courses at the point they leave the property along the easterly boundary:

Based on Exhibit 1:
Area A = 674 Acres
Area B = 123 Acres
Area C = 157 Acres

For C Values use Exhibit 3

To determine Precipitation, use Exhibit 4, the ispoluvial precipitation charts for San Diego County for the 50-year and the 100-year, 6-hour storms.

To determine I (intensity), use Exhibit 6:

I for Basin A:
For P =2.8 inches, Tc = 21.5 min, I = 2.9 iph (50 year storm)
For P =3.0 inches, Tc = 21.5 min, I = 3.1 iph (100 year storm)

I for Basin B:
For P =2.8 inches, Tc = 8.8 min, I = 5.1 iph (50 year storm)
For P =3.0 inches, Tc = 8.8 min, I = 5.5 iph (100 year storm)

I for Basin C:
For P =2.8 inches, Tc = 9 min, I = 5.1 iph (50 year storm)
For P =3.0 inches, Tc = 9 min, I = 5.4 iph (100 year storm)

Q for Basin A:
For 50 year storm, Q=0.30*2.9*674 = 583 CFS (cubic feet per second)
For 100 year storm, Q=0.30*3.1*674 = 624 CFS

Q for Basin B:
For 50 year storm, Q=0.36*5.1*123 = 228 CFS
For 100 year storm, Q=0.36*5.5*123 = 244 CFS

Q for Basin C:
For 50 year storm, Q=0.36*5.1*157 = 286 CFS
For 100 year storm, Q=0.36*5.4*157 = 306 CFS

See additional information in Exhibit 9 for more details on the above Calculations.

3. Floodplains with tributary areas greater than 25 acres

Basins A, B, and C are all more than 25 acres in size. Exhibit 7 includes hydrology and normal depth calculations for flow at various points along each drainage path. The calculated normal depth was used to approximate the limits of the floodplain on the preliminary grading plans. The actual limits will be more precisely defined at the time of final design.

4. Drainage of On-Site Development Areas

The various drainage areas discussed below are shown on Exhibit 2. Exhibit 8 contains approximate calculations of peak flow in the before and after conditions for each area.

AREA 1

- Consists of a line of buildings situated on a gently sloping terrain (+/-7%).
- Surface runoff from the tributary area effecting Area 1 is 22.7 acres and is part of the larger overall Basin C.
- Total disturbed area is about 2.2 acres, new impervious surface is 0.85 acres. Without mitigation, the run-off would be increased by 2.5 cfs.
- The disturbed area is at least 200 feet from the project boundary. There are no natural drainages between the disturbed area and the project boundary.
- Runoff from the natural area to the west will be captured above the disturbed area and routed through it in a series of 3 culvert systems.
- On site, the drainage system will be privately maintained. Rain water will be collected in a cistern, area drains, and routed to a detention basin via a system of vegetated bio-swales. At the discharge points, the flow will be spread out and slowed to non-erosive velocities by a series of level earthen berms.

- A Storm water detention and the on-site routing shall reduce the post development peak run-off to that of the existing run-off.

AREA 2

- Consists of two building clusters with a natural drainage between them. This area is situated in the majority of drainage Basin B, with some being in Basin C. The tributary area for sub area is 5.39 acres.
- Runoff from the water tank site located west of and above Area 2 flows to another natural drainage that runs between Areas 2 and 3.
- Each of the two building clusters will involve approximately 1 acre of disturbed area.
- Without mitigation, the additional impervious surfaces (primarily roofs) will result in an increased peak runoff rate from the two buildings sites approximately as flows: Southerly cluster 15%; Northerly cluster 10%.
- Both sites are situated so the natural drainage around them will not be disturbed.
- Runoff from the southerly building cluster will flow to a vegetated swale that will discharge into a detention basin. The basin captures the flow from approximately 2 acres including the southerly building cluster and some surrounding undisturbed area.
- Both the Northerly cluster and Southerly cluster will have a retention basin that will be sized and shaped to detain the additional 1.4 cfs.
- Runoff from the northerly building cluster will flow to a vegetated swale that will carry runoff east towards Area 4.
- In addition to the vegetated swales, there may be a system of area drains and small diameter pipes to carry local drainage to the swales.

AREA 3

- Total disturbed area will be approximately 7.6 acres. The total tributary area at the point of release is approximately 14 acres.
- Runoff from Area 3 and surrounding area will be captured in a series of earthen, vegetated swales surrounding the area, and released into the natural drainage south of the area.
- Where concentrated storm water must cross roads, parking areas or access walks, the flow will be carried underground in pipes. The largest of these pipes will be 18-inches in diameter.
- In addition, there may be a system of area drains and small diameter pipes to carry local drainage to the swales.
- At the point release into the natural drainage, and without any mitigating measures, the peak rate of runoff from Area 3 and areas draining onto Area 3 would be increased approximately 22% or 7.7 cfs.
- Detention facilities are proposed at the release point to reduce the peak flow rate to predevelopment conditions. Two detention facilities will be sized to store the additional 7.7 cfs. created from this area. These basins will be located at several points along the flow path of the (ultimately vegetated) bio swales.

AREA 4

- Consists of four buildings together with access drive, parking and tennis / basketball courts.
- Total disturbed area will be approximately 3.6 acres.
- Runoff from Area 4 and surrounding areas will be captured in a series of vegetated swales surrounding the area, and released into the natural drainage south and east of the area.
- Runoff from the tennis and basketball courts will be directed into an underground pipe approximately 12-inches in diameter. Where the drainage must cross roads, parking areas or access walks, runoff will also be carried underground in pipes. The largest of these pipes will be 18-inches in diameter.
- In addition, there may be a system of area drains and small diameter pipes to carry local drainage to the swales.
- The total tributary area at the point of release is approximately 5.6acres. Without mitigation, the overall increase in the peak flow rate in the natural drainage resulting from construction in Area 4 together with the northerly building cluster in area 2 would be approximately 34% or 5.6 cfs.
- The increase in peak flow rate will be mitigated by a detention facility at the release point. The detention facility and rain garden will store the increased 5.6 cfs for this area.

AREA 5

- Area 5 is not in Alternate 1, it has been combined with Area 6.

AREA 6

- Consists of ten buildings on the top of a hill with associated access road and parking, and an entrance drive up the hill from the main road in the campground.
- Total disturbed area will be approximately 6.5 acres.
- Runoff from the building clusters and tennis courts on Area 6 will be captured in a series of earthen, vegetated swales and released into the natural drainage south of the area. The tributary area at the release point is approximately 9.3 acres.
- Runoff from the tennis courts will be directed into an underground pipe approximately 12-inches in diameter. Where the drainage must cross roads, parking areas or access walks, runoff will also be carried underground in pipes. The largest of these pipes will be 18-inches in diameter.
- In addition, there may be a system of area drains and small diameter pipes to carry local drainage to the swales.
- Runoff from the entrance drive and surrounding slopes will sheet flow onto the existing natural ground west of the road.
- Without any mitigating measures, the peak rate of runoff from the building cluster area would be increased approximately 34%.
- The increase in peak flow rate will be mitigated by a detention facility at the release point. The detention facility will store the increased 4.5 cfs. for this area.

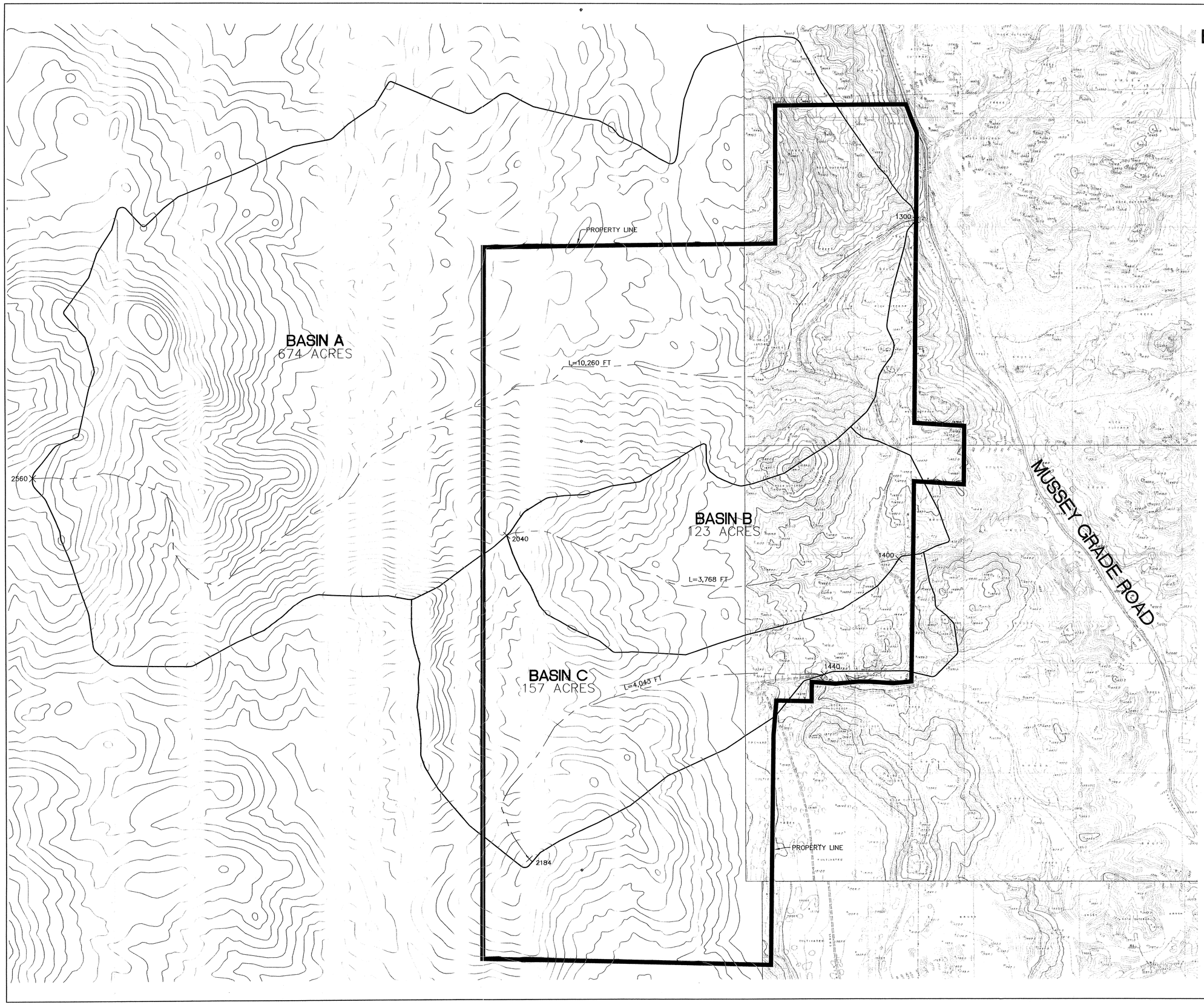
CONCLUSION

This study has discussed the existing and proposed conditions associated with the proposed Salvation Army Campground project. The existing site is over 577 Acres and currently is composed of several small buildings within three large drainage areas. These areas drain from the west of the site to the east. The proposed project, with the addition of new buildings and recreation areas will not change the drainage patterns. The proposed expansion would increase the runoff from the site (21.6 CFS) due to the creation of 8.2 acres of new impervious surfaces (new paved roadways and structures).

However; the proposed detention areas, low impact development improvements, and on-site routing will mitigate the peak run-off and reduce the post-development run-off to match that of the pre-developed condition with no adverse effects to the existing drainage system and surrounding areas.

EXHIBIT 1

EXHIBIT 1 - DRAINAGE BASINS



LEGEND

PROPERTY LINE (BOUNDARY)

BASIN AREA

LONGEST FLOW PATH

EXISTING CONTOURS

TOPOGRAPHIC SOURCE: SAN DIEGO COUNTY 200-SCALE AND SANGIS 25-FOOT CONTOURS

EXISTING FLOWTHROUGH – 50 YEAR STORM

BASIN	RUNOFF COEFF. C	INTENSITY (IN/HR)	AREA (ACRES)	DISCHARGE (CFS)
A	0.30	2.9	674	582.8
B	0.36	5.1	123	227.5
C	0.36	5.1	157	286.0

EXISTING FLOWTHROUGH – 100 YEAR STORM

BASIN	RUNOFF COEFF. C	INTENSITY (IN/HR)	AREA (ACRES)	DISCHARGE (CFS)
A	0.30	3.1	674	624.4
B	0.36	5.5	123	243.7
C	0.36	5.4	157	306.4

400 0 400 800 1,200 1,600

SCALE 1" = 400'

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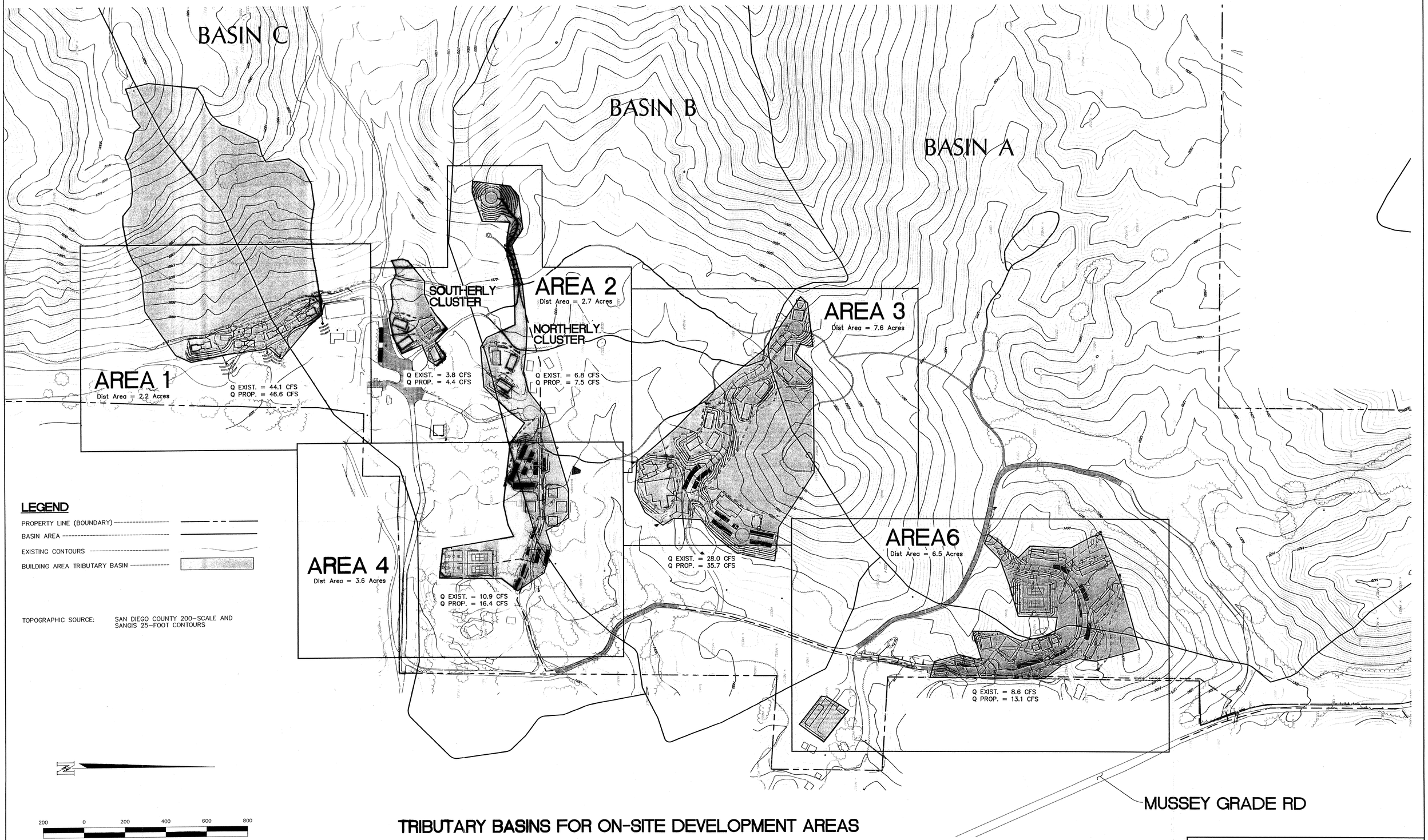
EXHIBIT 2

