BMP
Retrofit
Pilot Program

FINAL RESUBMITTAL
July 31, 1998 (Approved)
June 15, 2000 (Revised)

BASIS OF DESIGN REPORT DRAINAGE DESIGN, DISTRICT 11 PS&E

Caltrans Report ID #: CTSW-RT-98-52

Prepared For:

California Department of Transportation
CALTRANS ENVIRONMENTAL PROGRAM
1120 N St, MS 27
Sacramento, CA 95814
P.O. Box 942874, MS 27
Sacramento, CA 94274-0001

Prepared By:

Robert Bein, William Frost & Associates
Contact Persons:
Scott Taylor, P.E. 43053
Ann Walker, P.E. 57716

JN 34358

TABLE OF CONTENTS

ACRONYMS

AES	Advanced Engineering Software
ac	Acre
acft	Acre feet
BMP	Best Management Practice
Caltrans	California Department of Transportation
cfs	cubic feet per second
GMP	Caltrans Inlet Type
NRDC	Natural Resources Defense Council
PS&E	Plans, Specifications, and Estimates

1.0 Introduction

1.1 General

Pursuant to the District 11 Consent Decree, a BMP Retrofit Pilot Program is required to investigate the constituent removal efficiency, technical feasibility and costs of retrofitting Caltrans facilities with selected Best Management Practices (BMPs). This report documents the design parameters associated with the implementation of Best Management Practices for storm water discharges from the three Caltrans District 11 PS&E sites. Siting information for each of these locations is provided in the report entitled, "BMP Retrofit Pilot Program, Composite Siting Study, District 11" dated May 26, 1998, by Robert Bein, William Frost & Associates. The BMP Pilot Projects discussed in this report are two extended detention basins, and one infiltration basin.

1.2 Objectives

The purpose of this study is to provide design criteria in support of the construction drawings of the three BMP Retrofit Pilot Program projects. Specifically, the objectives of this report are as follows:

- Define hydrologic criteria for the design of the BMPs.
- Develop discharges for the design conditions above.
- Define hydraulic criteria for the design of the BMPs.
- Define design parameters for each BMP.
- Provide technical calculations supporting the drainage facility designs shown on the construction drawings.

1.3 Project Locations

Project and site reference numbers are as indicated in the program *Scoping Study*, dated May 22, 1998 and *Status Report #1,* dated March 30, 1998.

1.3.1 Project 1, Site 1: I-15/SR-78 Extended Detention Basin

The BMP Retrofit Pilot Project at Site 1 is an extended detention basin located at the I-15/SR-78 intersection. The basin is located in the area bounded by the I-15 north /SR-78 east connector to the north, the I-15 southbound mainline to the east, and the I-15 southbound/ SR-78 east connector to the south.

1.3.2 Project 3, Site 1: I-5/SR-56 Extended Detention Basin

The BMP Retrofit Pilot Project at Site 2 is an extended detention basin located south of Carmel Valley Road and west of I-5 at the I-5/SR 56 interchange. The project site is bounded by the I-5

southbound/SR-56 westbound connector to the east, and Old Sorrento Valley Road to the west.

1.3.3 Project 3, Site 2: I-5/La Costa Avenue

The BMP at this site is an infiltration basin located adjacent to the southbound I-5 offramp at La Costa Avenue. The site is bounded by the La Costa Avenue offramp to the East, the Batiquitos Lagoon to the north, La Costa Avenue to the south, and Caltrans R/W to the west.

1.4 Construction Costs

The estimated cost of construction for the three sites is $1,091,694.00. This estimate includes $259,000 allocated for construction of the concrete lining of the I-15/SR-78 extended detention basin. A copy of the Engineer's Estimate is included in Appendix E.

2.0 HYDROLOGIC CHARACTERISICS

2.1 Rainfall Characteristics

San Diego County has a Mediterranean-type climate characterized by long, dry summers and mild winters. The average annual precipitation is about 12 inches and increases to about 18 inches in elevations above 2000 feet. Most of the precipitation occurs form November through March, with little or no rainfall from May through October. The average rainfall depth, calculated using the rainfall obtained from the Averaged Mass Rainfall Plotting Sheets (Appendix A), for a 1-year, 24-hour storm is 1.5 inches.

2.2 Soil Types and Infiltration

Based on the U.S. Soil Conservation Services criteria, soils are classified into four hydrological soil groups: A, B, C, and D, where A is the most pervious with low runoff potential (such as sand or gravel) and D is the least pervious with high runoff potential (such as clay soils).

2.3 Methodology and Procedure

a. The County of San Diego Department of Public Works, Flood Control Division Hydrology Manual, dated January 5, 1985 was the procedure used for hydrologic computations.
b. Hydrologic calculations were performed using the Advanced Engineering Software (AES) Rational Method computer program for the 6-month, 1-year, and 25-year design storms.
c. Rainfall intensities were obtained from the isohyetals provided in the hydrology manual. The 6-month and 1-year 24-hour storms were extrapolated from the 2-year, 24-hour and 6-hour isohyetals. (See Appendix A.)
d. The unit hydrograph procedure was used to compute storm water runoff volumes. User specified rainfall-intensity data was determined by plotting the 6-month, 1-year, and 25-

year, 24-hour storm data on a mass rainfall plotting sheet. The data pairs were then selected and input into the AES Small Area Unit Hydrograph Modeling computer program.

2.4 Summary of Results

The hydrology maps for all sites are located in Appendix C. The hydrology maps show the tributary areas for drainage to the BMP Retrofit sites. Appendix A contains the result of the AES hydrologic calculations for the sites identified in this report.

3.0 WATER QUALITY DESIGN DISCUSSION AND ASSUMPTIONS

3.1 Project 1, Site 1: I-15/SR-78 Extended Detention Basin

The pilot is an in-line, concrete lined, extended detention basin with a tributary area that includes mainline freeway, a collector ramp and some adjacent slope areas for a total tributary area of 13.4 acres. Concrete lining will be deleted from the contract should this element prove to be unnecessary after further discussion with vector control and resource agencies. Inflow to the basin occurs at a single point, the total computed 1-year, 24-hour water quality design volume is 0.91 acre-feet. Flow is discharged through a series of orifices cut into the wall of the riser outlet. The orifices were set at two stages; the 6-month at the basin invert and the 1-year at the 6-month water surface elevation. A summary of the orifice calculations is shown in the table below.

Storm frequency	*Number of orifices*	*Orifice Diameter (in)*	*Orifice Invert (ft)*
6-month	2	1.64	0
1-year	2	1.01	3.35

A debris screen (¼" openings) protects the orifices from clogging as well as providing a 1-foot wide, 180° clear zone flow path. The rim of the riser has been set at the 1-year, 24-hour storage elevation. Less frequent storms will discharge through the top of the riser. An additional riser was provided for the 25-year storm recurrence interval and to pass higher flows. The area surrounding the basin which is disturbed during construction will be stabilized to reduce erosion potential using a hydroseed mix as indicated in the project specifications, Design Directive Memorandum No. 6, and page three of the planting recommendations by Martha Blane & Associates, dated May 12, 1998. (Appendix D.)

Maintenance access is provided at the perimeter of the basin. Storm water samples will be taken using automated equipment at both the basin inflow and outflow points. The discharge to the basin outlets onto a grouted riprap pad, which serves to reduce the outlet velocity and spreads the flow. The basin has a L:W ratio of 10:1.

The basin was designed as an inline facility to capture the tributary watershed for water quality monitoring purposes. In addition, the basin will accommodate less frequent storm events. A canal gate at the basin invert is provided to drain the basin should clogging of the orifice occur. A 30-foot clear zone setback to adjacent ramps and the freeway mainline was maintained adjacent to the basin. An AC pullout was provided to access the maintenance road located at the perimeter of the basin. Basin side slopes are 1:4. The residence time is 72-hours for the 6-month and 1-year storm frequency. Water depths are 3.35 feet and 3.77 feet respectively.

3.1.1 Tributary Drainage Area

The location selected for the Pilot Project is an infield area bounded by existing Caltrans ramps and freeway mainline. A storm drain system discharges to an existing depression, this depression will be enlarged to form the proposed extended detention basin. Outflow from the current depression discharges via an existing 30-inch storm drain system under the SR-78 eastbound/I-15 southbound connector. This existing Caltrans storm drain joins a municipal system near the southerly Caltrans right-of-way.

The existing municipal system connection was not sized to receive additional storm flows other than those currently draining to the proposed basin location. A detailed hydrology study would be required to determine the improvements necessary to the system downstream of the Caltrans right-of-way. Substantial improvements to other downstream facilities could also be necessary as a result of this diversion. An additional study would be required to estimate the costs for such improvements. A general principle of storm water master planning is to design the storm drain system to carry a specified capacity of flow for a particular rainfall return period. The capacities include future development (urbanization) for the watershed based on the area General Plan. By re-directing flow from one storm drain system to another the original storm drain master plan assumptions are violated. Even if excess downstream hydraulic capacity currently exists at a particular site, future development will use this capacity per master planning precepts. Walesh (1989) gives a good overview of the storm drain master planning process. General master planning principles, in combination with specific design criteria (Caltrans, County of San Diego, and local cities as appropriate) define the existing storm drain system capacity. Capacity beyond that required by the master planning process is not provided. Further, urban areas tend to increase in density as they urbanize, further exacerbating storm drain system capacity problems (Walesh, 1989).

Additional drainage area within the Caltrans right-of-way could be diverted to the proposed basin location by modifying the site to provide: 1) additional inflow piping, and 2) an upgrade to the existing outflow piping (see Hydrology Map areas X1 and X2, Appendix C). The cost to divert the additional runoff was estimated to be $314,400. Table 1 itemizes the costs to route an approximate additional 16 acres (Area X1), via the existing 24-inch storm drain, to the BMP site.

The following changes to the storm drain system (within Caltrans right-of-way) would be required:

Table 1

Description	Quantity	Unit Price	Total Cost
Jacking Pit	1 ea	$50,000	$50,000
Receiving Pit	1 ea	$50,000	$50,000
Jacked Pipe	225 lf, 48" RCP	$500	$112,500
Headwall	1 ea	$2500	$2,500
24" Storm Drain	470 lf	$100	$47,000
		Contingency @ 20%	$52,400
		Total	$314,400

Approximately 3 acres (Area X2) of runoff from a portion of the I-15 freeway could theoretically be re-routed to the proposed BMP basin. This would involve jacking under the southbound travel lanes of I-15.

3.1.2 Siting Constraints

The primary constraints on siting of the basin were to 1) maintain a 30-foot clear zone setback from all highway and mainline freeways, 2) provide suitable maintenance ingress and egress, 3) minimize construction costs (removal and land fill expenses) due to the use of the infield area as a disposal site for a demolished bridge. The basin depth was also governed by the invert elevations of the existing storm drain system. Since the inlet and outlet elevations of the existing storm drain systems could not be changed, the basin depth relative to the existing grade was fixed.

The site did provide sufficient space to allow a relative long, linear type layout (10:1 L:W ratio) while still maintaining adequate setback distance from the travel ways and adjacent slope areas. A significant portion of the existing storm drain system (about 220 feet) is being removed to accommodate the basin.

3.2 Project 3, Site 1: I-5/SR-56 Extended Detention Basin

The pilot project is an in-line, earthen, extended detention basin with a tributary area that includes mainline freeway, a collector ramp and some adjacent slope areas for a total tributary area of 5.3 acres. Inflow to the basin occurs at a single point, the total computed 1-year, 24-hour water quality design volume is 0.32 acre-feet. Flow is discharged through a series of orifices cut into the wall of the riser outlet. The orifices were set at two stages; the 6-month at the basin invert and the 1-year at the 6-month water surface elevation. A summary of the orifice

calculations is shown in the table below.