EXHIBIT 2 - TOPOGRAPHIC SITE MAP



LEGEND

PROPERTY LINE (BOUNDARY)

BASIN AREA

EXISTING CONTOURS

BUILDING AREA TRIBUTARY BASIN

TOPOGRAPHIC SOURCE: SAN DIEGO COUNTY 200-SCALE AND SANGIS 25-FOOT CONTOURS

200 0 200 400 600 800

SCALE 1" = 200

TRIBUTARY BASINS FOR ON-SITE DEVELOPMENT AREAS

FOR ALTERNATE 1

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EXHIBIT 3

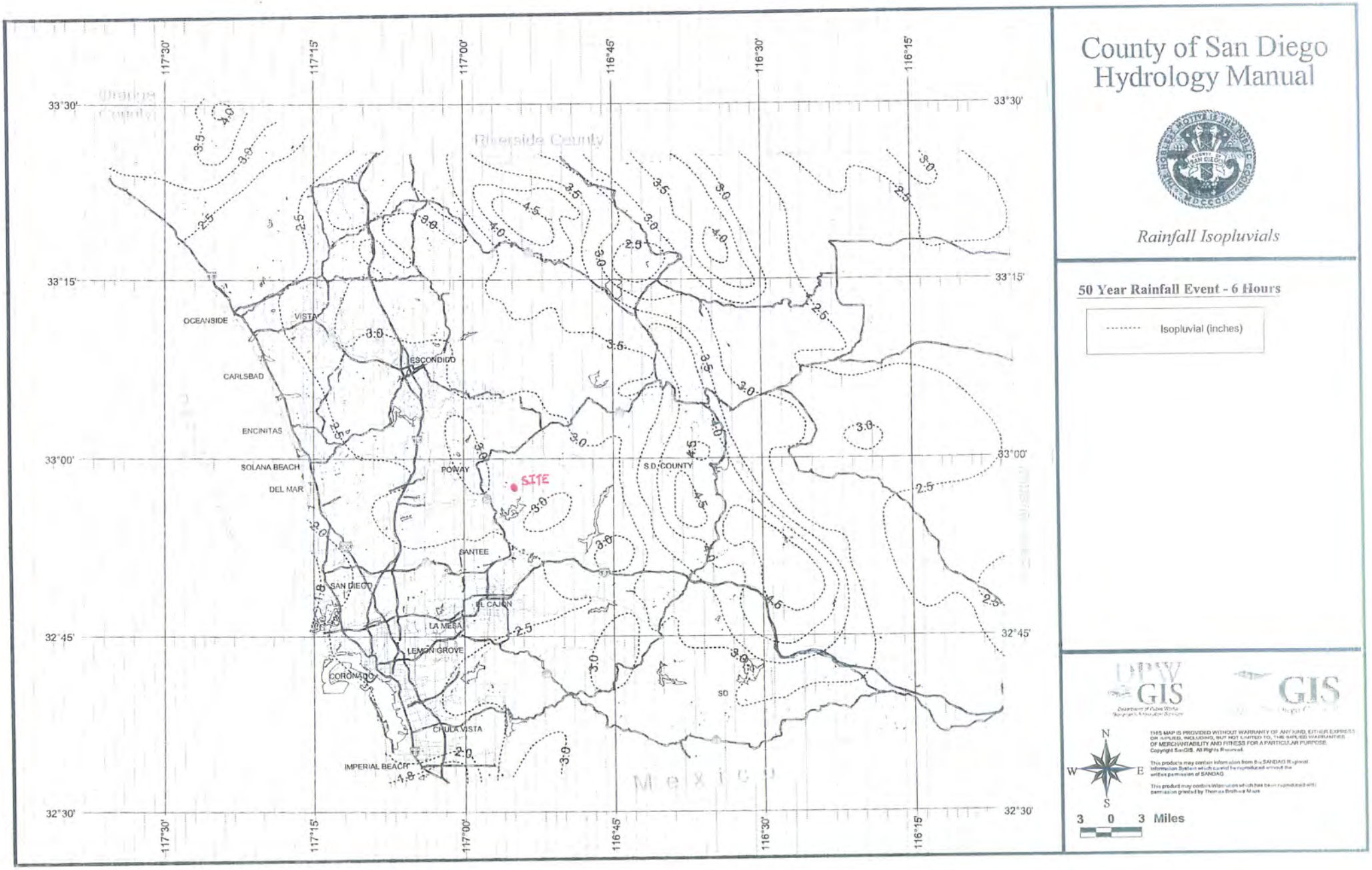
BA[redacted] A[redacted]
BASIN B & C

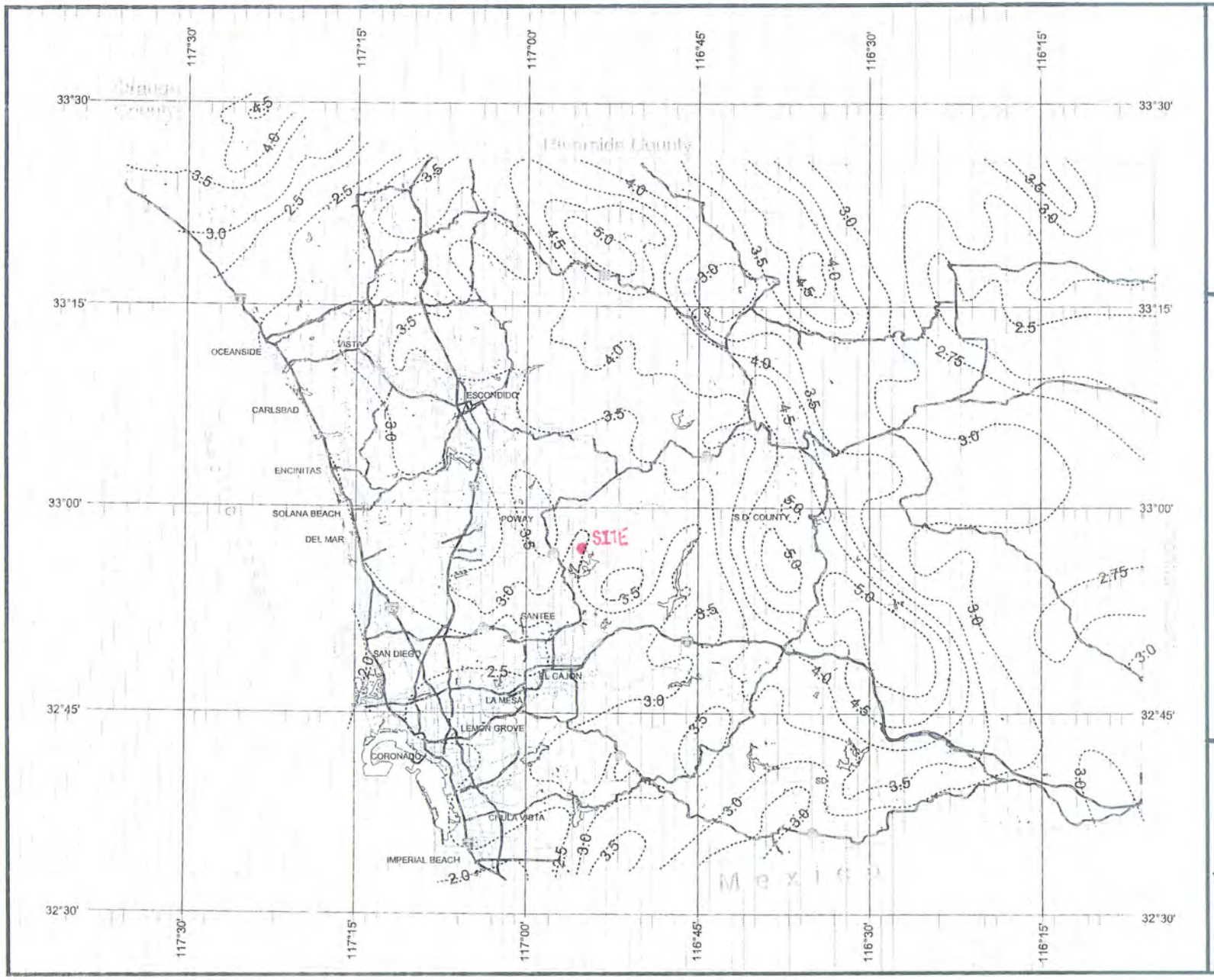
Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

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

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

EXHIBIT 4


County of San Diego
Hydrology Manual
Rainfall Isopluvials
50 Year Rainfall Event - 6 Hours
Isopluvial (inches)
Riverside County
Mexico
OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
SITE
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
CHULA VISTA
IMPERIAL BEACH
SD
33°30'
33°15'
33°00'
32°45'
32°30'
117°30'
117°15'
117°00'
116°45'
116°30'
116°15'
N
S
E
W
3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS

GIS

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N W E S

3 0 3 Miles

EXHIBIT 5

BASIN A

$$TC = \left(\frac{11.9(1.9)^3}{1760}\right)^{.385}$$

TC = 21.5 min.

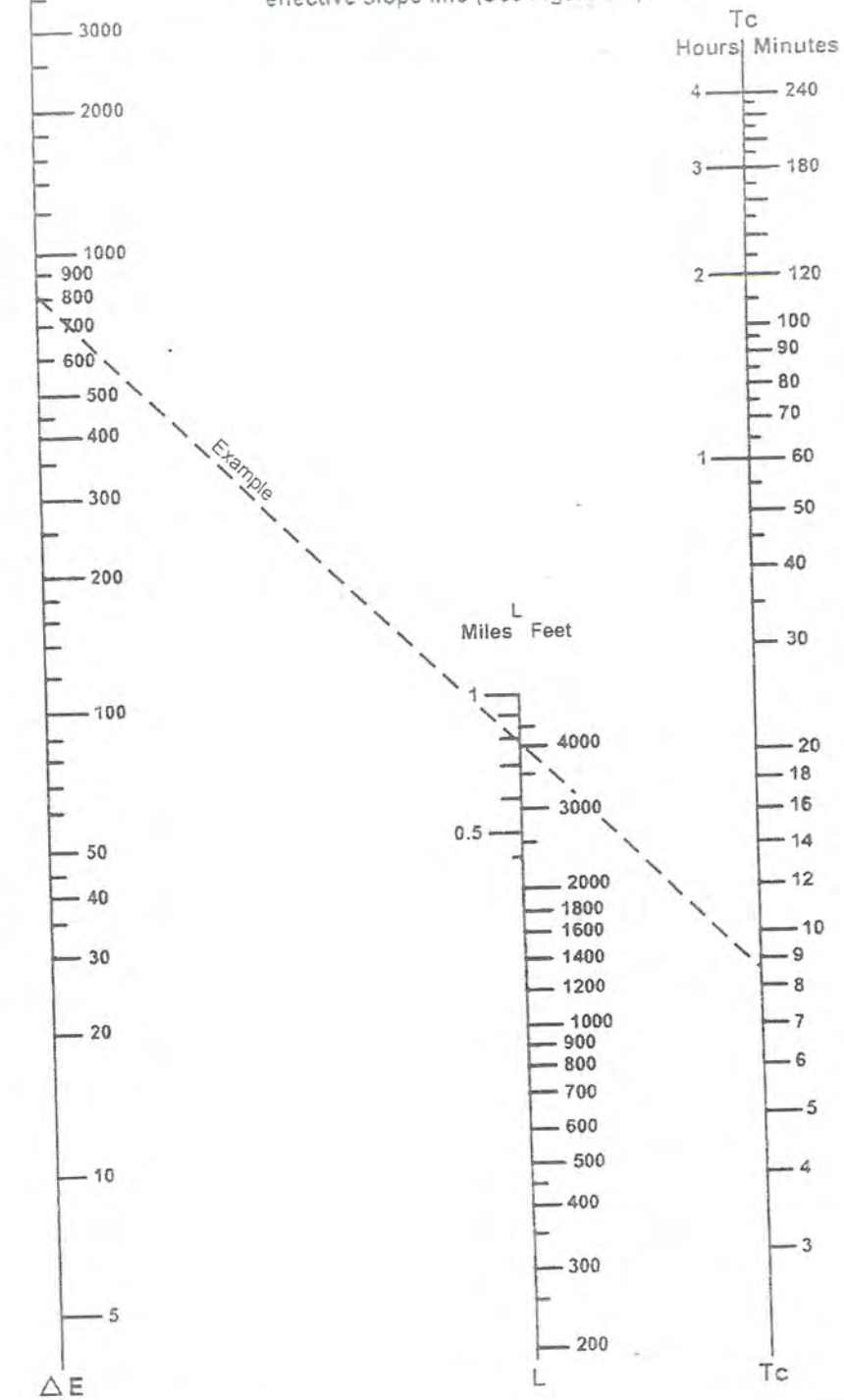
EQUATION

$$Tc = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

Tc = Time of concentration (hours)

L = Watercourse Distance (miles)

ΔE = Change in elevation along effective slope line (See Figure 3-4) (feet)



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

FIGURE

3-3

Nomograph for Determination of Time of Concentration (Tc) for Natural Watersheds

BASIN B

$T_c = 8.8$ min

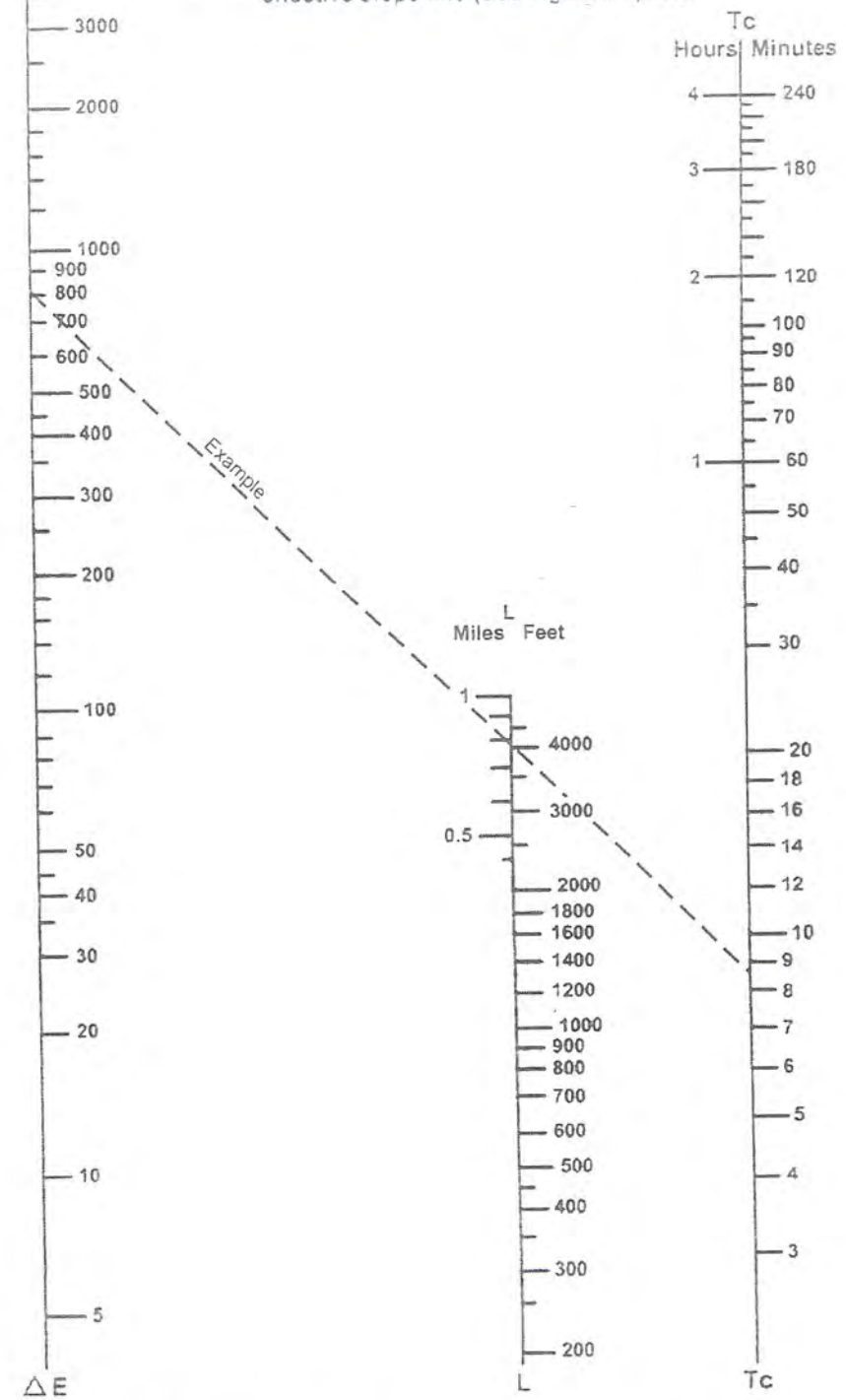
EQUATION

$$T_c = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

T_c = Time of concentration (hours)

L = Watercourse Distance (miles)

ΔE = Change in elevation along effective slope line (See Figure 3-4) (feet)



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

FIGURE

Nomograph for Determination of Time of Concentration (Tc) for Natural Watersheds

3-3

BASIN C

$T_c = 9.0$ min.

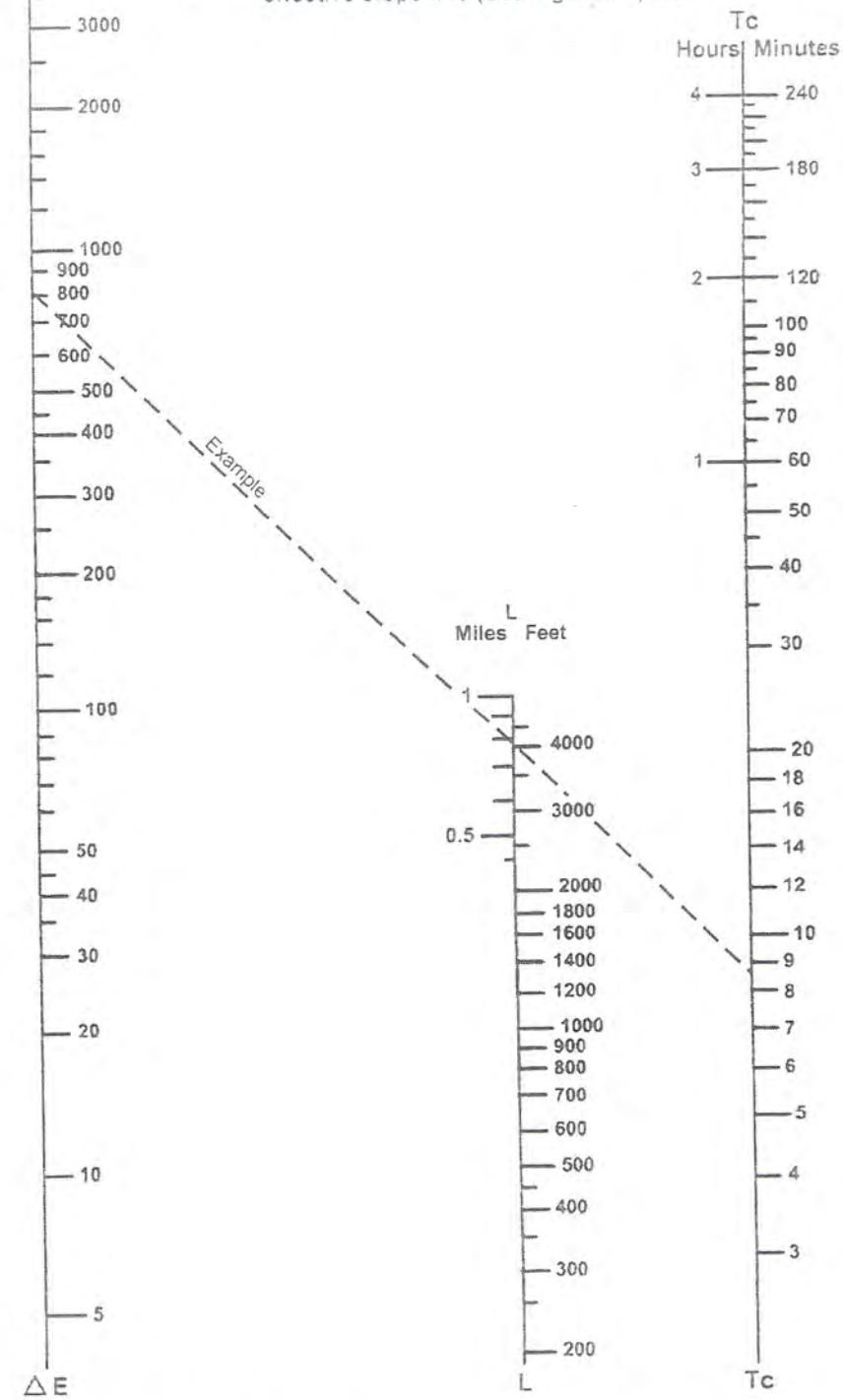
EQUATION

$$T_c = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

T_c = Time of concentration (hours)

L = Watercourse Distance (miles)

ΔE = Change in elevation along effective slope line (See Figure 3-4) (feet)



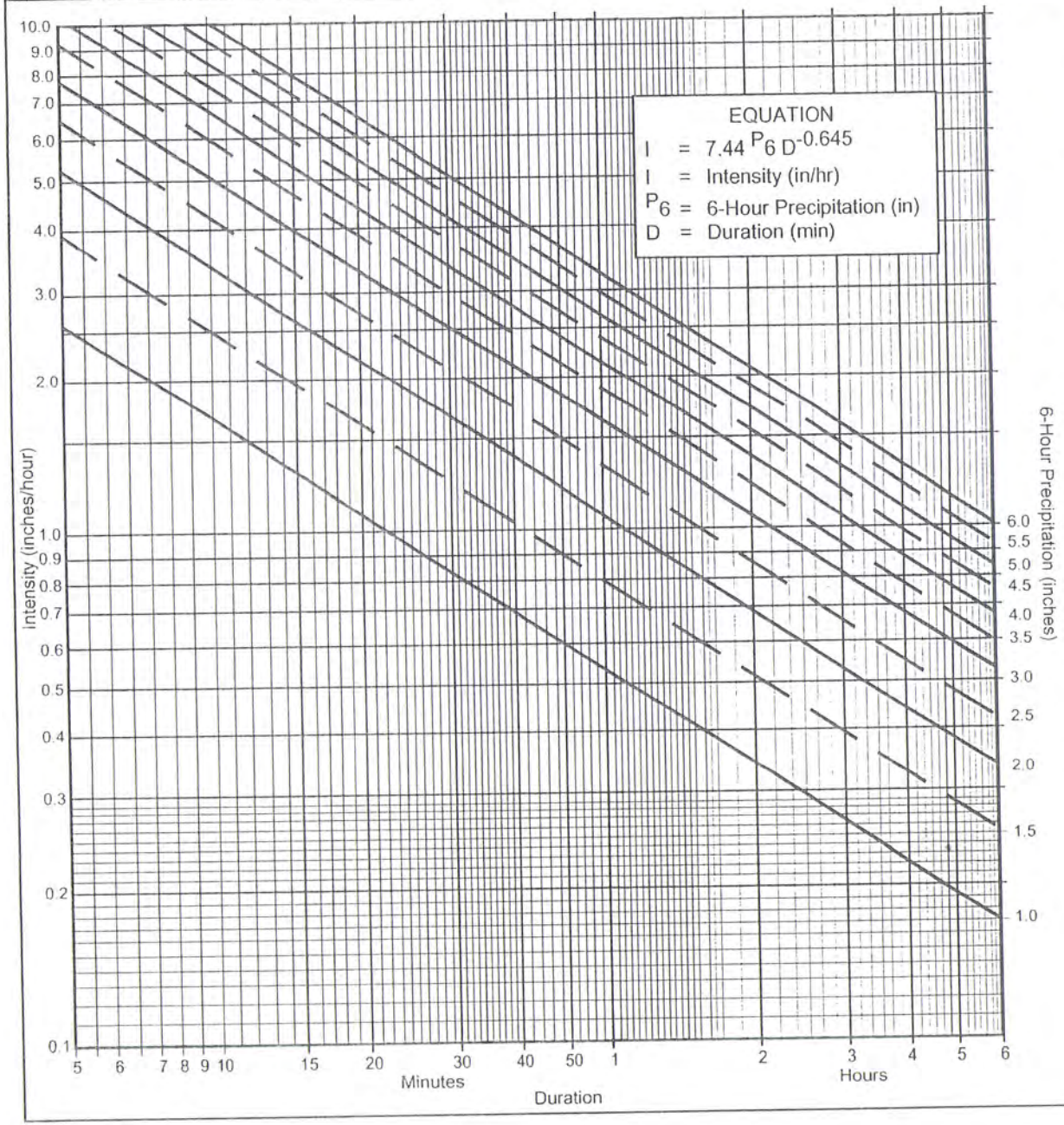
SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

Nomograph for Determination of Time of Concentration (Tc) for Natural Watersheds

3-3

EXHIBIT 6



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 50 year

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

(c) Adjusted P_6(2) = 2.8 in.

(d) t_x = 21.5 min.

(e) I = 2.9 in./hr.

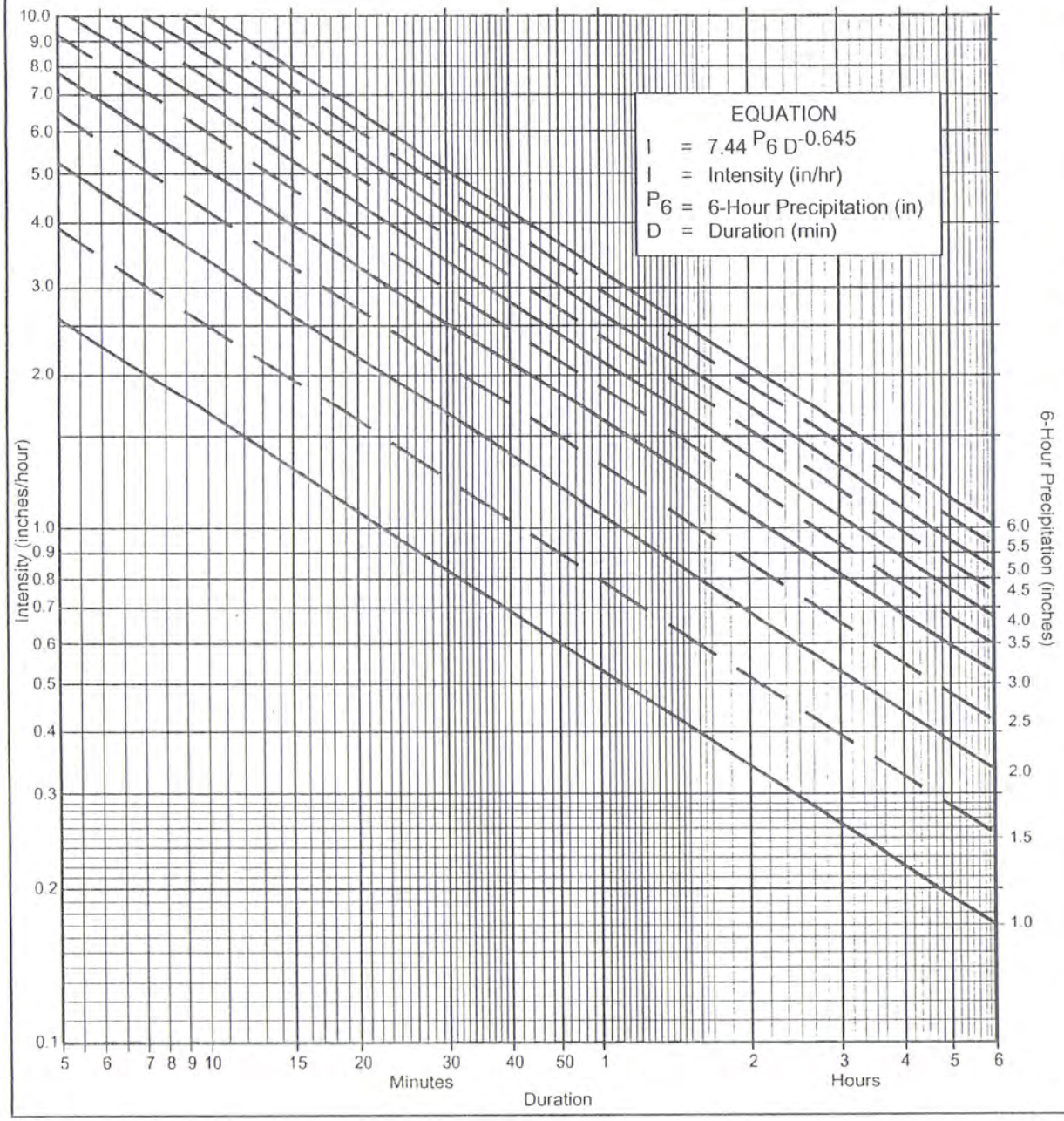
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

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

FIGURE

3-1

Intensity-Duration Design Chart - Template



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 100 year

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

(c) Adjusted P_6(2) = 3.0 in.

(d) t_x = 2.5 min.