Storm frequency	*Number of orifices*	*Orifice Diameter (in)*	*Orifice Invert (ft)*
6-month	2	1.15	0
1-year	2	0.70	1.48

A debris screen (¼" openings) protects the orifices from clogging as well as providing a 1-foot wide, 180° clear zone flow path. The rim of the riser has been set at the 1-year, 24-hour storage elevation. Less frequent storms will discharge through the top of the riser. A spillway designed for the 25-year storm recurrence interval has been incorporated to pass higher flows. The basin and the surrounding area which is disturbed during construction will be stabilized to reduce erosion potential using a hydroseed mix as indicated in the project specifications, Design Directive Memorandum No. 6, and page three of the planting recommendations by Martha Blane & Associates, dated May 12, 1998. (Appendix D.)

Maintenance access is provided at the perimeter of the basin. Storm water samples will be taken using automated equipment at both the basin inflow and outflow points. The discharge within the basin outlets onto a riprap pad, which reduces the outlet velocity thereby protecting the invert of the basin as well as dispersing the flow. Storm water from the basin discharges to an existing riprap pad, located within an easement, at a sump adjacent to Sorrento Valley Road. The basin side slopes are stabilized with the seed mix shown in the specifications. The basin flowpath geometry is a L:W ratio of approximately 6:1.

The basin was designed as an online facility to capture the tributary watershed for water quality monitoring purposes. In addition, the basin will accommodate less frequent storm events. The site geometry requires a riprap deflection berm to prevent short circuiting the basin. A canal gate at the basin invert is provided to drain the basin should clogging of the orifice occur. An asphalt concrete maintenance road is located above the basin.

3.2.1 Tributary Drainage Area

The existing storm drain system captures about 5.3 acres, which is tributary to the BMP Retrofit site. Flow discharges from the site to the rock slope protected shoulder of Old Sorrento Road. This is an existing outflow condition. Redirecting additional flow to this site would result in additional storm water crossing Old Sorrento Road and discharging directly into the Torrey Pines State Reserve, an environmentally sensitive area.

3.2.2 Siting Constraints

The site was selected as a conversion of a desilting basin constructed as a part of the new I-5/SR-56 interchange work. The basin site is constrained by slopes, structures or right-of-way on each boundary; however, some modifications to expand the available area were incorporated. A portion of the site was used as a disposal area for excess earth associated with the interchange construction. This fill was removed as a part of the design of the basin (along the easterly boundary) and the basin was designed to complement the existing 2:1 slope (ramp embankment). To the west, Old Sorrento Road and Caltrans right-of-way provide the boundary of the work, and to the south, an existing 2:1 slope and the Caltrans right-of-way are a constraint. Given these constraints, the site area was maximized for the retrofit project and neither additional tributary area nor expansion of the size of the facility is practical.

3.3 Project 3, Site 2: I-5/La Costa Avenue Infiltration Basin

The pilot is an off-line, infiltration basin with a tributary area that includes mainline freeway, an off ramp and some adjacent slope areas for a total tributary area of 3.2 acres. Inflow to the basin occurs at a single point, the total water quality design volume is 0.20 acre-feet. Flow percolates into the ground through permeable soils. The average in-drill hole permeability rate for this site is $2(10^{-5})$ ft/s (0.86 in/hr or $6.2(10^{-4})$cm/s). The depth to the seasonal high water table from existing ground is about 8 feet. The rim of the basin has been set at the 1-year, 24-hour storage elevation. The basin and the surrounding area which is disturbed during construction will be stabilized to reduce erosion potential using a hydroseed mix as indicated in the project specifications, Design Directive Memorandum No. 6, and page three of the planting recommendations by Martha Blane & Associates, dated May 12, 1998. (Appendix D.)

Maintenance access is provided at the perimeter of the basin. Ground water samples will be obtained at a well located downstream from the infiltration basin. The discharge to the basin outlets onto a riprap pad. The basin side slopes are stabilized with the seed mix shown in the specifications.

The basin was designed as an offline facility to capture the tributary watershed for water quality monitoring purposes. The existing inlets located at the southbound edge of shoulder will be replaced to accommodate the one-year storm water quality peak flow. The existing outflow pipes were reconnected to the proposed inlet at the existing invert elevation. A flow restrictor plate was used to reduce diversion of less frequent storm events. The depth of the infiltration basin was restricted by the elevation of the ground water table. The potential existing wetland areas and the 30-foot clear zone setback also confine the shape and location of the basin.

3.3.1 Tributary Drainage Area

The area tributary to this retrofit pilot site is 3.2 acres. The area tributary to the site in the existing condition is about 1.5 acres. It was feasible to divert additional area to this site because a) the diversion could be accomplished without a costly jacking operation, and b) the site

discharges directly to the Batiquitos Lagoon, and no downstream storm drain systems are impacted. The cost for constructing the pipe and manholes along the southbound I-5 shoulder to direct the additional flow to the site is approximately $75,000. It is not feasible to direct any additional flow to the site for two reasons. First, the redirection of additional flow would require jacking of a storm drain under the La Costa Avenue offramp with the associated expense of such an operation (estimated at about $250,000). Second, based on field observations, the flow line elevation of the storm drain inlets along the mainline freeway are at or near the elevation of the seasonal high ground water table. If additional runoff were diverted to the basin, the potential for mainline flooding would be exacerbated due to an increase of the hydraulic grade line at the basin outlet.

3.3.2 Site Constraints

The site at La Costa Avenue (west) is constrained by the existing Caltrans offramp to the east, existing Caltrans right-of-way to the west, and jurisdictional wetland areas to the west, north and south. The project biologist provided a preliminary review of the site and determined that potential jurisdictional wetland areas occur directly to the south of the basin site (as evidenced by a large depression and wetland plants established there) and directly to the west and north. A more detailed assessment was done in the area of the basin in order to confine the construction to non-jurisdictional area, as shown on the Hydrology Map. The area to the north begins encroaching on the upland portion of the Batiquitos Lagoon. The area available for the infiltration basin could be marginally expanded; however, construction begins to encroach on two large Canary Island palm trees and the potential wetland. The relocation of the trees was determined to be undesirable due to the additional costs. To the east, the site is constrained by the La Costa Avenue offramp and the 30-foot clear zone setback.

4.0 HYDRAULIC ANALYSIS – ALL LOCATIONS

4.1 Design Criteria

Technical references include the Caltrans Highway Design Manual (Caltrans 1997), and the Caltrans Storm Water Quality Handbook, Planning and Design Staff Guide (Caltrans 1996) and the project *Scoping Study*.

4.2 Methodology and Design Procedures

a. The inlet capacity for the GMP and modified GMP inlets with debris rack cages over the top of the inlet was calculated using “Figure 6.1-5: Circular Riser Inflow Curves”, from the U.S. Department of Agriculture.
b. The orifice opening was calculated using the orifice equation cited in the Caltrans Storm Water Quality Handbook, Planning and Design Staff Guide.

c. Full pond drawdown time of 72-hours.
d. The surface area is computed from the 1-year water runoff volume.

4.3 Summary of Results

The extended detention basin risers will control the water quality inflow to achieve the desired detention time, and discharge storm events greater than the one year water quality volume with less attenuation. The infiltration basin has been designed as an offline device. The peak water quality inflow will be directed to the infiltration basin, the portion of the storm with a peak discharge in excess of the 1-year 24-hour storm will bypass the facility. Hydraulic calculations are provided in Appendix B.

REFERENCES

BMP Retrofit Pilot Program, Scoping Study, Caltrans District 11 prepared by Robert Bein, William Frost and Associates dated May 22, 1998.

BMP Retrofit Pilot Program, Composite Siting Study, District 11 prepared by Robert Bein, William Frost and Associates dated May 26, 1998.

California Department of Transportation (Caltrans), *Highway Design Manual.* Fifth Edition. March 1997.

Caltrans Storm Water Quality Handbook, Planning and Design Staff Guide (Caltrans 1996).

County of San Diego, Department of Public Works, Flood Control Division, Hydrology Manual, dated January 1985.

Pre-Construction Geotechnical Evaluation Report, Caltrans Storm Water Runoff Study, Retrofit Facilities, District 11, San Diego County California prepared by The LKR Group dated March 18, 1998.

Walesh, Stuart G., *Urban Surface Water Management,* John Wiley & Sons, Inc, New York, 1989.

APPENDIX A HYDROLOGY CALCULATIONS

GOAL: FIND 1YR-24 hr. Storm. 0.2 "/hr x 24 = 1.2

ASSUME: The 1yr data can be extrapolated from the 2yr. data.

From County of SD Hydrology Manual, p. II-A-2 Isopluvial map. for 2-YR/24-hr precipitation: (1yr isopluvials don't exist)

(Isopluvial Maps) Site	2YR/24 HR Isopluvial (0.1")	25yr 24hr.	2YR/6 HR Isopluvial (0.1")	25yr 6hr
SR-56/I-5 //	16 ~ 1.6"	31	10 ~ 1.0"	17
(2) MANCHESTER AVE/I-5 //	16	31	10	17
(2) La Costa Ave./I-5 ✓	17	32	12	~~16~~ 17
SR-78/I-15 //	24	48	15	26
* SR-78/MELROSE DR.	22	43	15	25
(2)* CALSBAD MS	18	36	12	20
* KEARNY MESA MS	16	31	11	18
* Palomar Airport Rd./I-5	18	35	12	20
* SR-78/I-5	18	34	12	20
* Escondido MS	22	45	15	24

From I-D-F curves (App. XI) at t = 1 hr

$$2yr = 0.61 \text{ in/hr}$$
$$1yr = 0.48 \text{ in/hr}$$

$$\text{Conversion Factor} = \frac{0.48}{0.61} = 0.787$$

Now using the values above and the correction factor, plot 2 points on B-15 graph (Mass Curve) to draw the new 1 yr.-24 hr line.

example w/ SR78/I-15 (Isopluvials 2YR/24 HR = 2.4 in., 2YR/6HR = 1.5 in)

$$1\text{-YR } 6\text{HR TOT} = \underset{CF}{0.787}(1.5 \text{ in}) = 1.18 \text{ in}$$
$$1\text{-YR } 24\text{HR TOT} = 0.787(2.4 \text{ in}) = 1.89 \text{ in}$$

> two points on mass curve.

I-5/La Costa

~~1yr 6hr tot = 0.787 (1.2) = 0.94 in~~
~~1yr 24hr tot = 0.787 (1.7) = 1.34 in~~

JN 3A358

S 2998F
AMW

6 MOS - 24 HOUR STORM

SD DEPT PUBLIC WORKS FLOOD CONTROL - HYDROLOGY MANUAL

1YR, 2YR + 5YR STORM EXTRAPOLATION

FROM THE RAINFALL INTENSITY - DURATION - FREQUENCY CURVES

STORM FREQUENCY	Δ	DURATION (HRS)	INTENSITY $\frac{IN}{HR}$	RATIO
6MOS		1	Y	
	0.5			X
1YR		1	0.48	
	1.0			0.7869
2YR		1	0.61	
	3			0.7821
5YR		1	0.78	

6-MOS / 1YR RATIO:

Δ	RATIO
0.5YR	X
1YR	0.7869
3YR	0.7821

$X = (0.7821) + \frac{Z}{0.5}(0.0048)$

$X = 0.8013$

6-MOS / 1YR INTENSITY:

$Y = 0.48(X)$

$= 0.48(0.8013)$

$= 0.3846 \frac{IN}{HR}$

STORM DURATION PTS FOR THE RAIN MASS CURVE

$\frac{\text{6 MOS}}{\text{2 YR}}$ INTENSITY RATIO $= \frac{0.3846 \frac{IN}{HR}}{0.61 \frac{IN}{HR}} = 0.6305$

I-5/SR-56: (ISOPLUVIALS 2YR-24HR = 1.6 IN, 2YR-6-HR = 1.0 IN)

6-MOS 24-HR = INTENSITY RATIO (INCHES OF RAIN)

$= 0.6305(1.6\text{ IN}) = 1.0088\text{ IN}$

6-MOS 6-HR = $0.6305(1.0\text{ IN}) = 0.6305\text{ IN}$

I-15/SR-78: (ISOPLUVIALS 2YR-24HR = 2.4 IN, 2YR-6HR = 1.5 IN)

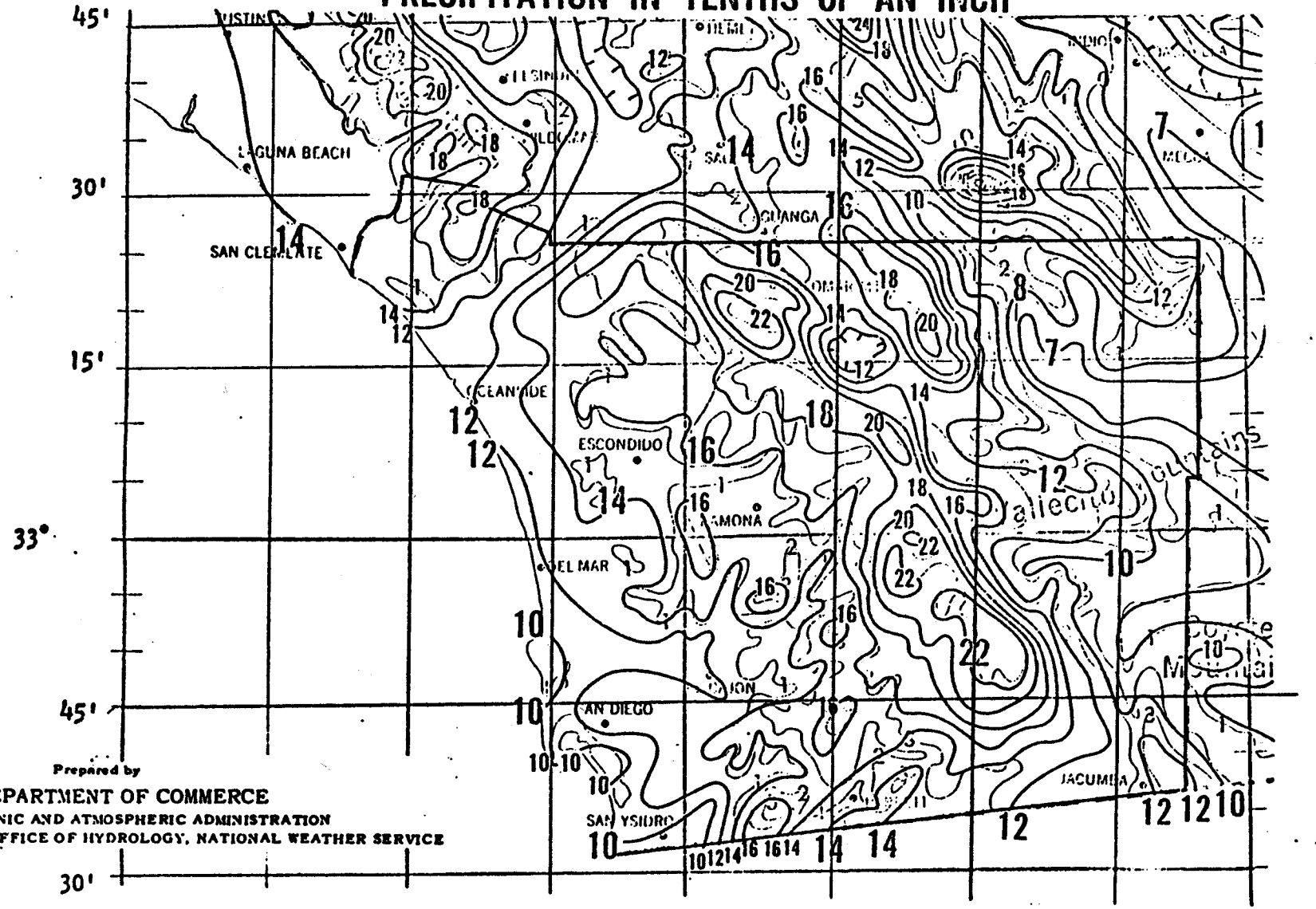
6-MOS 24-HR = $(0.6305)(2.4\text{IN}) = 1.5132\text{ IN}$