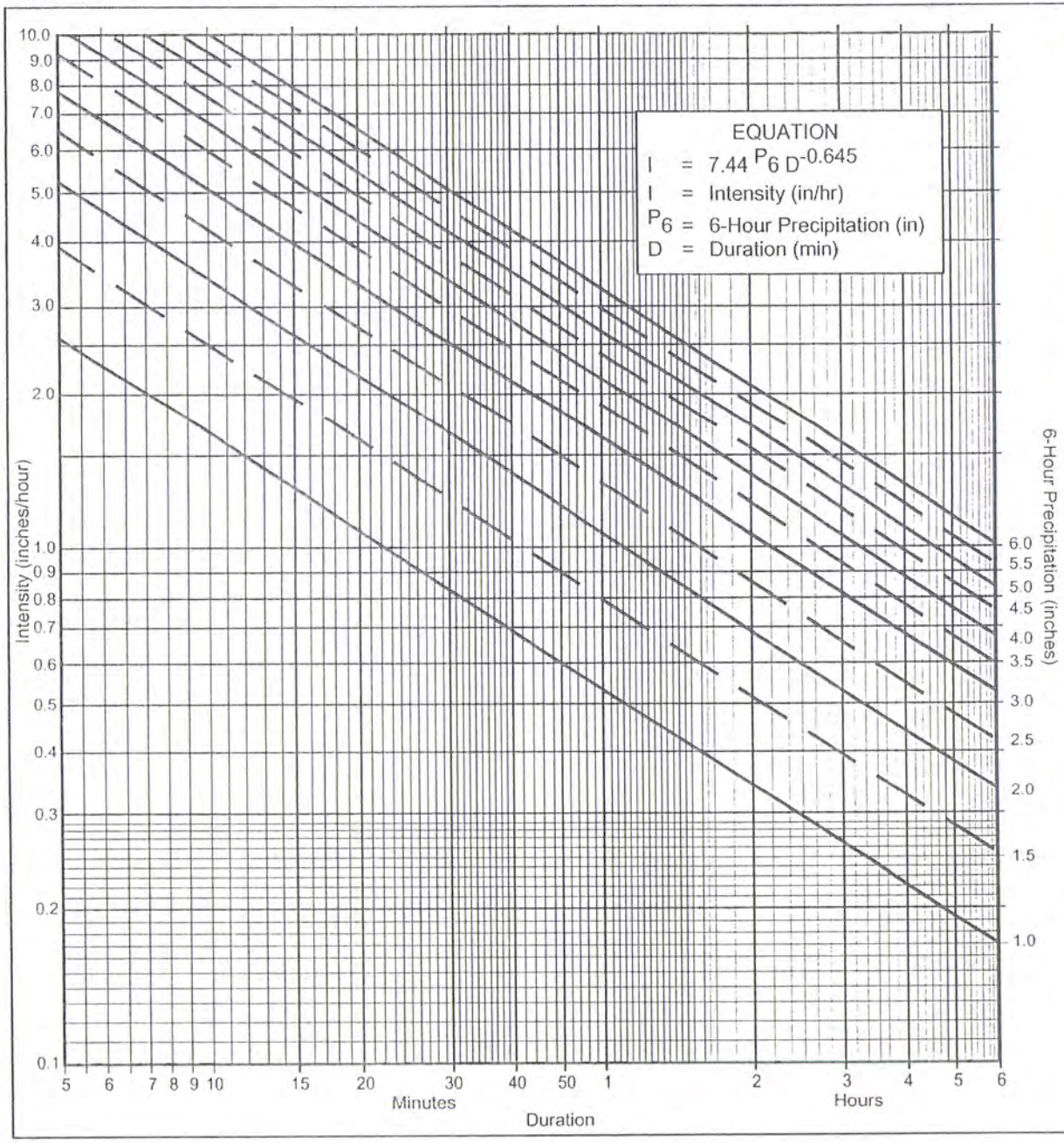
(e) I = 3.1 in./hr.

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

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

Intensity-Duration Design Chart - Template

FIGURE 3-1



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 50 year

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

(c) Adjusted P_6(2) = 2.8 in.

(d) t_x = 8.8 min.

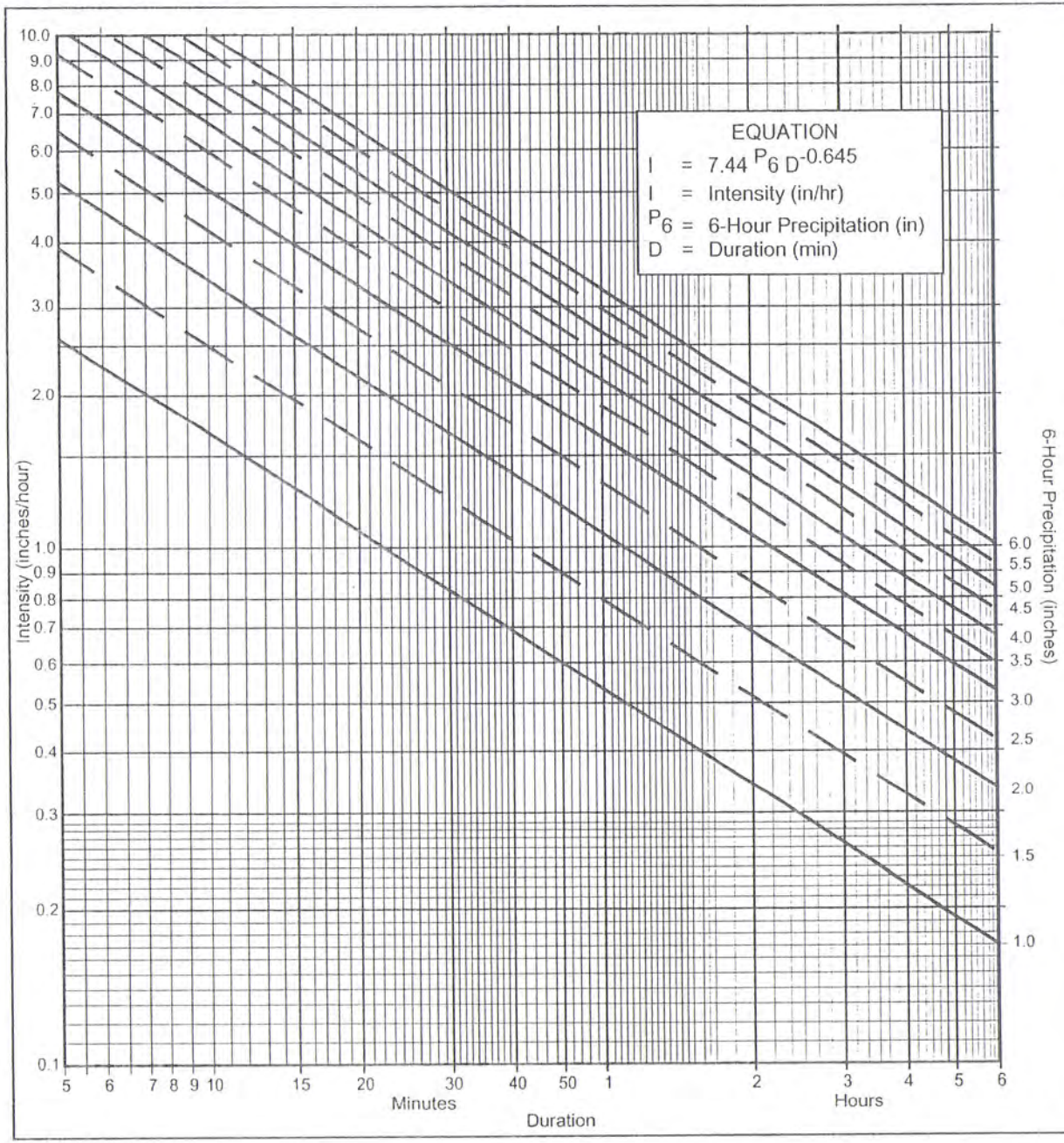
(e) I = 5.1 in./hr.

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

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

Intensity-Duration Design Chart - Template

FIGURE 3-1



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 100 year

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

(c) Adjusted P_6(2) = 3.0 in.

(d) t_x = 8.8 min.

(e) I = 5.5 in./hr.

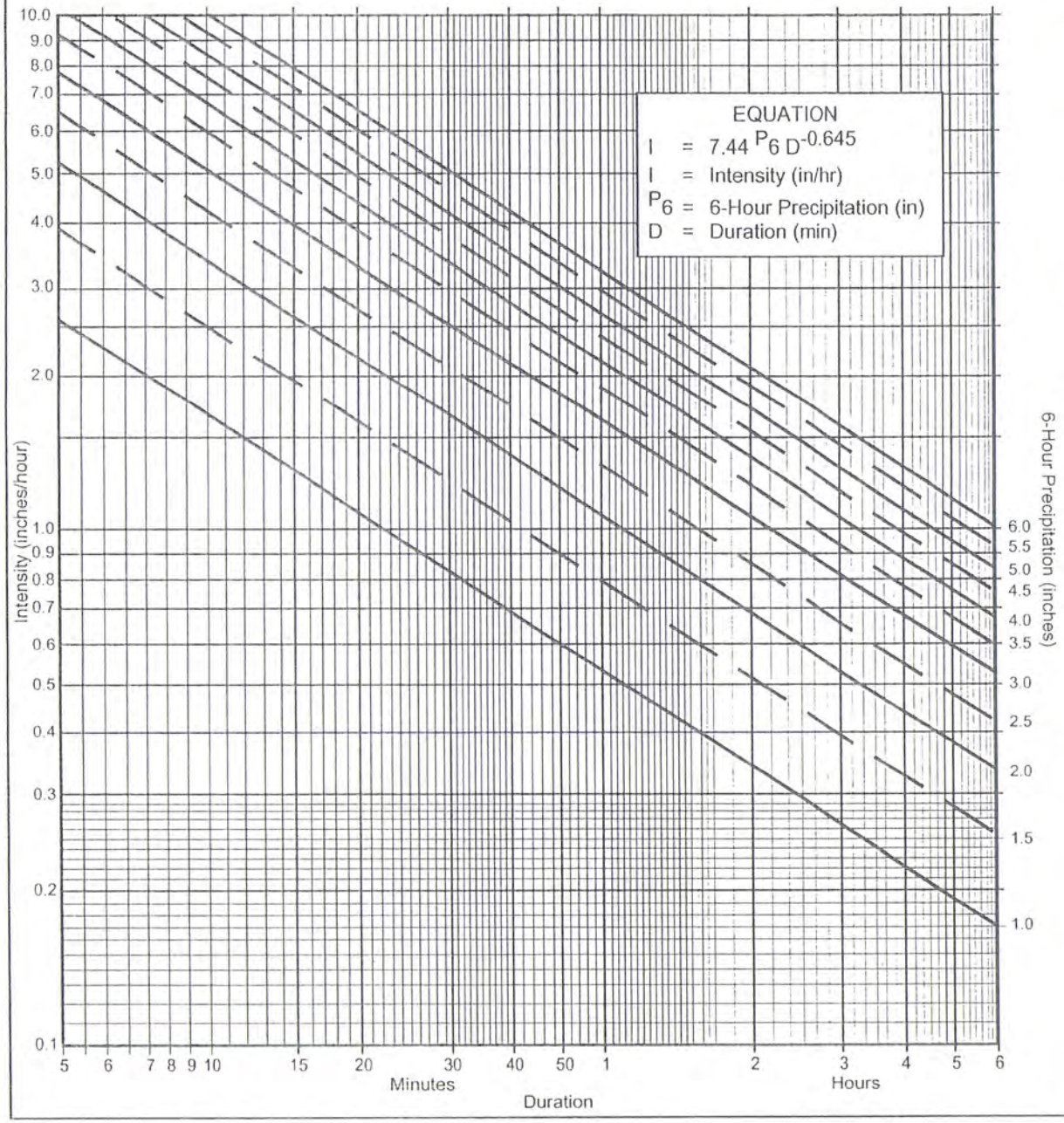
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

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

FIGURE

3-1

Intensity-Duration Design Chart - Template



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 50 year

(b) P_6 = _____ in., P_{24} = _____ ; $\frac{P_6}{P_{24}}$ = _____ %(2)

(c) Adjusted P_6(2) = 2.8 in.

(d) t_x = 9 min.

(e) I = 5.1 in./hr.

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

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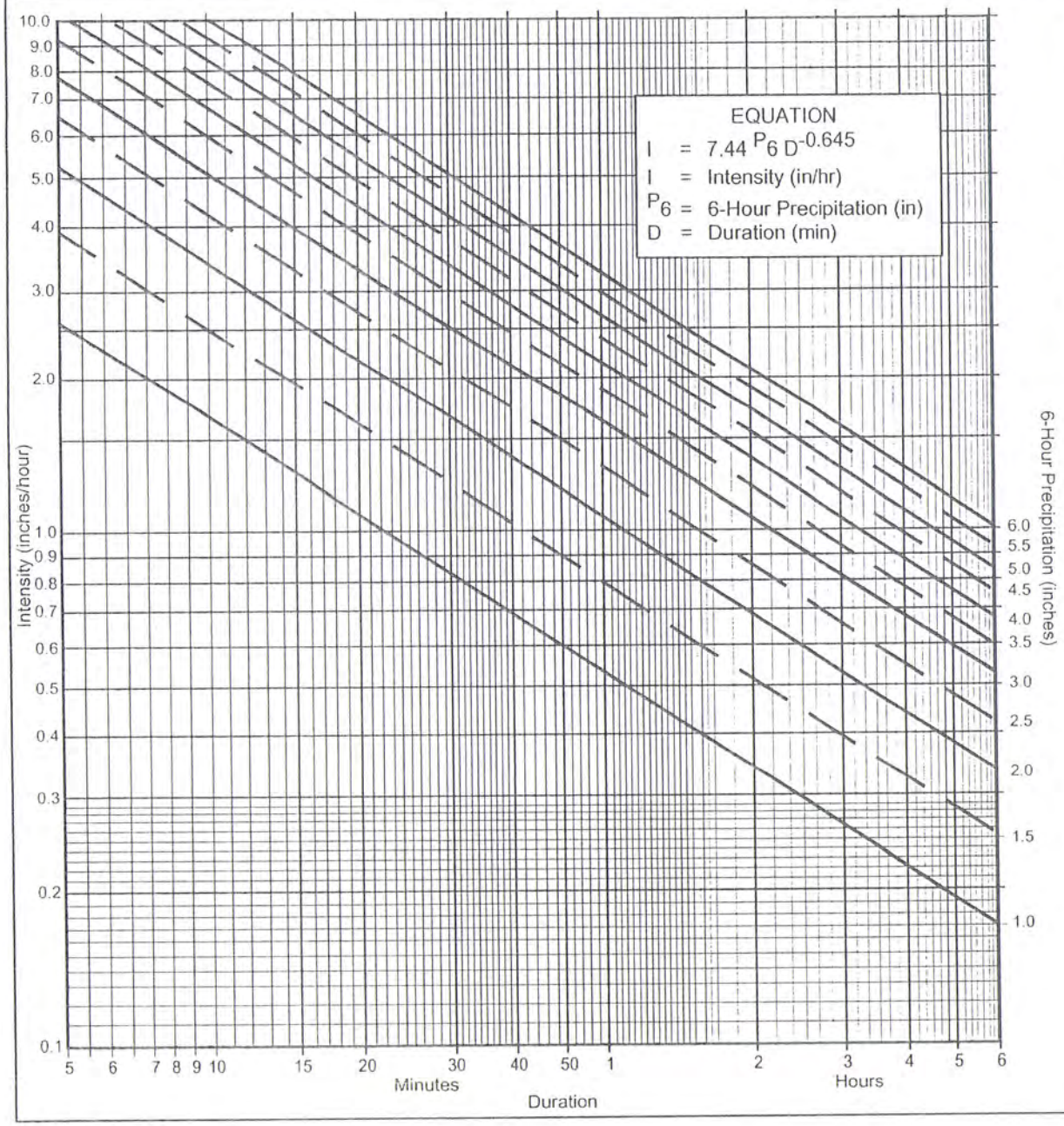
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

FIGURE

3-1

Intensity-Duration Design Chart - Template



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 100 year

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

(c) Adjusted P_6(2) = 3.0 in.