6-MOS 6-HR = $(0.6305)(1.5\text{ IN}) = 0.9458\text{ IN}$

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



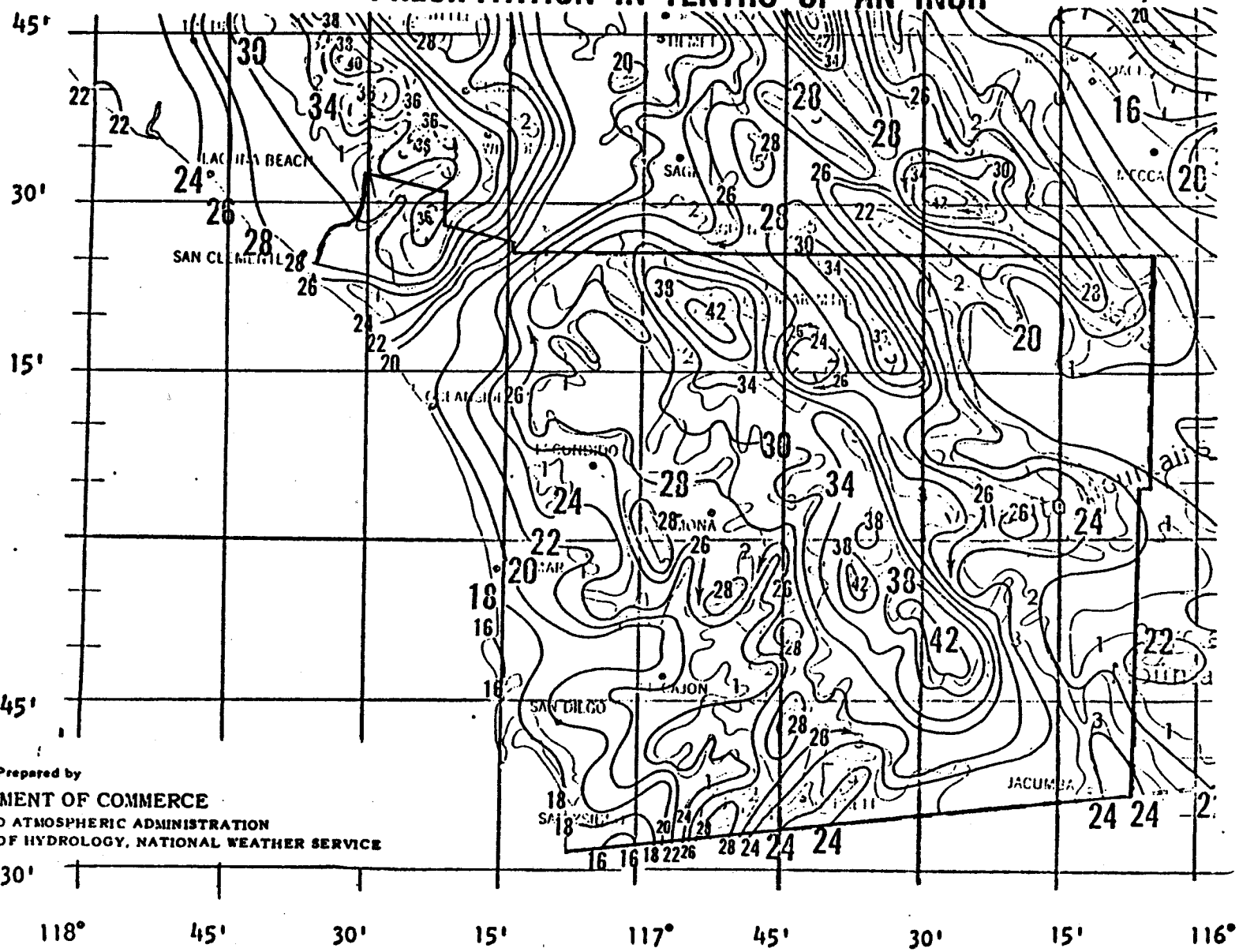
Prepared by

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH

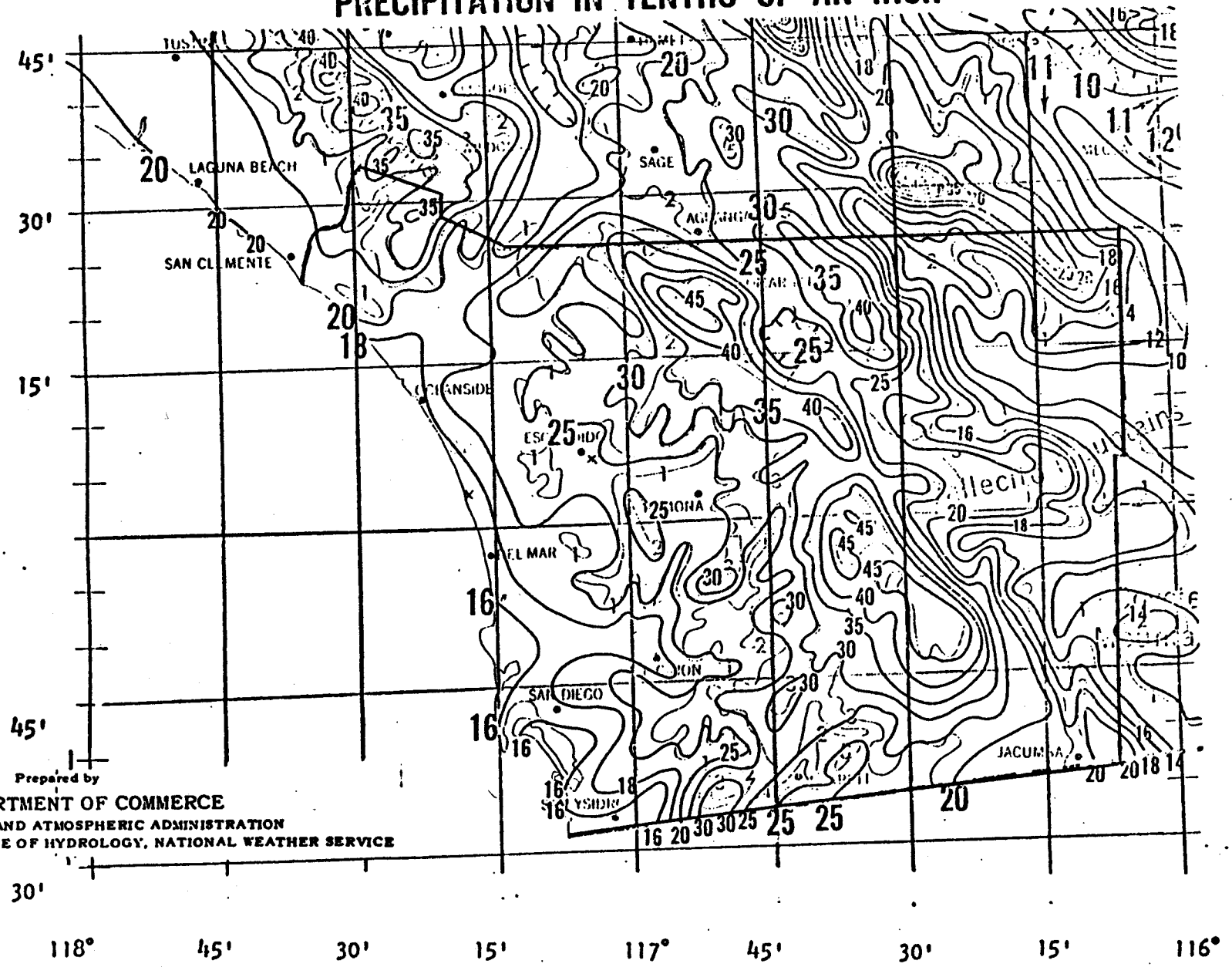


Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



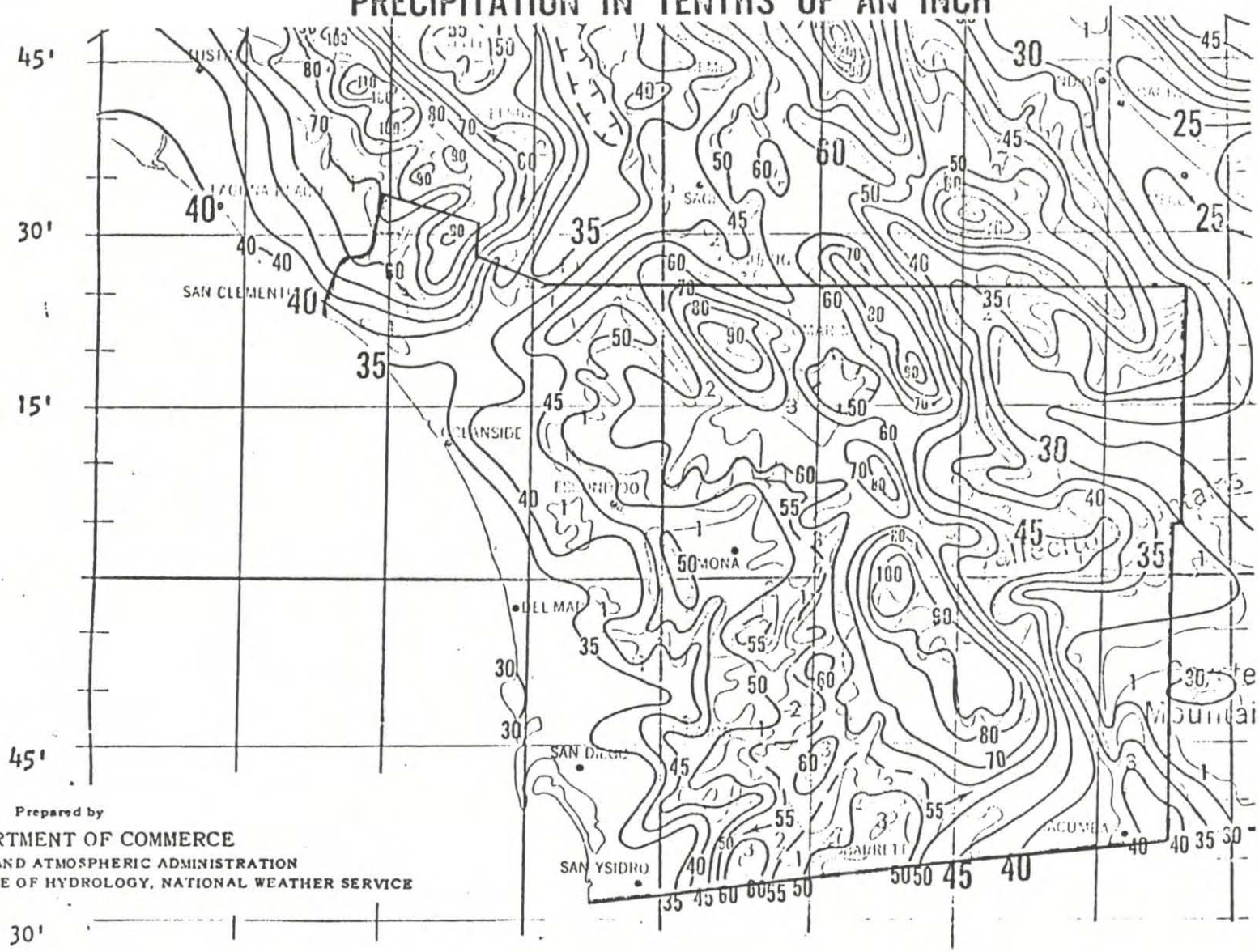
Prepared by

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

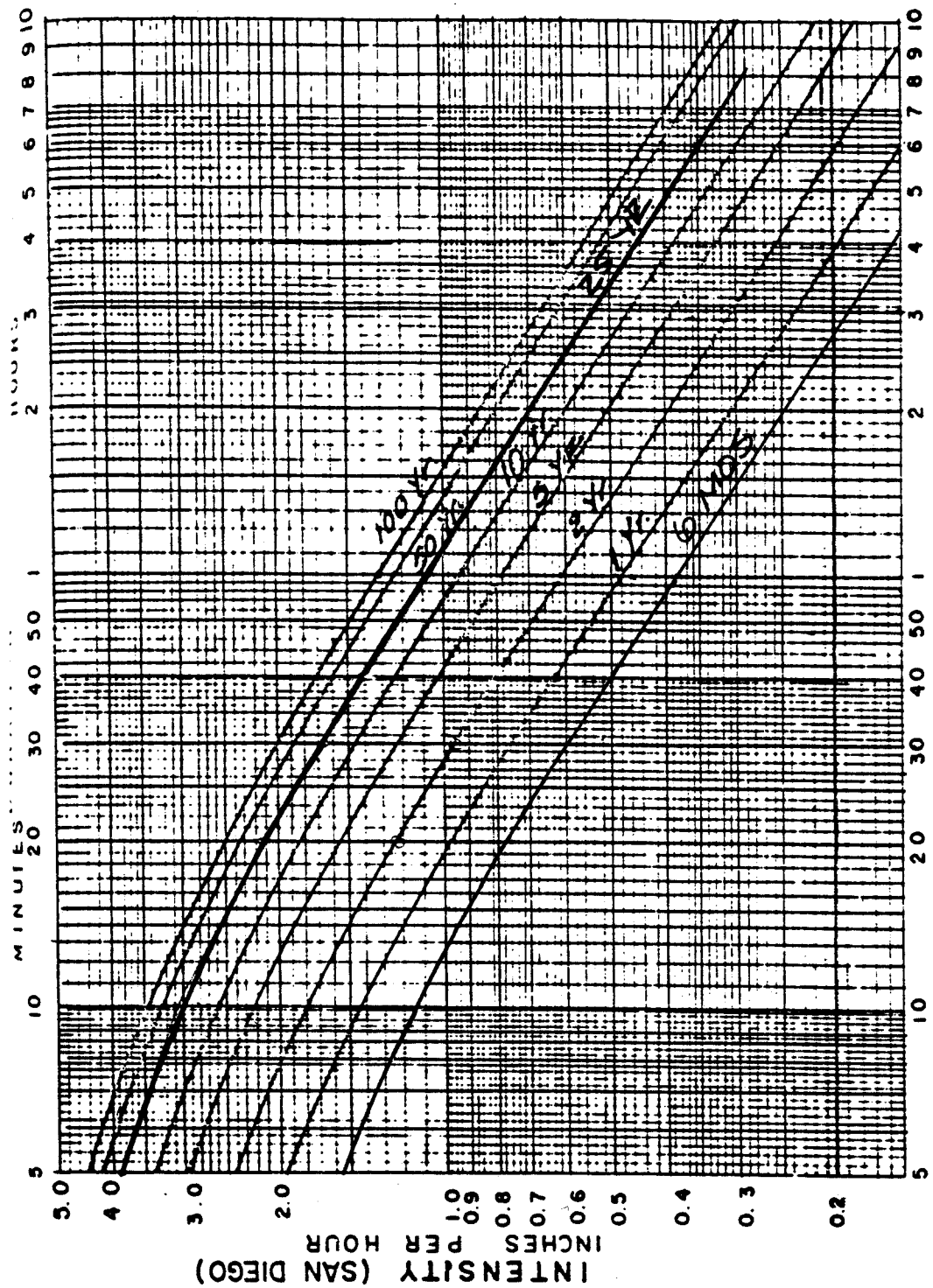
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

(20) ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE



ELEV.	FACTOR
0–1500	1.00
1500–3000	1.25
3000–4000	1.42
4000–5000	1.60
5000–6000	1.70
DESERT	1.25

To obtain correct intensity, multiply intensity on chart by factor for design elevation.