(d) t_x = 9 min.

(e) I = 5.4 in./hr.

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

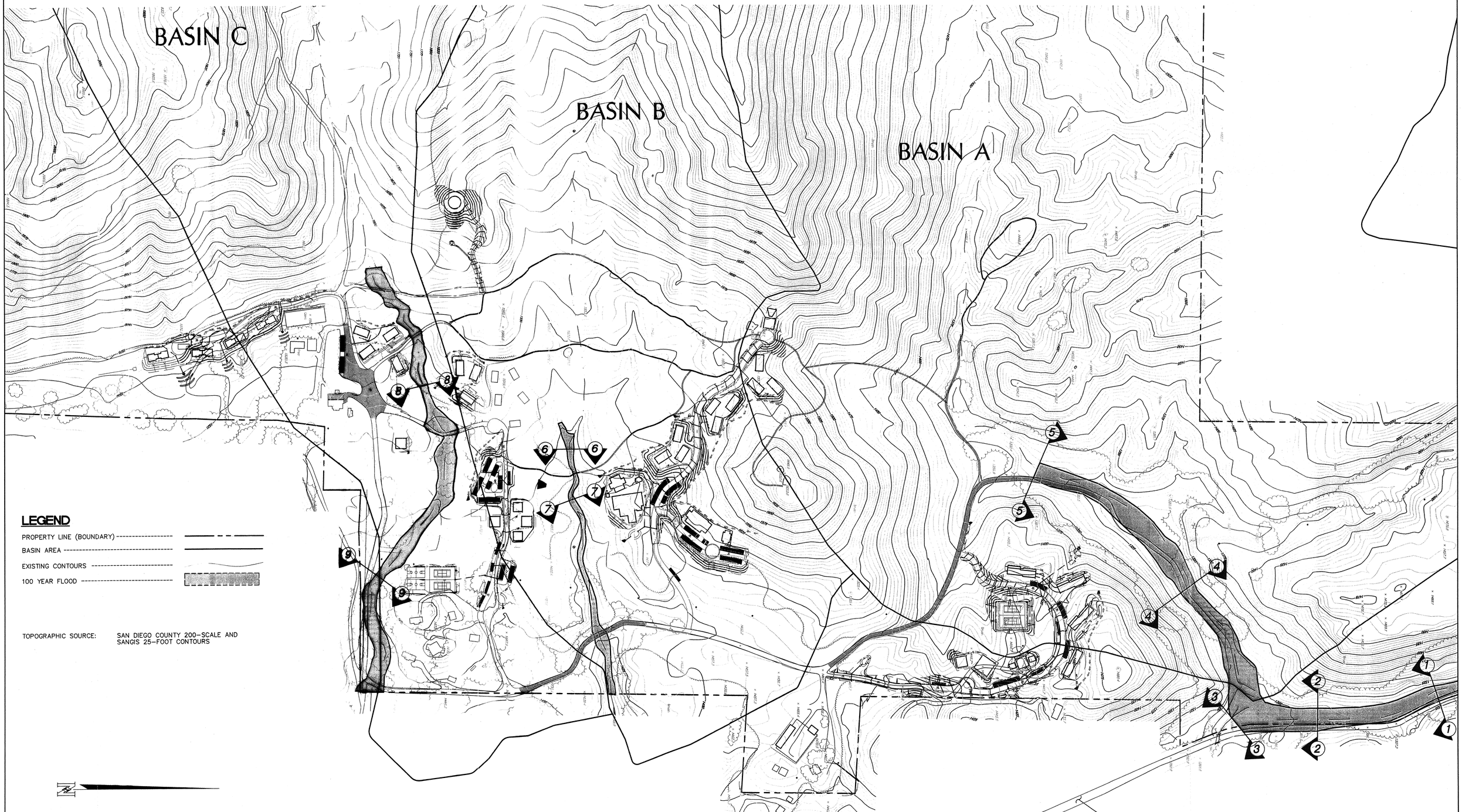
P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15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