RAINFALL

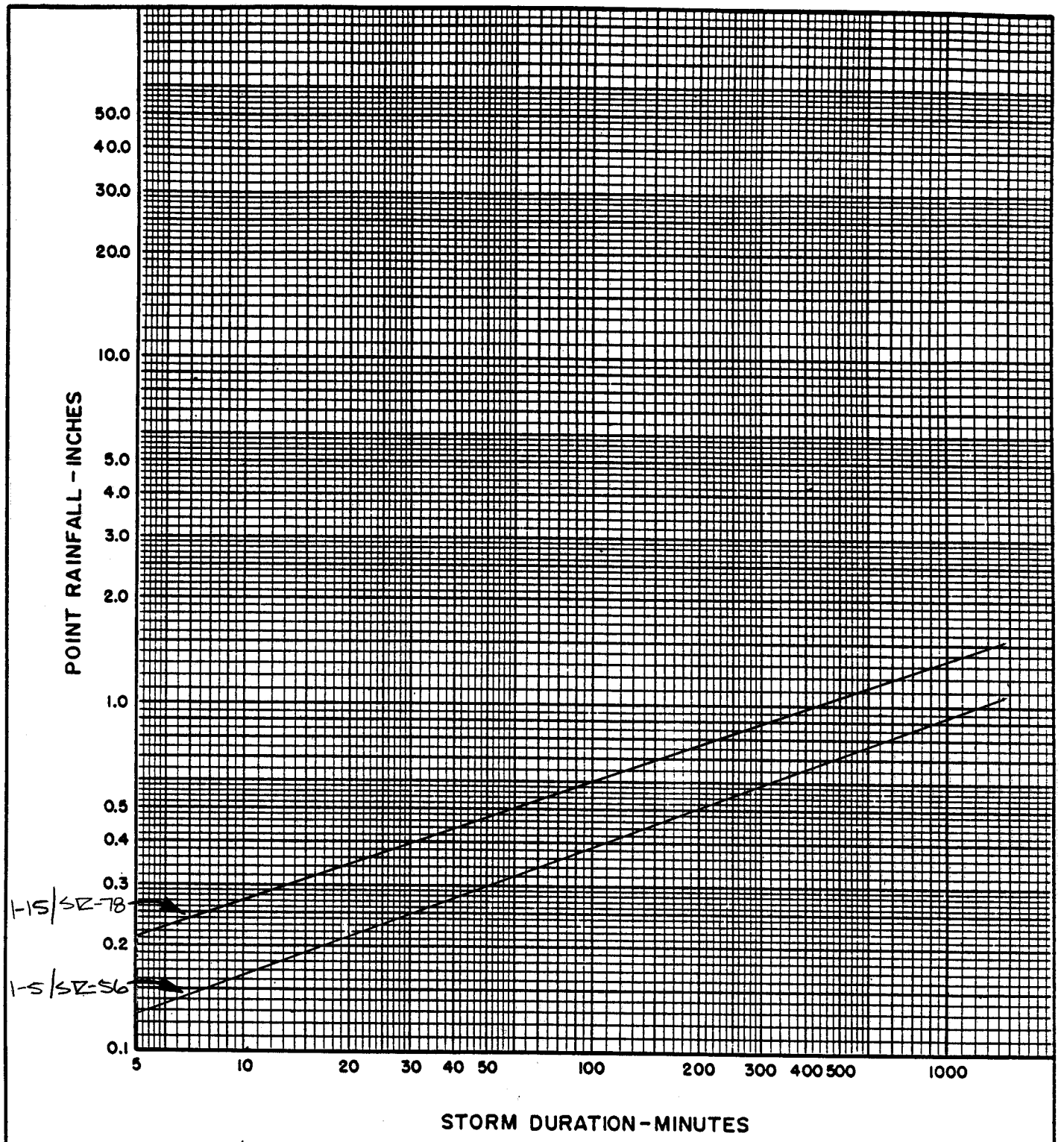
INTENSITY – DURATION – FREQUENCY

CURVES

for

COUNTY OF SAN DIEGO

APPENDIX XI

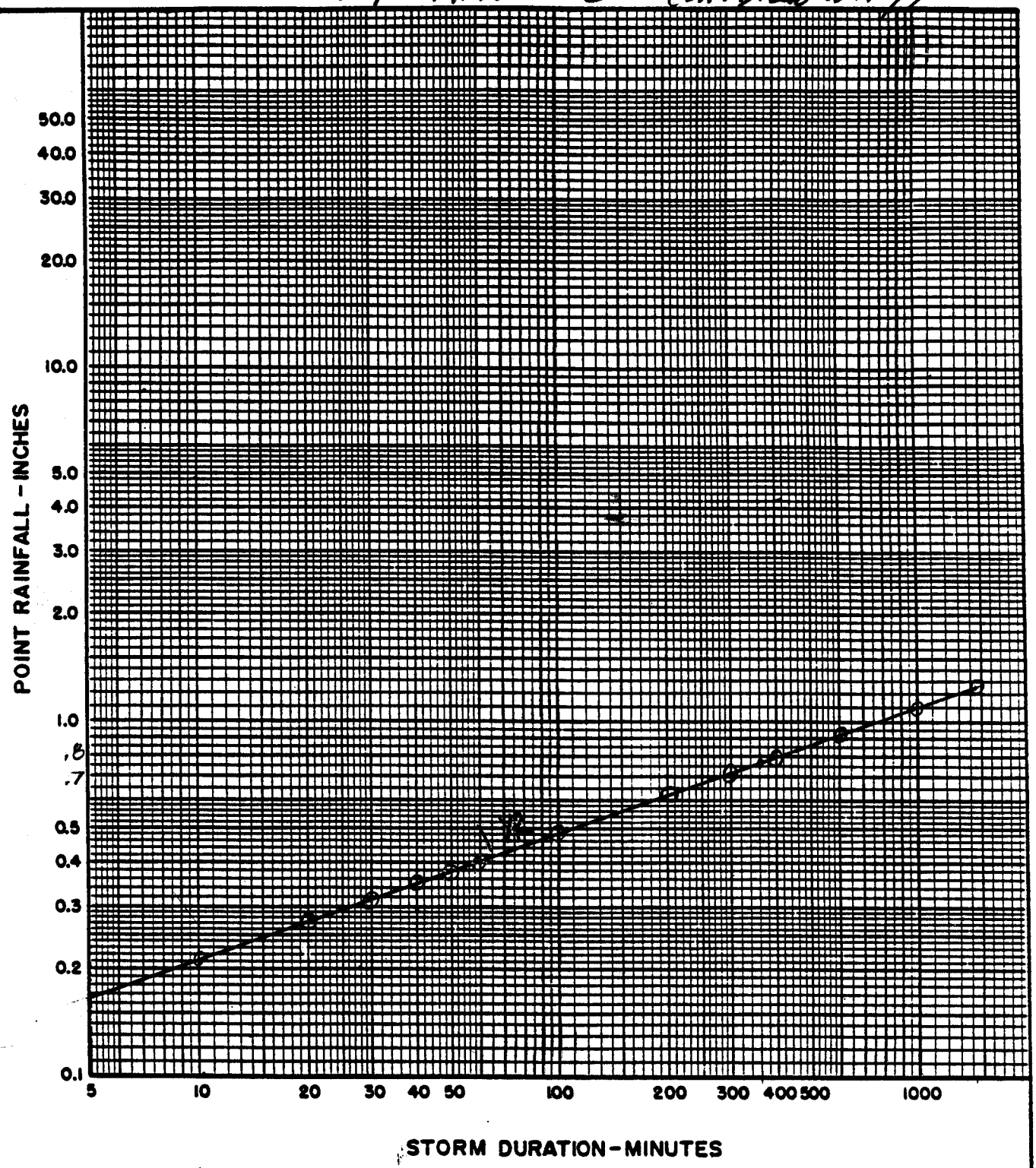


PROJECT LOCATION SAN DIEGO

NOTES

6MOS AREA - AVERAGED MASS RAINFALL PLOTTING SHEET

1-YR MASS CURVE (SAN DIEGO COUNTY)



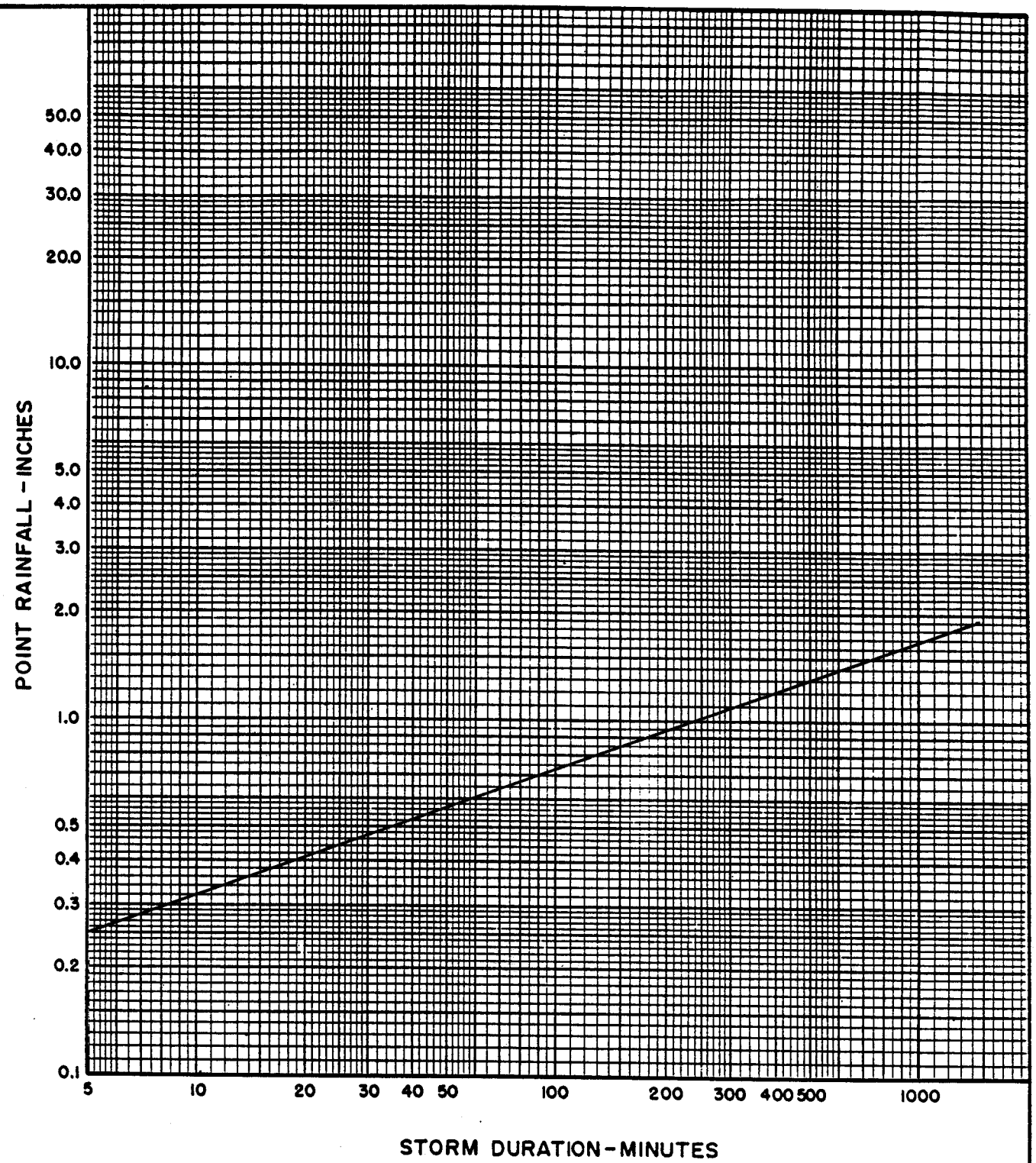
PROJECT LOCATION SR56/I5

NOTES 2-YR 6HR TOT. = 1.0 IN 2-YR 24HR TOT = 1.6 IN (Isopluvial Data)
Application of Factor Gives ⇒ 1-YR 6HR TOT = 0.787 IN 1-YR 24HR TOT = 1.26 IN

2-YR (60 MIN.) INTENSITY = 0.61 IN/HR
1-YR (60 MIN) INTENSITY = 0.48 IN/HR
FACTOR = $\frac{0.48}{0.61}$ = 0.787

1 YR AREA - AVERAGED MASS RAINFALL PLOTTING SHEET

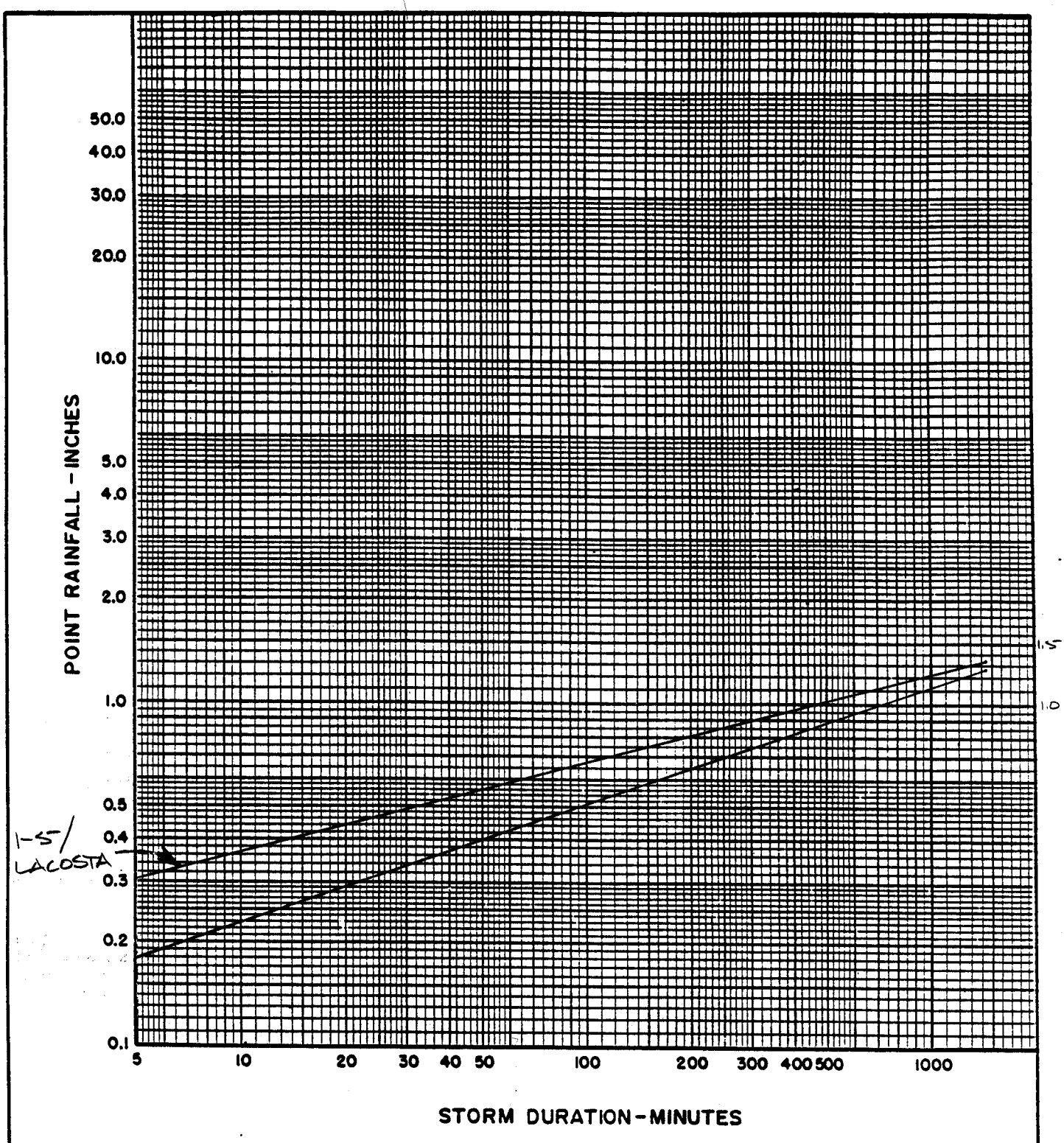
Figure B-7



PROJECT LOCATION I-15 / SR-78

NOTES

I 4R2 AREA - AVERAGED MASS RAINFALL PLOTTING SHEET



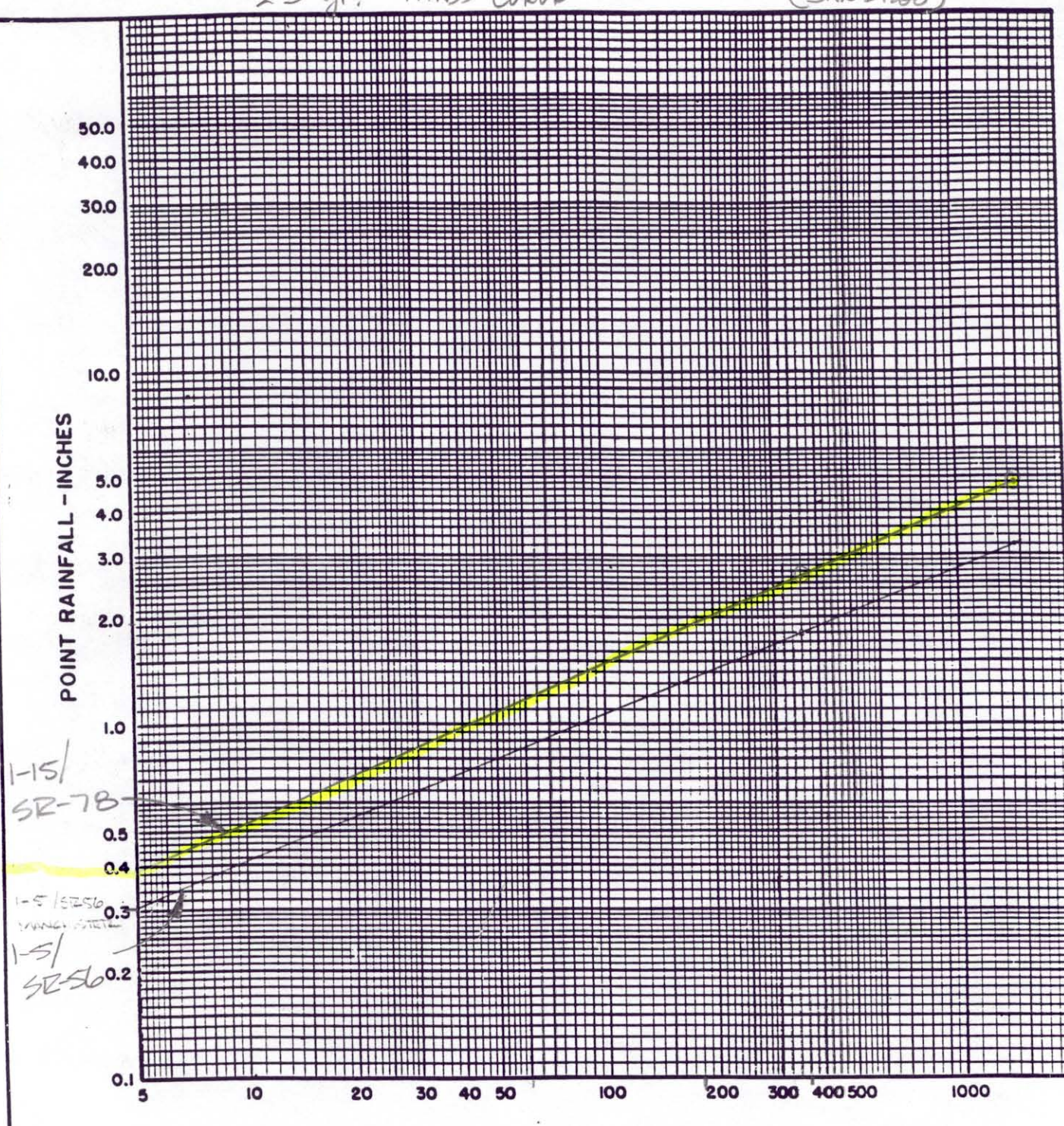
PROJECT LOCATION 1-5 LACOSTA

NOTES REVISED 1-YR - 24HR MASS RAINFALL 2998M

1YR AREA - AVERAGED MASS RAINFALL PLOTTING SHEET

Figure B-7

25-yr. MASS CURVE (SAN DIEGO)



PROJECT LOCATION I-5/SR-56 & I-15/SR-78

NOTES 25 YR 24 HR MASS RAINFALL

78/15

5 min	0.39
30	0.95
1 hr	1.17
3	1.93
6	2.60
24	4.80

25-YR AREA - AVERAGED MASS RAINFALL PLOTTING SHEET

Figure B-7

ROBERT BEIN, WILLIAM FROST & ASSOCIATES
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS
14725 ALTON PARKWAY, IRVINE, CA 92618-2069 • P.O. BOX 57057, IRVINE, CA 92619-7057
714.472.3505 • FAX 714.472.8373

JOB Rial Tracts
SHEET NO. 3856/E5 OF
CALCULATED BY JCS DATE
CHECKED BY DATE
SCALE

Loss Rates

$F_p = 0.25$

$a_p = \frac{1.32}{4.17} = 0.31$ (4.26)

$F_m = a_p f_p = 0.0775$

$I_a = 0.2\,S$

$S = \frac{1000}{CN} - 10$

$CN = 90$ Laguna
$= 86$ Basin & Slopes } Composite 88.73

$S = 1.27$

$I_a = 0.25$

$I_a = 0.254$

$Y_j = \frac{(P_{24} - I_a)^2}{(P_{24} - I_a + S)P_{24}} = 0.353$

$P_{24} = 1.26$ in.

$\overline{Y} = 1 - Y$

$Y = Y_j$

$\boxed{\overline{Y} = 0.647}$

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
        (c) Copyright 1982-96 Advanced Engineering Software (aes)
            Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                    Robert Bein, William Frost & Associates
                              14725 Alton Parkway
                               Irvine, CA  92618


 ************************* DESCRIPTION OF STUDY *************************
* JN 34358 I-5/SR-56 EXTENDED DETENTION BASIN                            *
* 6-MONTH STORM FREQUENCY                                                *
* AMW                                                                    *
 **************************************************************************

  FILE NAME: SR56I56M.DAT
  TIME/DATE OF STUDY: 10:19   5/30/1998
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  1.550
   2)  10.000;  1.140
   3)  20.000;   .780
   4)  30.000;   .600
   5)  40.000;   .500
   6)  50.000;   .435
   7)  60.000;   .385
   8) 120.000;   .248
   9) 180.000;   .188
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.01 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "C"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
  INITIAL SUBAREA FLOW-LENGTH =  1230.00
  UPSTREAM ELEVATION =      50.50
  DOWNSTREAM ELEVATION =    37.50
  ELEVATION DIFFERENCE =    13.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   12.395
  *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
     NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.054
  SUBAREA RUNOFF(CFS) =      1.93
  TOTAL AREA(ACRES) =      2.03   TOTAL RUNOFF(CFS) =      1.93


**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      2.01 IS CODE =   4
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
==========================================================================
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   2.9 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =   8.9
  UPSTREAM NODE ELEVATION =    32.00
```

```
 DOWNSTREAM NODE ELEVATION =    24.07
 FLOWLENGTH(FEET) =   100.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.93
 TRAVEL TIME(MIN.) =    .19    TC(MIN.) =  12.58

****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     2.01 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  12.58
 RAINFALL INTENSITY(INCH/HR) =   1.05
 TOTAL STREAM AREA(ACRES) =    2.03
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.93

****************************************************************************
 FLOW PROCESS FROM NODE     2.00 TO NODE     2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 INITIAL SUBAREA FLOW-LENGTH =  1200.00
 UPSTREAM ELEVATION =     50.00
 DOWNSTREAM ELEVATION =     40.00
 ELEVATION DIFFERENCE =     10.00
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   13.252
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.023
 SUBAREA RUNOFF(CFS) =      2.23
 TOTAL AREA(ACRES) =      2.42   TOTAL RUNOFF(CFS) =      2.23

****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     2.01 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  13.25
 RAINFALL INTENSITY(INCH/HR) =   1.02
 TOTAL STREAM AREA(ACRES) =    2.42
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.23

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
     1         1.93     12.58       1.047          2.03
     2         2.23     13.25       1.023          2.42

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
     1         4.10     12.58       1.047
     2         4.11     13.25       1.023

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      4.11   Tc(MIN.) =   13.25
 TOTAL AREA(ACRES) =      4.45

****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     3.00 IS CODE =   4
```

```
------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
========================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   5.6 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   7.5
 UPSTREAM NODE ELEVATION =    24.07
 DOWNSTREAM NODE ELEVATION =    21.30
 FLOWLENGTH(FEET) =   110.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      4.11
 TRAVEL TIME(MIN.) =    .25    TC(MIN.) =  13.50