Intensity-Duration Design Chart - Template

FIGURE 3-1

EXHIBIT 7

EXHIBIT 7 - 100 YEAR FLOOD INUNDATION



LEGEND

PROPERTY LINE (BOUNDARY) ----------

BASIN AREA ----------

EXISTING CONTOURS ----------

100 YEAR FLOOD ----------

TOPOGRAPHIC SOURCE: SAN DIEGO COUNTY 200-SCALE AND SANGIS 25-FOOT CONTOURS

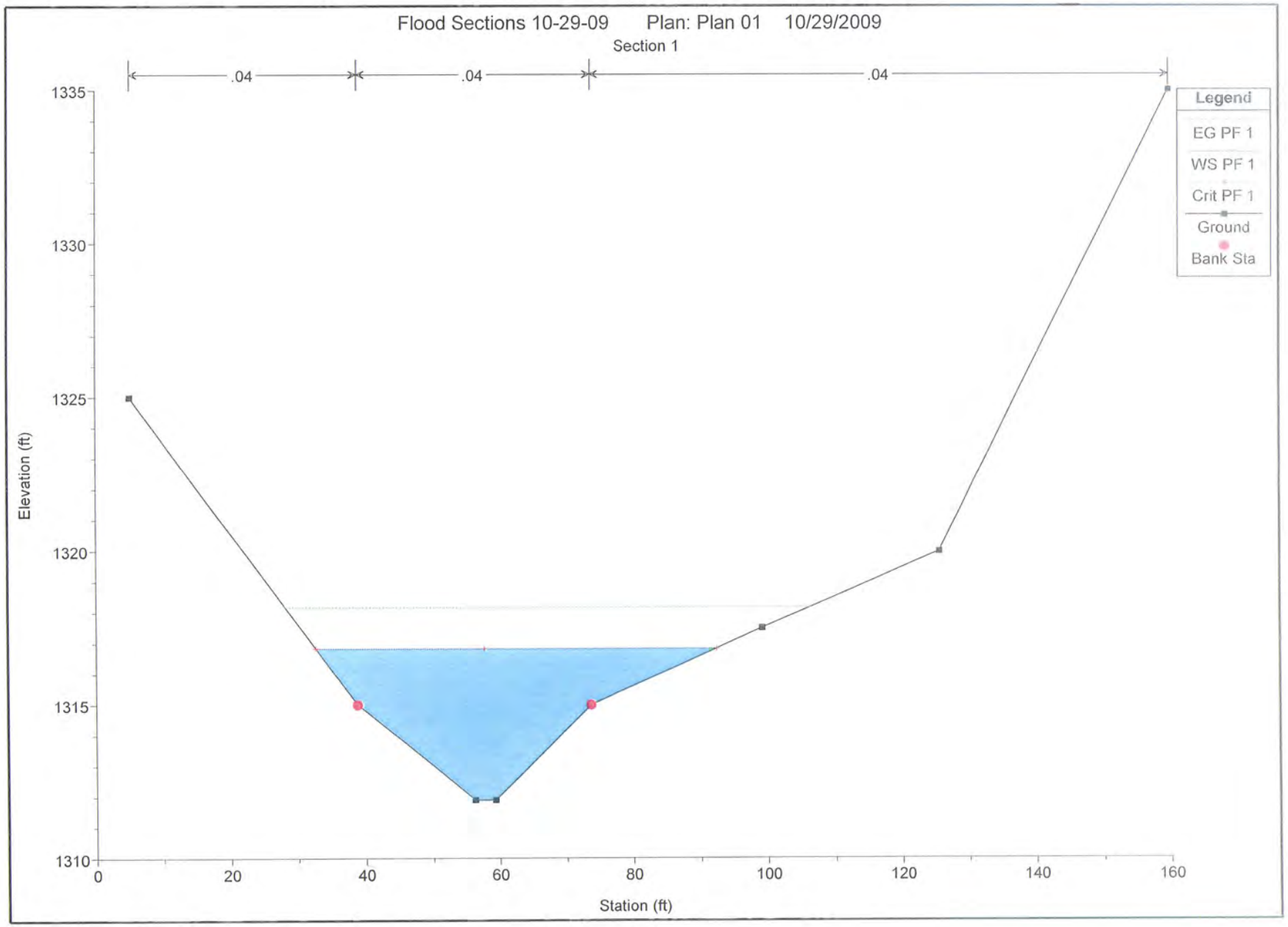
200 0 200 400 600 800

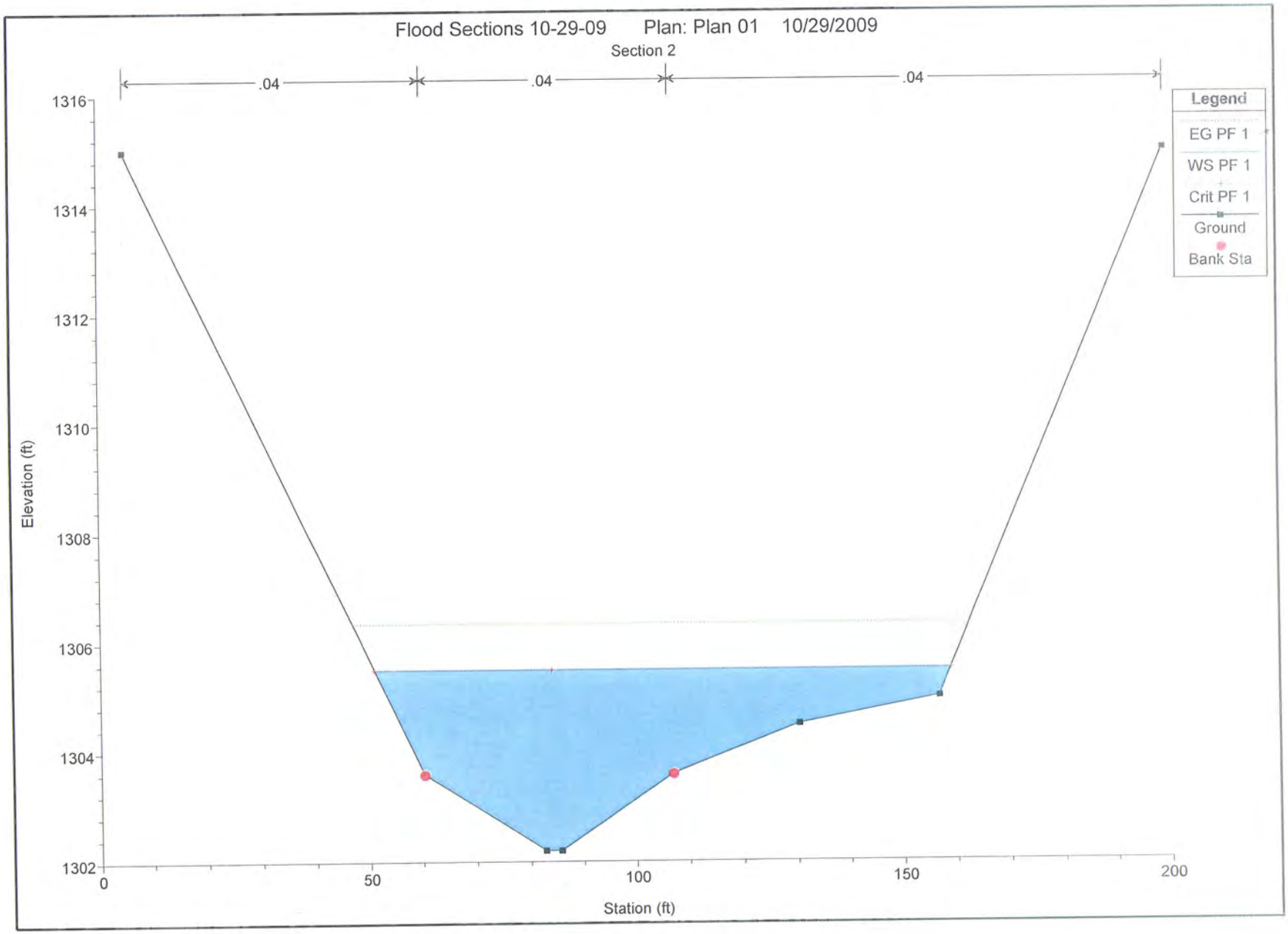
SCALE 1" = 200

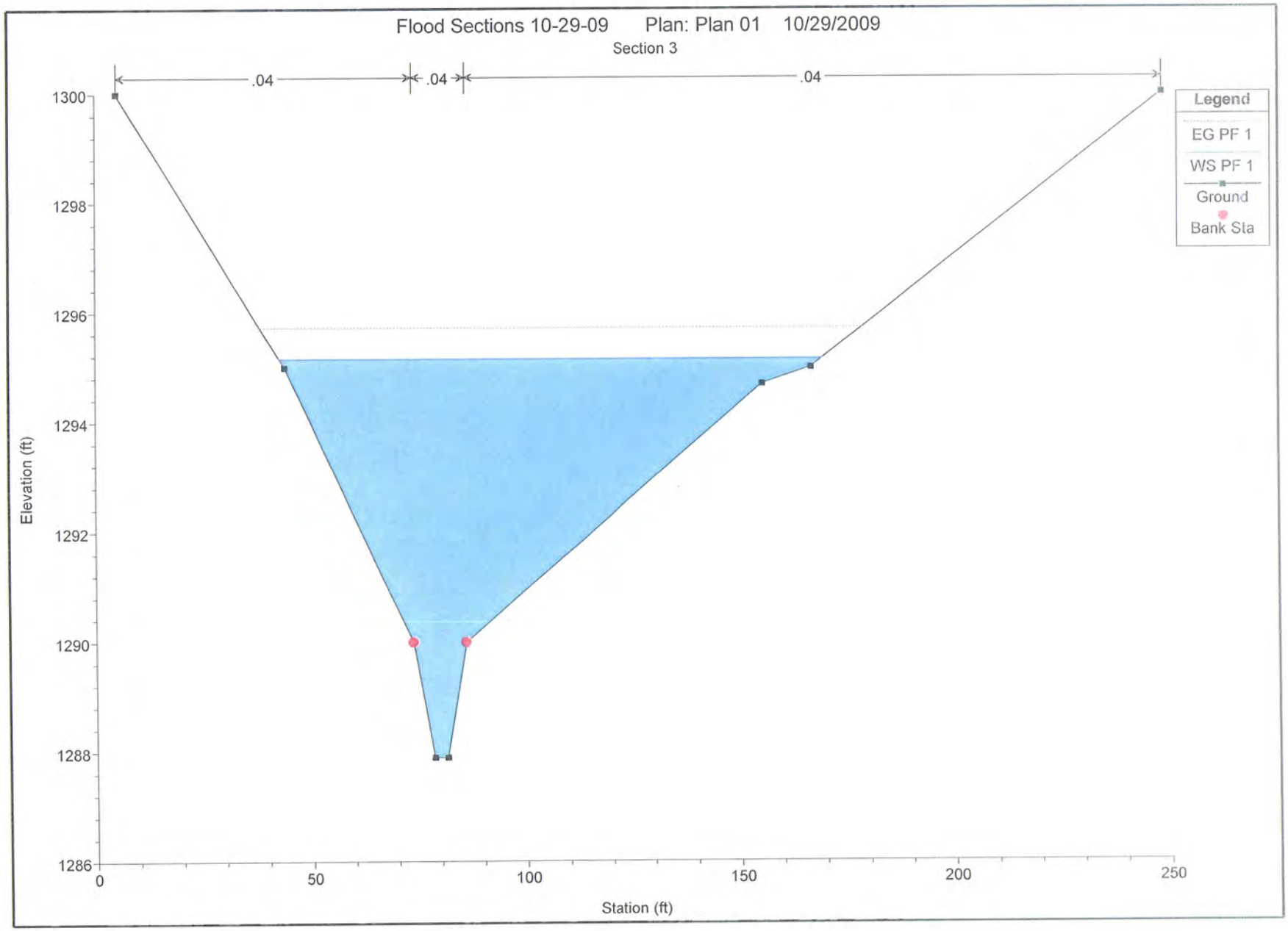
100 YEAR FLOOD LINES OF INUNDATION

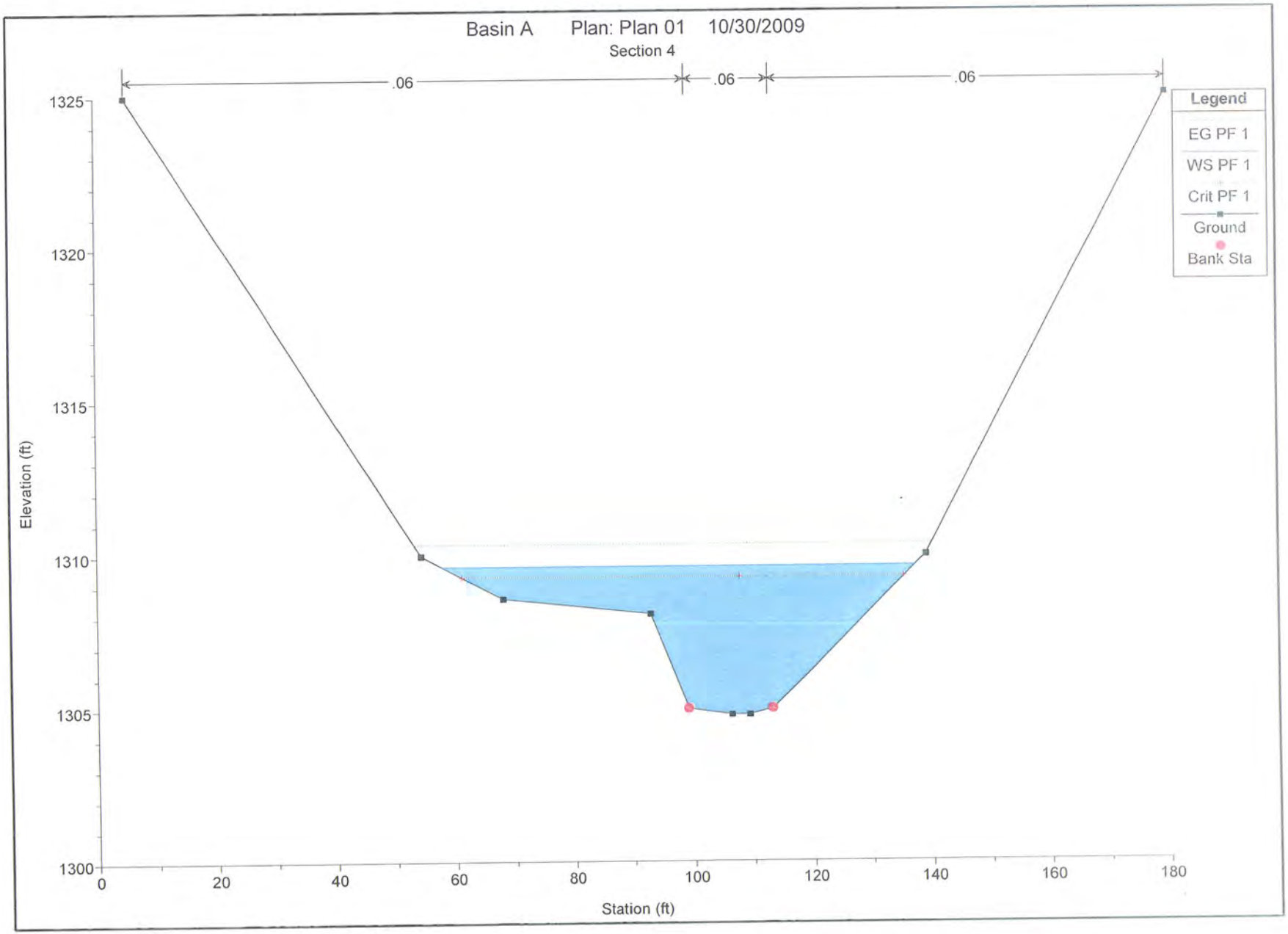
FOR ALTERNATE 1

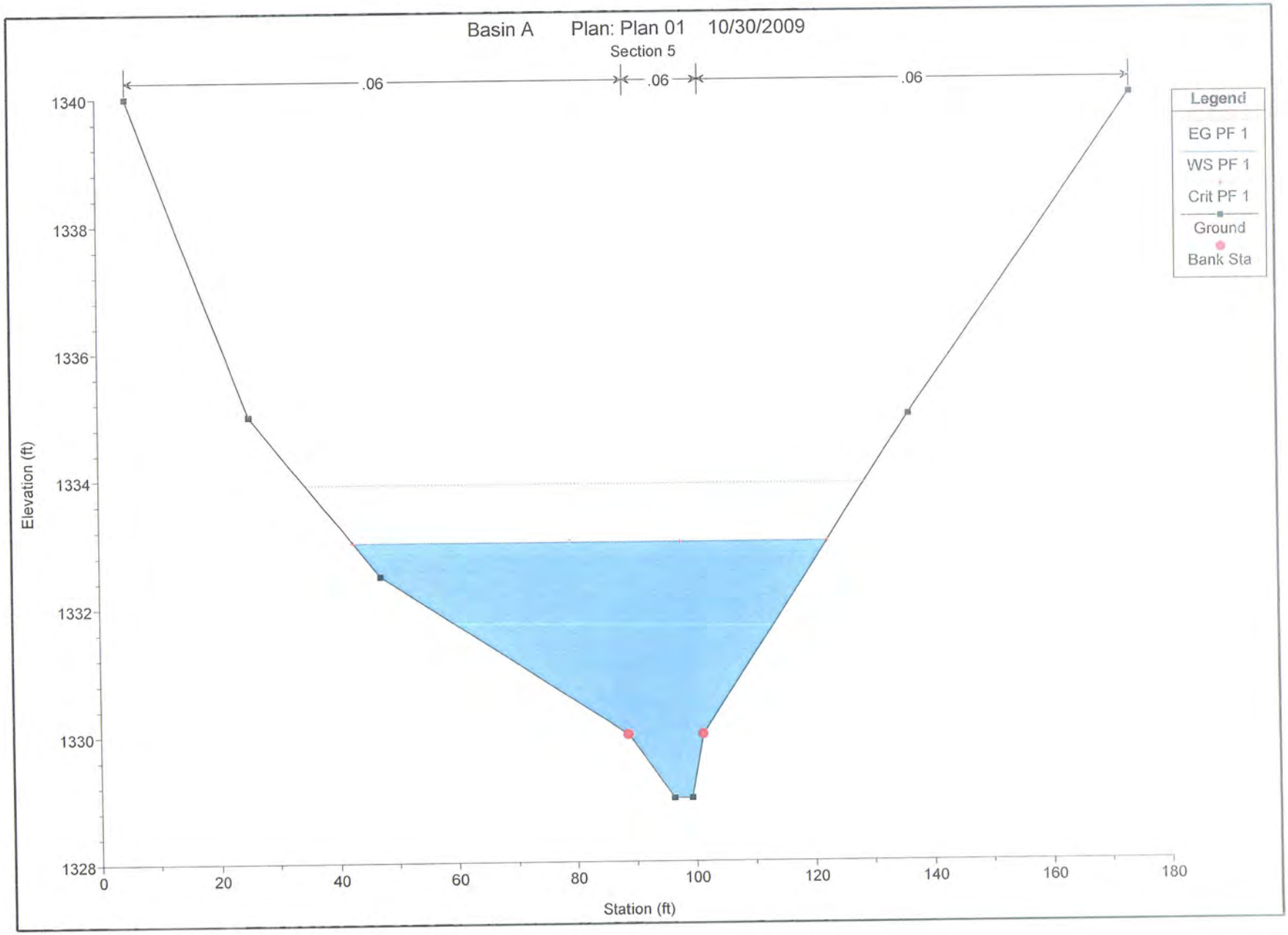
NASLAND ENGINEERING
CIVIL ENGINEERING • SURVEYING • LAND PLANNING
4740 Ruffner Street, San Diego, California, 92111 • 858-292-7770

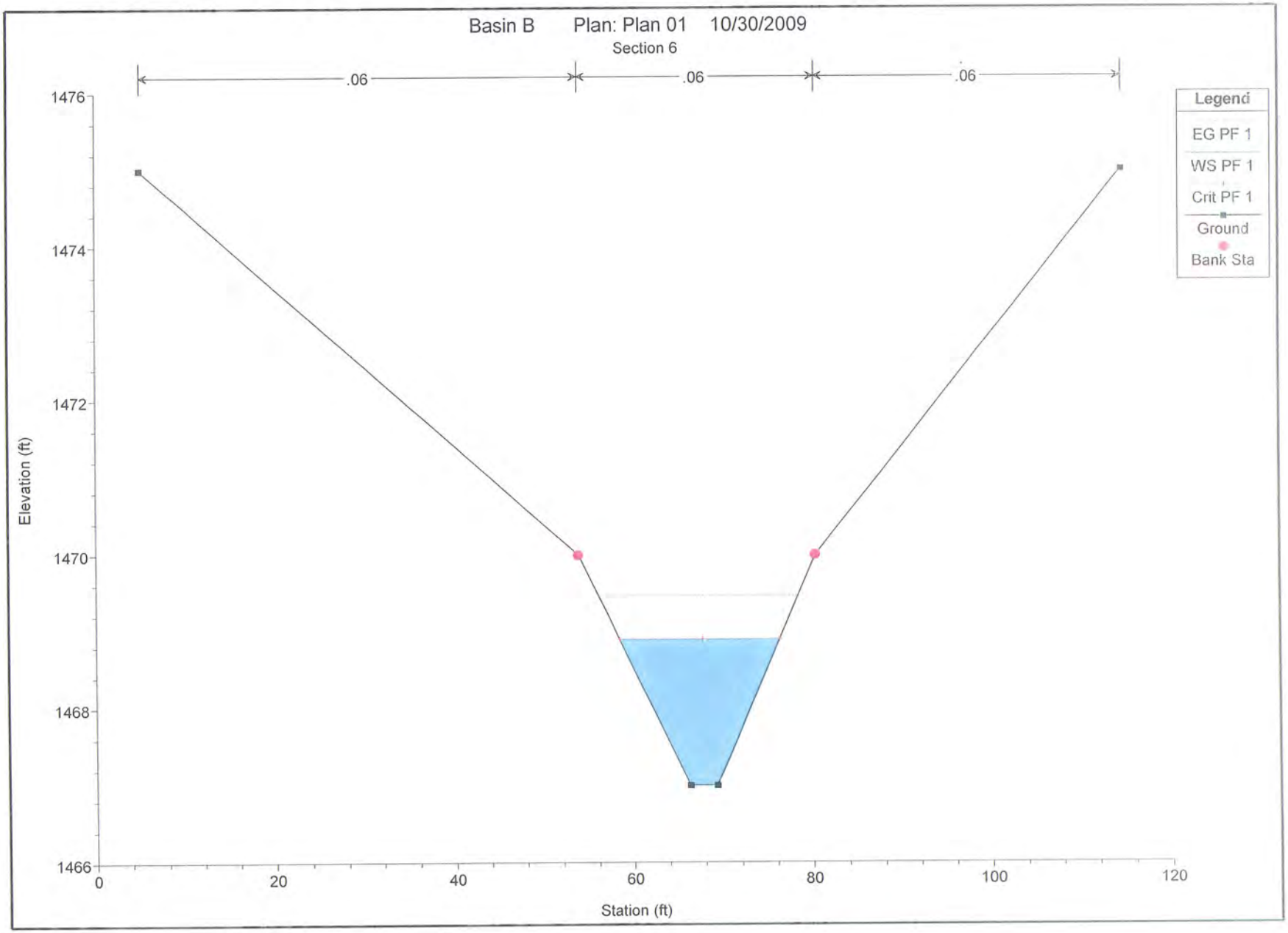

Flood Sections 10-29-09 Plan: Plan 01 10/29/2009
Section 1
.04
.04
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
0
20
40
60
80
100
120
140
160
Station (ft)

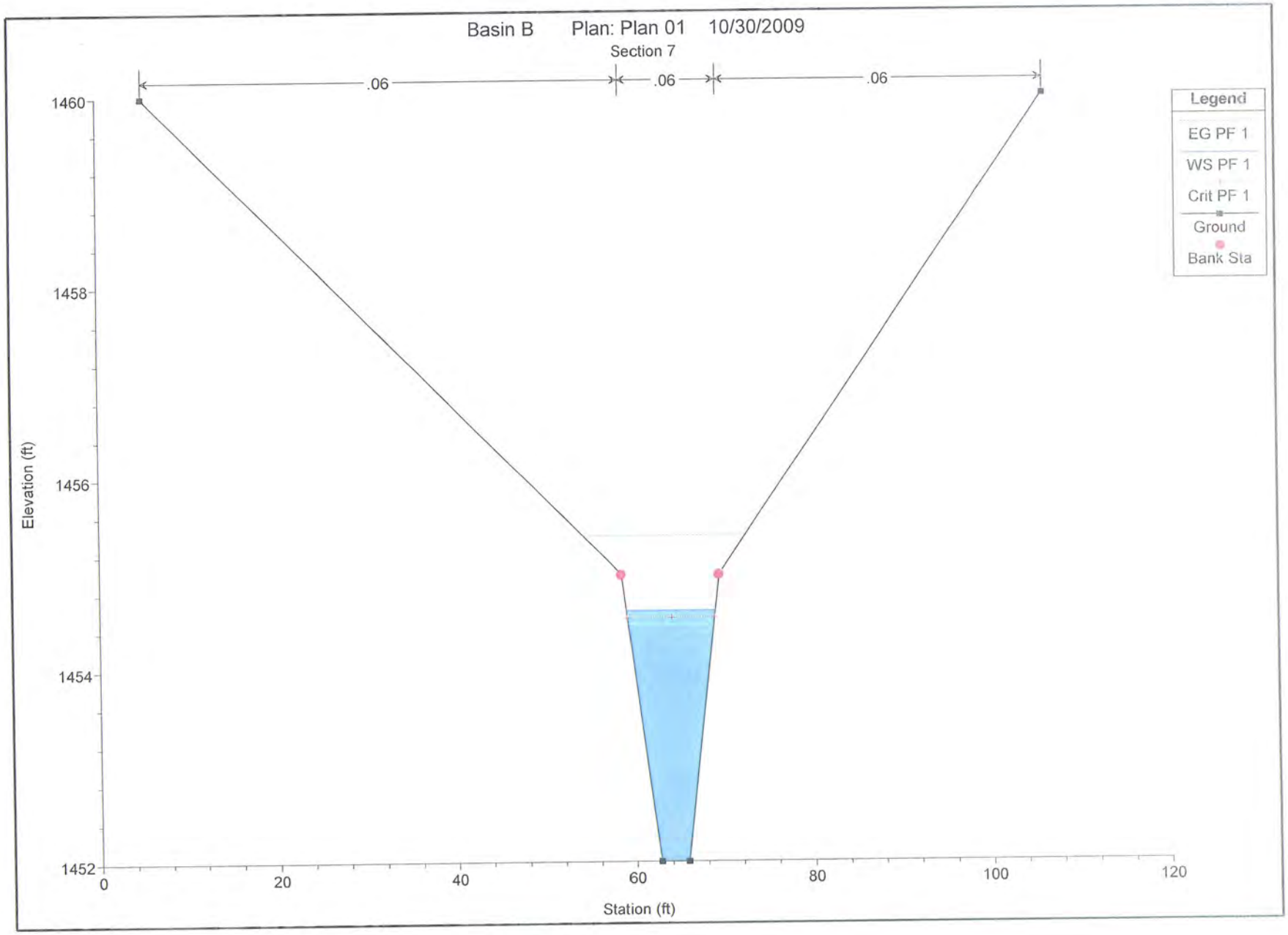

Flood Sections 10-29-09 Plan: Plan 01 10/29/2009
Section 2
.04
.04
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1316
1314
1312
1310
1308
1306
1304
1302
0
50
100
150
200
Station (ft)

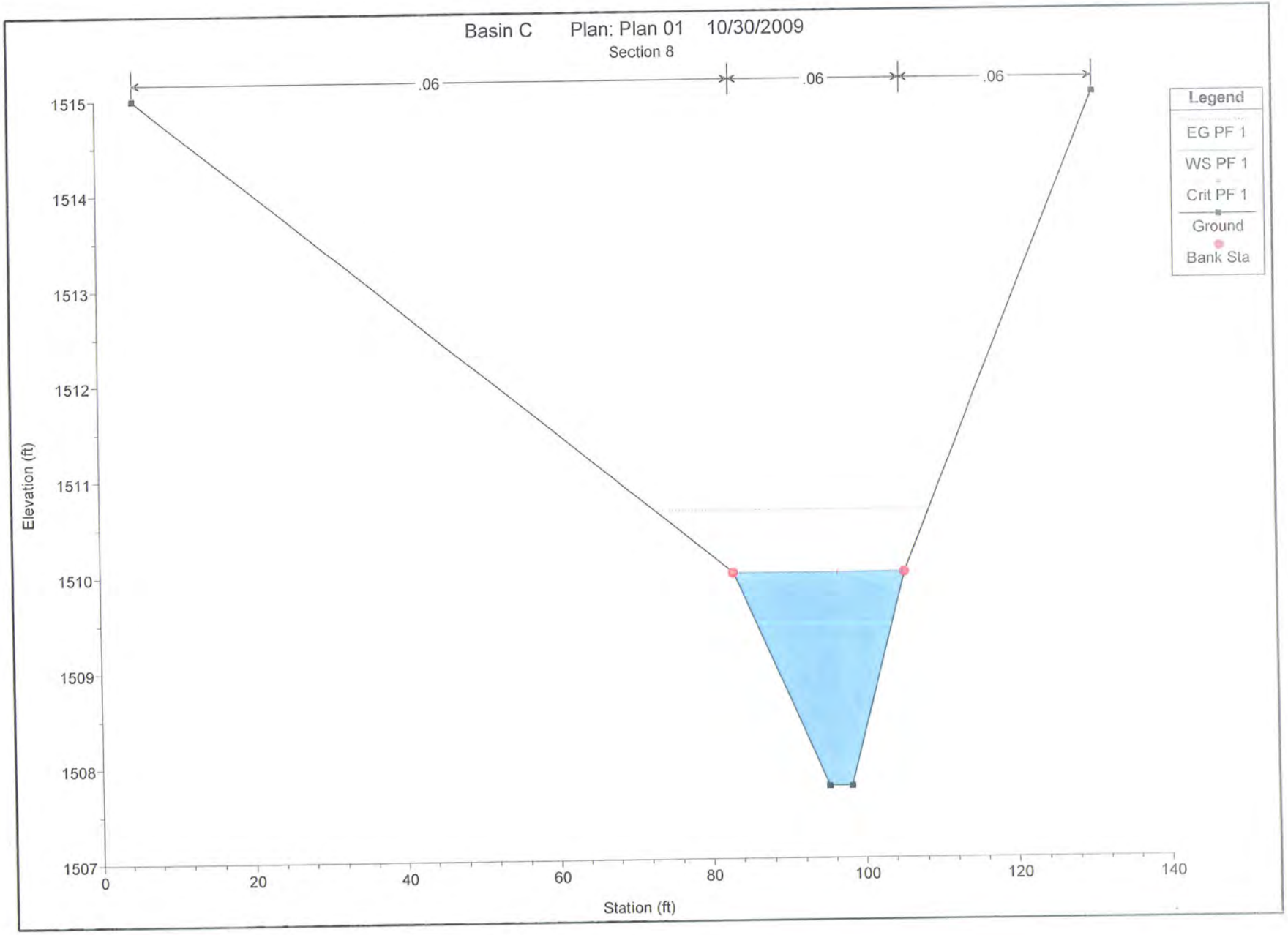

Flood Sections 10-29-09 Plan: Plan 01 10/29/2009
Section 3
.04
.04
.04
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1300
1298
1296
1294
1292
1290
1288
1286
0
50
100
150
200
250
Station (ft)

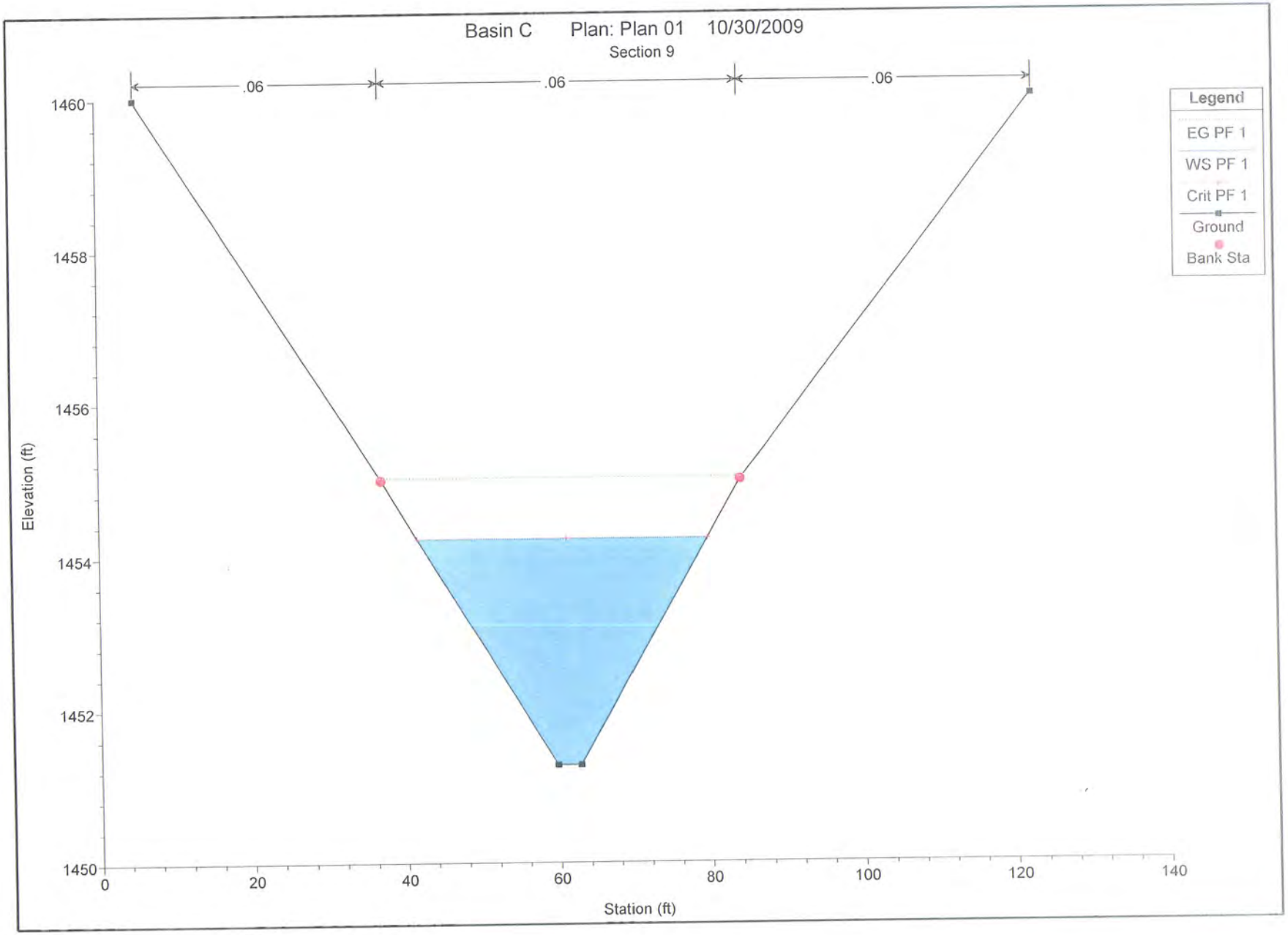

Basin A Plan: Plan 01 10/30/2009
Section 4
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1325
1320
1315
1310
1305
1300
0
20
40
60
80
100
120
140
160
180
Station (ft)


Basin A Plan: Plan 01 10/30/2009
Section 5
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1340
1338
1336
1334
1332
1330
1328
0
20
40
60
80
100
120
140
160
180
Station (ft)


Basin B Plan: Plan 01 10/30/2009
Section 6
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1476
1474
1472
1470
1468
1466
0
20
40
60
80
100
120
Station (ft)

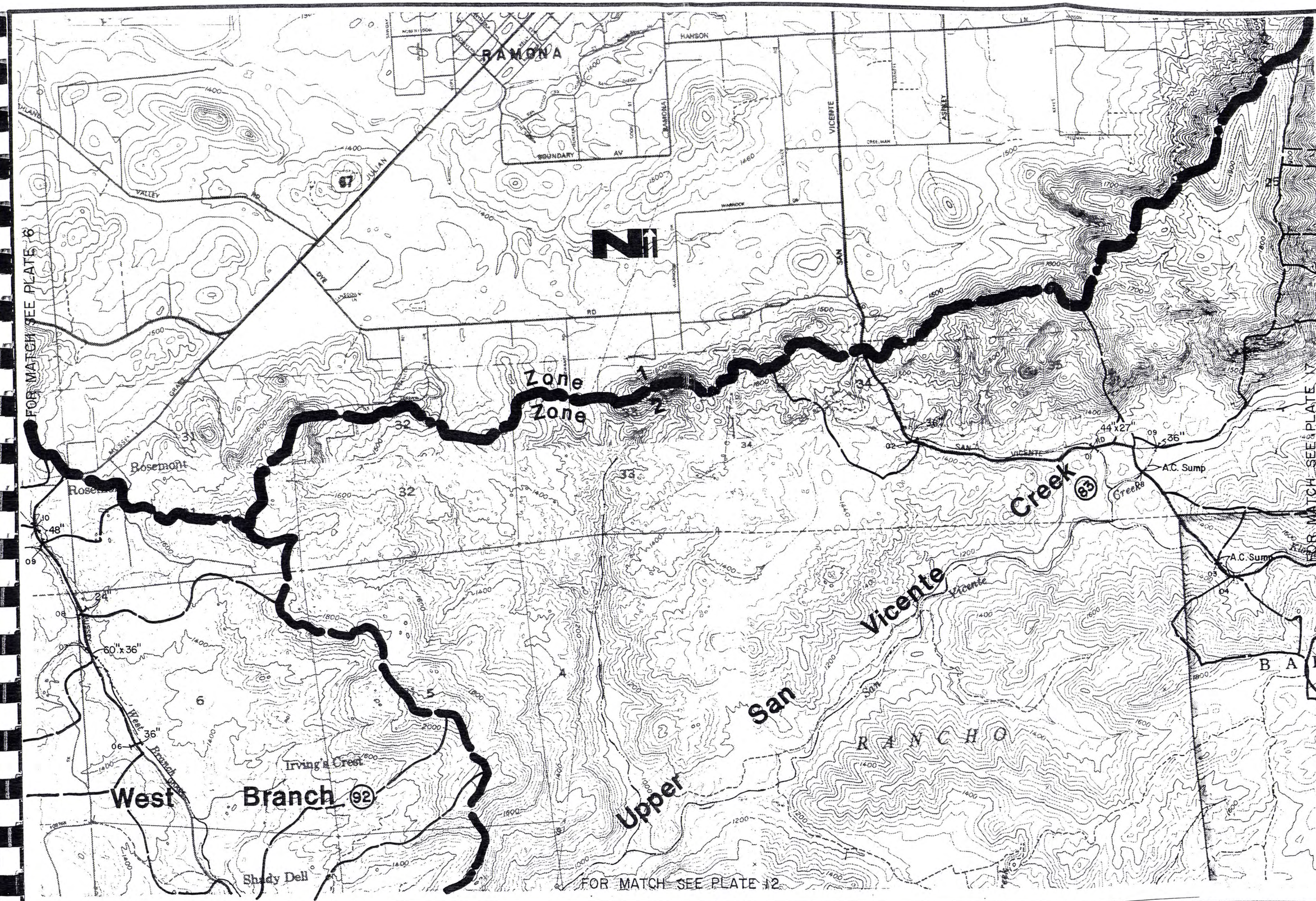

Basin B Plan: Plan 01 10/30/2009
Section 7
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1460
1458
1456
1454
1452
0
20
40
60
80
100
120
Station (ft)


Basin C Plan: Plan 01 10/30/2009
Section 8
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1515
1514
1513
1512
1511
1510
1509
1508
1507
0
20
40
60
80
100
120
140
Station (ft)


Basin C Plan: Plan 01 10/30/2009
Section 9
.06
.06
.06
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1460
1458
1456
1454
1452
1450
0
20
40
60
80
100
120
140
Station (ft)

Section	Velocity
1	9.58 ft/s
2	7.96 ft/s
3	8.18 ft/s
4	8.30 ft/s
5	9.68 ft/s
6	6.04 ft/s
7	7.09 ft/s
8	6.47 ft/s
9	7.17 ft/s