************************************************************************
 FLOW PROCESS FROM NODE     3.00 TO NODE     3.00 IS CODE =   8
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.014
 SOIL CLASSIFICATION IS "C"
 MOBILE HOME DEVELOPMENT RUNOFF COEFFICIENT = .5500
 SUBAREA AREA(ACRES) =     .85   SUBAREA RUNOFF(CFS) =     .47
 TOTAL AREA(ACRES) =     5.30   TOTAL RUNOFF(CFS) =    4.58
 TC(MIN) =  13.50
========================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =      4.58   Tc(MIN.) =   13.50
 TOTAL AREA(ACRES) =      5.30
========================================================================
 END OF RATIONAL METHOD ANALYSIS
```

□

Refer to Appendix B, Hydraulic Calculations, I-5/SR-56 Extended Detention Basin, Basin Design and Volume Calculations for the 6 month volume calculation.

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-96 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                   Robert Bein, William Frost & Associates
                            14725 Alton Parkway
                             Irvine, CA  92618


 ************************* DESCRIPTION OF STUDY *************************
* JN 34358 I-5/SR-56 EXTENDED DETENTION BASIN                           *
* 1-YR STORM FREQUENCY                                                  *
* AMW                                                                   *
 **************************************************************************

  FILE NAME: SR56I51Y.DAT
  TIME/DATE OF STUDY: 10: 1   5/30/1998
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  1.950
   2)  10.000;  1.430
   3)  20.000;   .960
   4)  30.000;   .770
   5)  40.000;   .630
   6)  50.000;   .545
   7)  60.000;   .480
   8) 120.000;   .320
   9) 180.000;   .235
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.01 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "C"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
  INITIAL SUBAREA FLOW-LENGTH =  1230.00
  UPSTREAM ELEVATION =      50.50
  DOWNSTREAM ELEVATION =      37.50
  ELEVATION DIFFERENCE =      13.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   12.395
  *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
     NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.317
  SUBAREA RUNOFF(CFS) =       2.41
  TOTAL AREA(ACRES) =       2.03   TOTAL RUNOFF(CFS) =       2.41


**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      2.01 IS CODE =   4
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
==========================================================================
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   3.2 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =   9.6
  UPSTREAM NODE ELEVATION =     32.00
```

```
 DOWNSTREAM NODE ELEVATION =    24.07
 FLOWLENGTH(FEET) =   100.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      2.41
 TRAVEL TIME(MIN.) =    .17    TC(MIN.) =  12.57


****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     2.01 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  12.57
 RAINFALL INTENSITY(INCH/HR) =   1.31
 TOTAL STREAM AREA(ACRES) =    2.03
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.41


****************************************************************************
 FLOW PROCESS FROM NODE     2.00 TO NODE     2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 INITIAL SUBAREA FLOW-LENGTH =  1200.00
 UPSTREAM ELEVATION =     50.00
 DOWNSTREAM ELEVATION =     40.00
 ELEVATION DIFFERENCE =     10.00
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   13.252
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.277
 SUBAREA RUNOFF(CFS) =      2.78
 TOTAL AREA(ACRES) =      2.42   TOTAL RUNOFF(CFS) =      2.78


****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     2.01 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  13.25
 RAINFALL INTENSITY(INCH/HR) =   1.28
 TOTAL STREAM AREA(ACRES) =    2.42
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.78

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
     1         2.41     12.57       1.309          2.03
     2         2.78     13.25       1.277          2.42

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
     1         5.12     12.57       1.309
     2         5.13     13.25       1.277

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      5.13   Tc(MIN.) =   13.25
 TOTAL AREA(ACRES) =      4.45


****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     3.00 IS CODE =   4
```

```
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   6.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   8.0
 UPSTREAM NODE ELEVATION =    24.07
 DOWNSTREAM NODE ELEVATION =    21.30
 FLOWLENGTH(FEET) =   110.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =       5.13
 TRAVEL TIME(MIN.) =     .23    TC(MIN.) =  13.48


 ****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   8
 ----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
 ============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.266
 SOIL CLASSIFICATION IS "C"
 MOBILE HOME DEVELOPMENT RUNOFF COEFFICIENT = .5500
 SUBAREA AREA(ACRES) =      .85   SUBAREA RUNOFF(CFS) =      .59
 TOTAL AREA(ACRES) =      5.30   TOTAL RUNOFF(CFS) =    5.72
 TC(MIN) =  13.48
 ============================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =       5.72   Tc(MIN.) =   13.48
 TOTAL AREA(ACRES) =       5.30
 ============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

SMALL AREA UNIT HYDROGRAPH MODEL

Ver. 6.1 Release Date: 01/01/96 License ID 1264

Analysis prepared by:

Robert Bein, William Frost & Associates
14725 Alton Parkway
Irvine, California 92618

RATIONAL METHOD CALIBRATION COEFFICIENT = .90
TOTAL CATCHMENT AREA(ACRES) = 5.30
SOIL-LOSS RATE, Fm,(INCH/HR) = .078
LOW LOSS FRACTION = .647
TIME OF CONCENTRATION(MIN.) = 13.48
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = .18
30-MINUTE POINT RAINFALL VALUE(INCHES) = .34
1-HOUR POINT RAINFALL VALUE(INCHES) = .42
3-HOUR POINT RAINFALL VALUE(INCHES) = .65
6-HOUR POINT RAINFALL VALUE(INCHES) = .79
24-HOUR POINT RAINFALL VALUE(INCHES) = 1.26

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = .32
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = .23

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0. 2.5 5.0 7.5 10.0
.05	.0000	.00	Q
.27	.0003	.03	Q
.50	.0008	.03	Q
.72	.0014	.03	Q
.95	.0020	.03	Q
1.17	.0025	.03	Q
1.40	.0031	.03	Q
1.62	.0037	.03	Q
1.85	.0043	.03	Q
2.07	.0049	.03	Q
2.30	.0055	.03	Q
2.52	.0061	.03	Q
2.74	.0067	.03	Q
2.97	.0073	.03	Q
3.19	.0080	.03	Q
3.42	.0086	.03	Q
3.64	.0093	.04	Q
3.87	.0099	.04	Q
4.09	.0106	.04	Q
4.32	.0112	.04	Q
4.54	.0119	.04	Q
4.77	.0126	.04	Q
4.99	.0133	.04	Q
5.22	.0140	.04	Q
5.44	.0147	.04	Q
5.67	.0155	.04	Q
5.89	.0162	.04	Q
6.11	.0169	.04	Q
6.34	.0177	.04	Q
6.56	.0185	.04	Q
6.79	.0192	.04	Q
7.01	.0200	.04	Q
7.24	.0208	.04	Q

7.46	.0217	.04	Q	.	.	.	.	.
7.69	.0225	.05	Q	.	.	.	.	.
7.91	.0233	.05	Q	.	.	.	.	.
8.14	.0242	.05	Q	.	.	.	.	.
8.36	.0251	.05	Q	.	.	.	.	.
8.59	.0260	.05	Q	.	.	.	.	.
8.81	.0269	.05	Q	.	.	.	.	.
9.04	.0278	.05	Q	.	.	.	.	.
9.26	.0288	.05	Q	.	.	.	.	.
9.48	.0298	.05	Q	.	.	.	.	.
9.71	.0308	.05	Q	.	.	.	.	.
9.93	.0318	.06	Q	.	.	.	.	.
10.16	.0328	.06	Q	.	.	.	.	.
10.38	.0339	.06	Q	.	.	.	.	.
10.61	.0350	.06	Q	.	.	.	.	.
10.83	.0361	.06	Q	.	.	.	.	.
11.06	.0373	.06	Q	.	.	.	.	.
11.28	.0385	.07	Q	.	.	.	.	.
11.51	.0397	.07	Q	.	.	.	.	.
11.73	.0410	.07	Q	.	.	.	.	.
11.96	.0423	.07	Q	.	.	.	.	.
12.18	.0436	.07	Q	.	.	.	.	.
12.41	.0448	.06	Q	.	.	.	.	.
12.63	.0460	.07	Q	.	.	.	.	.
12.85	.0473	.07	Q	.	.	.	.	.
13.08	.0486	.08	Q	.	.	.	.	.
13.30	.0501	.08	Q	.	.	.	.	.
13.53	.0516	.08	Q	.	.	.	.	.
13.75	.0532	.09	Q	.	.	.	.	.
13.98	.0549	.10	Q	.	.	.	.	.
14.20	.0569	.12	Q	.	.	.	.	.
14.43	.0594	.16	Q	.	.	.	.	.
14.65	.0625	.17	Q	.	.	.	.	.
14.88	.0658	.19	Q	.	.	.	.	.
15.10	.0695	.21	Q	.	.	.	.	.
15.33	.0745	.33	.Q	.	.	.	.	.
15.55	.0807	.34	.Q	.	.	.	.	.
15.78	.0893	.58	. Q	.	.	.	.	.
16.00	.1053	1.14	. Q	.	.	.	.	.
16.22	.1967	8.70	.	.	.	.	Q	.
16.45	.2807	.35	.Q	.	.	.	.	.
16.67	.2864	.26	.Q	.	.	.	.	.
16.90	.2905	.18	Q	.	.	.	.	.
17.12	.2936	.15	Q	.	.	.	.	.
17.35	.2958	.09	Q	.	.	.	.	.
17.57	.2975	.08	Q	.	.	.	.	.
17.80	.2989	.07	Q	.	.	.	.	.
18.02	.3002	.07	Q	.	.	.	.	.
18.25	.3015	.07	Q	.	.	.	.	.
18.47	.3028	.07	Q	.	.	.	.	.
18.70	.3040	.06	Q	.	.	.	.	.
18.92	.3052	.06	Q	.	.	.	.	.
19.15	.3063	.06	Q	.	.	.	.	.
19.37	.3073	.05	Q	.	.	.	.	.
19.59	.3083	.05	Q	.	.	.	.	.
19.82	.3093	.05	Q	.	.	.	.	.
20.04	.3102	.05	Q	.	.	.	.	.
20.27	.3111	.05	Q	.	.	.	.	.
20.49	.3119	.04	Q	.	.	.	.	.
20.72	.3127	.04	Q	.	.	.	.	.
20.94	.3135	.04	Q	.	.	.	.	.
21.17	.3143	.04	Q	.	.	.	.	.
21.39	.3150	.04	Q	.	.	.	.	.
21.62	.3158	.04	Q	.	.	.	.	.
21.84	.3165	.04	Q	.	.	.	.	.
22.07	.3172	.04	Q	.	.	.	.	.
22.29	.3178	.04	Q	.	.	.	.	.
22.52	.3185	.03	Q	.	.	.	.	.
22.74	.3191	.03	Q	.	.	.	.	.
22.96	.3197	.03	Q	.	.	.	.	.
23.19	.3204	.03	Q	.	.	.	.	.
23.41	.3210	.03	Q	.	.	.	.	.
23.64	.3215	.03	Q	.	.	.	.	.
23.86	.3221	.03	Q	.	.	.	.	.

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
        (c) Copyright 1982-96 Advanced Engineering Software (aes)
            Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                    Robert Bein, William Frost & Associates
                              14725 Alton Parkway
                               Irvine, CA  92618


 ************************* DESCRIPTION OF STUDY *************************
* JN 34358 I-5/SR-56 EXTENDED DETENTION BASIN                            *
* 25-YR STORM FREQUENCY                                                  *
* AMW                                                                    *
 **************************************************************************

  FILE NAME: SR56I525.DAT
  TIME/DATE OF STUDY: 10: 7   5/30/1998
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  3.850
   2)  10.000;  3.000
   3)  20.000;  2.140
   4)  30.000;  1.680
   5)  40.000;  1.420
   6)  50.000;  1.230
   7)  60.000;  1.090
   8) 120.000;   .700
   9) 180.000;   .540
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE     1.00 TO NODE     1.01 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "C"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
  INITIAL SUBAREA FLOW-LENGTH =  1230.00
  UPSTREAM ELEVATION =     50.50
  DOWNSTREAM ELEVATION =     37.50
  ELEVATION DIFFERENCE =     13.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   12.395
  *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
   25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.794
  SUBAREA RUNOFF(CFS) =      5.10
  TOTAL AREA(ACRES) =      2.03   TOTAL RUNOFF(CFS) =      5.10


**************************************************************************
  FLOW PROCESS FROM NODE     1.01 TO NODE     2.01 IS CODE =   4
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
==========================================================================
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   4.7 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =  11.9
  UPSTREAM NODE ELEVATION =    32.00
```

```
 DOWNSTREAM NODE ELEVATION =     24.07
 FLOWLENGTH(FEET) =   100.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      5.10
 TRAVEL TIME(MIN.) =     .14    TC(MIN.) =  12.53


****************************************************************************
 FLOW PROCESS FROM NODE      2.01 TO NODE      2.01 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  12.53
 RAINFALL INTENSITY(INCH/HR) =   2.78
 TOTAL STREAM AREA(ACRES) =    2.03
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.10


****************************************************************************
 FLOW PROCESS FROM NODE      2.00 TO NODE      2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 INITIAL SUBAREA FLOW-LENGTH =  1200.00
 UPSTREAM ELEVATION =      50.00
 DOWNSTREAM ELEVATION =      40.00
 ELEVATION DIFFERENCE =      10.00
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   13.252
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
   25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.720
 SUBAREA RUNOFF(CFS) =      5.92
 TOTAL AREA(ACRES) =      2.42   TOTAL RUNOFF(CFS) =      5.92


****************************************************************************
 FLOW PROCESS FROM NODE      2.01 TO NODE      2.01 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  13.25
 RAINFALL INTENSITY(INCH/HR) =   2.72
 TOTAL STREAM AREA(ACRES) =    2.42
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.92

 ** CONFLUENCE DATA **
 STREAM     RUNOFF      Tc       INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
    1         5.10     12.53       2.782         2.03
    2         5.92     13.25       2.720         2.42

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc       INTENSITY
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)
    1        10.90     12.53       2.782
    2        10.92     13.25       2.720

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     10.92   Tc(MIN.) =   13.25
 TOTAL AREA(ACRES) =      4.45


****************************************************************************
 FLOW PROCESS FROM NODE      2.01 TO NODE      3.00 IS CODE =   4
```

```
>>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
>>>>>USING USER-SPECIFIED PIPESIZE<<<<<
```

```
DEPTH OF FLOW IN  24.0 INCH PIPE IS   9.2 INCHES
PIPEFLOW VELOCITY(FEET/SEC.) =   9.8
UPSTREAM NODE ELEVATION =    24.07
DOWNSTREAM NODE ELEVATION =    21.30
FLOWLENGTH(FEET) =   110.00   MANNING'S N =  .013
GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
PIPEFLOW THRU SUBAREA(CFS) =     10.92
TRAVEL TIME(MIN.) =    .19    TC(MIN.) =  13.44
```

```
**************************************************************************
FLOW PROCESS FROM NODE     3.00 TO NODE     3.00 IS CODE =   8
--------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.704
SOIL CLASSIFICATION IS "C"
MOBILE HOME DEVELOPMENT RUNOFF COEFFICIENT = .5500
SUBAREA AREA(ACRES) =     .85   SUBAREA RUNOFF(CFS) =    1.26
TOTAL AREA(ACRES) =     5.30   TOTAL RUNOFF(CFS) =   12.18
TC(MIN) =  13.44
==========================================================================
END OF STUDY SUMMARY:
PEAK FLOW RATE(CFS) =     12.18   Tc(MIN.) =   13.44
TOTAL AREA(ACRES) =      5.30
==========================================================================
END OF RATIONAL METHOD ANALYSIS
```