From Exhibit 7



SCALE
1"=2000'
DATE
NOV, 1975

GEORGE S. NOLTE AND ASSOCIATES
8333 CLAIREMONT MESA BLVD.
SAN DIEGO, CALIFORNIA 92111

RECOMMENDED FLOOD CONTROL & DRAINAGE PLAN
ZONE 2
SAN DIEGO COUNTY FLOOD CONTROL DISTRICT

PLATE
11

EXHIBIT 8

UPPER SAN VICENTE CREEK

PLATE NO.	REACH NO.	S.D. CO. G.P. 1990 LAND USE	DRAINAGE AREA (SQ.MI.)	REACH LENGTH (FT.)	LOCATION	EXISTING IMPROVEMENT	CAPACITIES (cfs) EXISTING	ULTIMATE Q_{50}	ULTIMATE Q_{100}	PROBLEMS ASSOC. WITH EXISTING CONDITIONS	RECOMMENDED IMPROVEMENTS	EST. COST (DOLLARS)	PRIORITY
WEST BRANCH													
12	01	S.D. Co. G.P. Low density res. Open space Undeveloped land	1.2	60	Mussey Grade	Unknown			618	Adequate	None - road has reverted to private ownership	0	0
12	02	Lakeside Comm. Plan Open space Undeveloped land	8.7	30	Mussey Grade	20' x 6' bridge	1500		3386	Adequate	None - road has reverted to private ownership	0	0
12	03		8.6	60	Mussey Grade at Fernbrook Dr.	14' x 10' RCB	2100		3343	Minor overflow	None	0	0
12	04		0.4	40	Mussey Grade at Ronan Dr.	Double 30" CMP	125	138		Adequate Some debris build-up	None	0	0
12	05		5.2	50	Mussey Grade n. of Laurel La.	12' x 9' RCB	1650		2065	Minor ponding	None	0	0
11 ~~12~~	06		0.4	60	Mussey Grade n. of Laurel La.	36" CMP	60	145		Minor overflow	None	0	0
11	07		3.4	60	Mussey Grade n. of Laurel La.	60" x 36" CMPA	82		1888	Nuisance flooding	Replace with dbl. 72" RCP	12,000	0
11	08		0.4	60	Mussey Grade n. of Laurel La.	24" CMP	23	253		Nuisance flooding	Replace with 54" RCP	5,000	0
11	09		0.4	60	Mussey Grade n. of Laurel La.	48" CMP	125	240		Minor ponding	None	0	0

Use Rational Method
Q= CIA
Q = Peak flow in cubic feet per second from 100-year, 6-hour storm
Use C = .3 for natural areas (Area A) and .36 for Area B & C (See Exhibit 3)
Use C = .9 for impervious areas
Use I = 3.1 cfs for Basin A (See Exhibit 9)
Use I = 5.5 cfs for Basin B
Use I = 5.4 cfs for Basin C
For Tributary Area for each Building Sub-Area See Exhibit 2

PEAK FLOW FOR NEW DEVELOPMENT

BUILDING AREA	IN DRAINAGE BASIN	TRIBUTARY AREA FOR BLDG. AREA (ACRES)	RUNOFF COEFF. C	INTENSITY (I in/hr)	UNDEVELOPED PROJECT DISCHARGE (Q cfs)	NEW IMPERVIOUS AREA (ACRES)	NEW DEVELOPMENT RUNOFF COEFF. C	COMPOSITE RUNOFF COEFF. C	INTENSITY (I in/hr)	DEVELOPED PROJECT DISCHARGE (Q cfs)	UNMITIGATED NET INCREASE IN PEAK FLOW (Q cfs)	UNMITIGATED PERCENT INCREASE IN PEAK FLOW	MITIGATED PROJECT DISCHARGE (Q cfs)	TOTAL INCREASE IN PEAK FLOW (Q cfs)
1	C	22.70	0.36	5.4	44.1	0.85	0.90	0.38	5.4	46.6	2.5	5.3%	44.1	0.0
2 (S Cluster)	C	1.94	0.36	5.4	3.8	0.23	0.90	0.42	5.4	4.4	0.7	15.1%	3.8	0.0
2 (N cluster)	B	3.45	0.36	5.5	6.8	0.24	0.90	0.40	5.5	7.5	0.7	9.4%	6.8	0.0
3	B	14.12	0.36	5.5	28.0	2.60	0.90	0.46	5.5	35.7	7.7	21.6%	28.0	0.0
4	C	5.59	0.36	5.4	10.9	1.91	0.90	0.54	5.4	16.4	5.6	33.9%	10.9	0.0
6	A	9.28	0.30	3.1	8.6	2.40	0.90	0.46	3.1	13.1	4.5	34.1%	8.6	0.0

TOTAL PROJECT INCREASE WITHOUT MITIGATION 21.6

TOTAL PROJECT INCREASE WITHOUT MITIGATION 0.0

TOTAL PROPERTY AREA 577.8 ACRES
NEW IMPERVIOUS AREA 8.2 ACRES

INCREASE IN RUNOFF WITHOUT MITIGATION 21.6 CFS

TOTAL INCREASE IN RUNOFF WITH MITIGATION 0.0 CFS

EXHIBIT 9

EXISTING FLOWTHROUGH - 50 YR Storm

BASIN	RUNOFF COEFF. C	INTENSITY (I in/hr)	AREA (ACRES)	DISCHARGE (Q cfs)
A	0.30	2.9	674.0	582.8
B	0.36	5.1	123.0	227.5
C	0.36	5.1	157.0	286.0

TOTAL RUNOFF FLOWING BY THE SITE = **1096.2**

BASIN A

C= 0.30
L= 10260.00 FEET
Δ= 1260.00 FEET
S= 12.3 %

50 Yr Isopluvial= 2.80

T_C= 21.5 MINUTES
I= 2.9 INCHES/HR

BASIN B

C= 0.36
L= 3768.00 FEET
Δ= 640.00 FEET
S= 17.0 %

50 Yr Isopluvial= 2.80

T_C= 8.8 MINUTES
I= 5.1 INCHES/HR

BASIN C

C= 0.36
L= 4043.00 FEET
Δ= 744.00 FEET
S= 18.4 %

50 Yr Isopluvial= 2.80

T_C= 9.0 MINUTES
I= 5.1 INCHES/HR

BASIN A Tc Calc.	L in Miles	L in Feet
0.36 hrs	1.94	10260.00
21.5 minutes		

EXISTING FLOWTHROUGH - 100 YR Storm

BASIN	RUNOFF COEFF. C	INTENSITY (I in/hr)	AREA (ACRES)	DISCHARGE (Q cfs)
A	0.30	3.1	674.0	624.4
B	0.36	5.5	123.0	243.7
C	0.36	5.4	157.0	306.4

TOTAL RUNOFF FLOWING BY THE SITE = **1174.6**

BASIN A

C= 0.30
L= 10260.00 FEET
Δ= 1260.00 FEET
S= 12.3 %

100Yr Isopluvial= 3.00

T_C= 21.5 MINUTES
I= 3.1 INCHES/HR

BASIN B

C= 0.36
L= 3768.00 FEET
Δ= 640.00 FEET
S= 17.0 %

100Yr Isopluvial= 3.00

T_C= 8.8 MINUTES
I= 5.5 INCHES/HR

BASIN C

C= 0.36
L= 4043.00 FEET
Δ= 744.00 FEET
S= 18.4 %

100Yr Isopluvial= 3.00

T_C= 9.0 MINUTES
I= 5.4 INCHES/HR

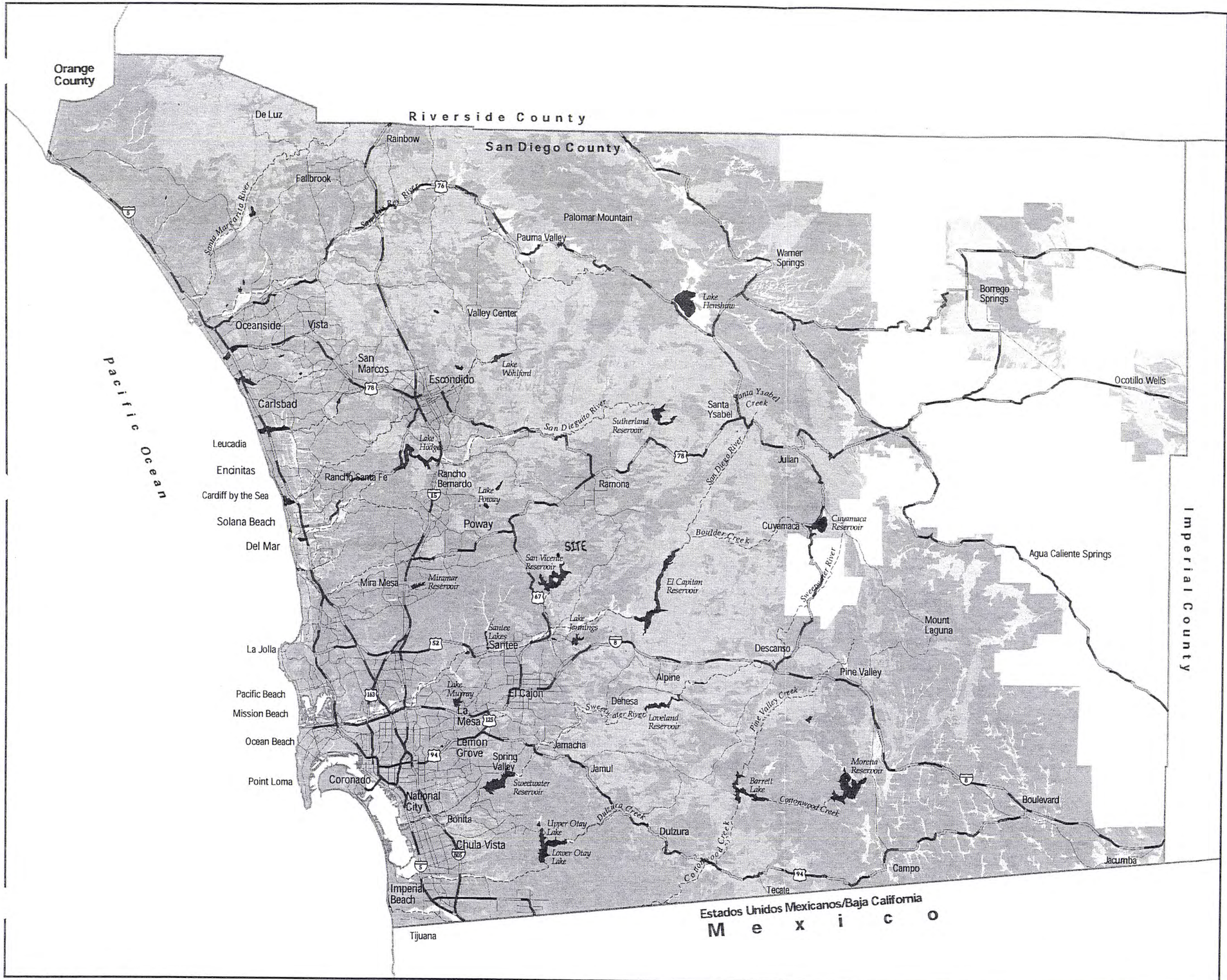
BASIN B Tc Calc.	L in Miles	L in Feet
0.15 hrs	0.71	3768.00
8.76 minutes		

BASIN C Tc Calc.	L in Miles	L in Feet
0.15 hrs	0.77	4043.00
8.97 minutes		

EXHIBIT 10

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

- Group A
- Group B
- Group C ✓
- Group D
- Undetermined (Made or Urban or Gullied or Escarpments)
- Data Unavailable

Map Notes

Stateplane Projection, Zone6, NAD83
Creation Date: June 18, 2001
NOT TO BE USED FOR DESIGN CALCULATIONS

N

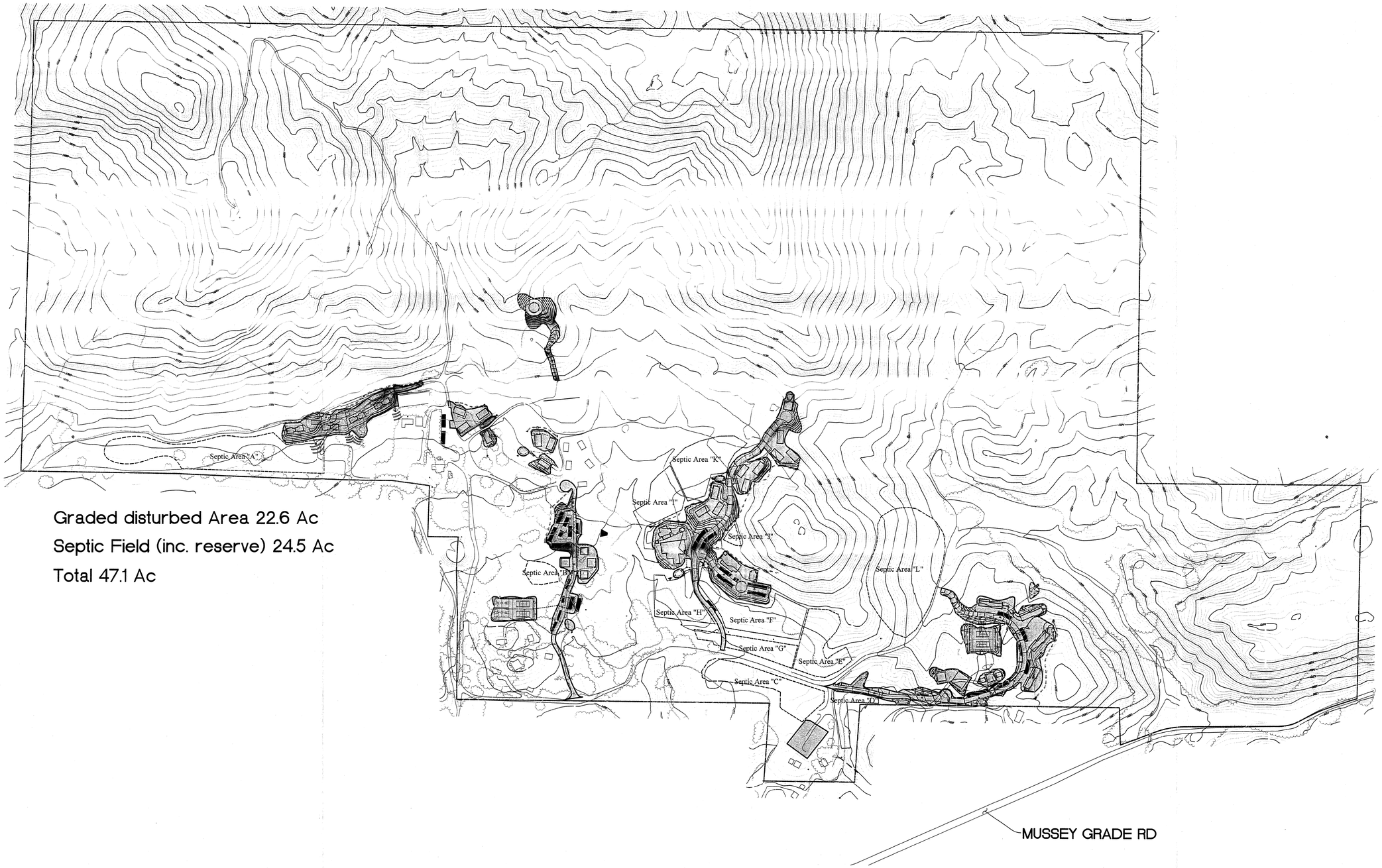
0 7.5
MILES

amec
Earth & Environmental Services

/gis1/cnty_hydro/plots/figamls/cnty.aml

EXHIBIT 11

EXHIBIT 11



Graded disturbed Area 22.6 Ac

Septic Field (inc. reserve) 24.5 Ac

Total 47.1 Ac

DISTURBED AREAS FOR ALTERNATE 1

250 0 250 500 750 1000

SCALE 1" = 250'

NASLAND ENGINEERING

CIVIL ENGINEERING • SURVEYING • LAND PLANNING
4740 Ruffner Street, San Diego, California, 92111 •858-292-7770

THE SALVATION ARMY
DIVISIONAL CAMP AND RETREAT CENTER
RAMONA, CALIFORNIA