****

SMALL AREA UNIT HYDROGRAPH MODEL

Ver. 6.1 Release Date: 01/01/96 License ID 1264

Analysis prepared by:

Robert Bein, William Frost & Associates
14725 Alton Parkway
Irvine, California 92618

RATIONAL METHOD CALIBRATION COEFFICIENT = .90
TOTAL CATCHMENT AREA(ACRES) = 5.30
SOIL-LOSS RATE, Fm,(INCH/HR) = .078
LOW LOSS FRACTION = .647
TIME OF CONCENTRATION(MIN.) = 13.44
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = .31
30-MINUTE POINT RAINFALL VALUE(INCHES) = .65
1-HOUR POINT RAINFALL VALUE(INCHES) = .86
3-HOUR POINT RAINFALL VALUE(INCHES) = 1.36
6-HOUR POINT RAINFALL VALUE(INCHES) = 1.80
24-HOUR POINT RAINFALL VALUE(INCHES) = 3.20

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = .71
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = .71

****

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
.10	.0004	.09	Q	.	.	.	.
.32	.0021	.09	Q	.	.	.	.
.54	.0038	.09	Q	.	.	.	.
.77	.0056	.10	Q	.	.	.	.
.99	.0074	.10	Q	.	.	.	.
1.22	.0092	.10	Q	.	.	.	.
1.44	.0110	.10	Q	.	.	.	.
1.66	.0128	.10	Q	.	.	.	.
1.89	.0146	.10	Q	.	.	.	.
2.11	.0165	.10	Q	.	.	.	.
2.34	.0183	.10	Q	.	.	.	.
2.56	.0202	.10	Q	.	.	.	.
2.78	.0221	.10	Q	.	.	.	.
3.01	.0240	.10	Q	.	.	.	.
3.23	.0260	.11	Q	.	.	.	.
3.46	.0279	.11	Q	.	.	.	.
3.68	.0299	.11	Q	.	.	.	.
3.90	.0319	.11	Q	.	.	.	.
4.13	.0339	.11	Q	.	.	.	.
4.35	.0360	.11	Q	.	.	.	.
4.58	.0381	.11	Q	.	.	.	.
4.80	.0402	.11	Q	.	.	.	.
5.02	.0423	.12	Q	.	.	.	.
5.25	.0444	.12	Q	.	.	.	.
5.47	.0466	.12	Q	.	.	.	.
5.70	.0488	.12	Q	.	.	.	.
5.92	.0510	.12	Q	.	.	.	.
6.14	.0533	.12	Q	.	.	.	.
6.37	.0555	.12	Q	.	.	.	.
6.59	.0578	.13	Q	.	.	.	.
6.82	.0602	.13	Q	.	.	.	.
7.04	.0626	.13	Q	.	.	.	.
7.26	.0650	.13	Q	.	.	.	.

7.49	.0674	.13	Q
7.71	.0699	.14	Q
7.94	.0724	.14	Q
8.16	.0750	.14	Q
8.38	.0776	.14	Q
8.61	.0802	.14	Q
8.83	.0829	.15	Q
9.06	.0857	.15	Q
9.28	.0885	.15	Q
9.50	.0913	.16	Q
9.73	.0942	.16	Q
9.95	.0972	.16	Q
10.18	.1002	.16	Q
10.40	.1033	.17	Q
10.62	.1065	.17	Q
10.85	.1097	.18	Q
11.07	.1130	.18	Q
11.30	.1164	.19	Q
11.52	.1199	.19	Q
11.74	.1235	.20	Q
11.97	.1272	.20	Q
12.19	.1311	.21	Q
12.42	.1351	.22	Q
12.64	.1395	.25	.Q
12.86	.1444	.27	.Q
13.09	.1497	.31	.Q
13.31	.1556	.33	.Q
13.54	.1621	.37	.Q
13.76	.1693	.40	.Q
13.98	.1772	.46	.Q
14.21	.1862	.51	. Q
14.43	.1966	.61	. Q
14.66	.2085	.67	. Q
14.88	.2221	.80	. Q
15.10	.2378	.89	. Q
15.33	.2567	1.15	. Q
15.55	.2794	1.31	. Q
15.78	.3100	2.00	. Q
16.00	.3556	2.92	. .Q
16.22	.4631	8.70	. Q
16.45	.5580	1.55	. Q
16.67	.5817	1.00	. Q
16.90	.5977	.73	. Q
17.12	.6097	.57	. Q
17.34	.6190	.43	.Q
17.57	.6262	.35	.Q
17.79	.6321	.29	.Q
18.02	.6369	.24	Q
18.24	.6411	.21	Q
18.46	.6449	.19	Q
18.69	.6484	.18	Q
18.91	.6517	.17	Q
19.14	.6549	.17	Q
19.36	.6579	.16	Q
19.58	.6608	.15	Q
19.81	.6636	.15	Q
20.03	.6663	.14	Q
20.26	.6689	.14	Q
20.48	.6714	.13	Q
20.70	.6739	.13	Q
20.93	.6762	.13	Q
21.15	.6785	.12	Q
21.38	.6808	.12	Q
21.60	.6830	.12	Q
21.82	.6851	.11	Q
22.05	.6872	.11	Q
22.27	.6893	.11	Q
22.50	.6913	.11	Q
22.72	.6932	.10	Q
22.94	.6952	.10	Q
23.17	.6970	.10	Q
23.39	.6989	.10	Q
23.62	.7007	.10	Q
23.84	.7025	.10	Q

Small Area Unit Hydrograph Calculations

Assume: Orange Co. methodology OK for SD.

Loss Rate (Orange Co Hydro Manual)

$F_p = 0.25$

$Q_p = \frac{\text{Pervious Area}}{\text{Total Area}} = \frac{(2.2+3.3+5.8+0.8)}{15.39} = 0.79$

$F_m = Q_p F_p = 0.1975$

$I_a = 0.25$

$S = \frac{1000}{CN} - 10$

CN = 90 Roadway
= 86 Basin & Slope
} Composite CN = 86.8

$\therefore S = 1.52$

$\therefore I_a = 0.304$

$\therefore y_j = \frac{(P_{24} - I_a)^2}{(P_{24} - I_a + S) P_{24}} = \left(\frac{(1.9-0.304)^2}{(1.9-0.304+1.52)1.9}\right) = 0.430$

$P_{24} = 1.9$ inch Max rainfall / 24hr Storm

$\boxed{\bar{Y} = 1 - y_j = 0.570}$

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-96 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                    Robert Bein, William Frost & Associates
                              14725 Alton Parkway
                               Irvine, CA  92618


 ************************* DESCRIPTION OF STUDY *************************
* JN 34358 I-15/SR-78 EXTENDED DETENTION BASIN                           *
* 6-MONTH STORM FREQUENCY                                                *
* AMW                                                                    *
 **************************************************************************

  FILE NAME: S78I156M.DAT
  TIME/DATE OF STUDY: 10:35   5/30/1998
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  1.550
   2)  10.000;  1.140
   3)  20.000;   .780
   4)  30.000;   .600
   5)  40.000;   .500
   6)  50.000;   .435
   7)  60.000;   .385
   8) 120.000;   .248
   9) 180.000;   .188
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.01 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "C"
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5000
  INITIAL SUBAREA FLOW-LENGTH =  1800.00
  UPSTREAM ELEVATION =     695.00
  DOWNSTREAM ELEVATION =    652.40
  ELEVATION DIFFERENCE =     42.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   34.384
  *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
     NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) =   .556
  SUBAREA RUNOFF(CFS) =       1.19
  TOTAL AREA(ACRES) =       4.29   TOTAL RUNOFF(CFS) =       1.19


**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  34.38
  RAINFALL INTENSITY(INCH/HR) =    .56
```

```
 TOTAL STREAM AREA(ACRES) =     4.29
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.19


****************************************************************************
 FLOW PROCESS FROM NODE      2.00 TO NODE      2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 INITIAL SUBAREA FLOW-LENGTH =   720.00
 UPSTREAM ELEVATION =     670.00
 DOWNSTREAM ELEVATION =     664.50
 ELEVATION DIFFERENCE =       5.50
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   10.567
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.120
 SUBAREA RUNOFF(CFS) =        .65
 TOTAL AREA(ACRES) =        .65   TOTAL RUNOFF(CFS) =        .65


****************************************************************************
 FLOW PROCESS FROM NODE      2.01 TO NODE      2.02 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.0 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   6.2
 UPSTREAM NODE ELEVATION =   659.40
 DOWNSTREAM NODE ELEVATION =   654.00
 FLOWLENGTH(FEET) =    85.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =       .65
 TRAVEL TIME(MIN.) =    .23    TC(MIN.) =  10.79


****************************************************************************
 FLOW PROCESS FROM NODE      2.02 TO NODE      2.02 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.111
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 SUBAREA AREA(ACRES) =    1.16   SUBAREA RUNOFF(CFS) =    1.16
 TOTAL AREA(ACRES) =     1.81   TOTAL RUNOFF(CFS) =    1.82
 TC(MIN) =  10.79


****************************************************************************
 FLOW PROCESS FROM NODE      2.02 TO NODE      3.00 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.9 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   4.6
 UPSTREAM NODE ELEVATION =   656.00
 DOWNSTREAM NODE ELEVATION =   654.80
 FLOWLENGTH(FEET) =   103.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.82
 TRAVEL TIME(MIN.) =    .37    TC(MIN.) =  11.17


****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.098
  SOIL CLASSIFICATION IS "C"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
  SUBAREA AREA(ACRES) =     1.32   SUBAREA RUNOFF(CFS) =     1.30
  TOTAL AREA(ACRES) =      3.13   TOTAL RUNOFF(CFS) =     3.12
  TC(MIN) =  11.17


****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      1.01 IS CODE =   3
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.4 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =   7.0
  UPSTREAM NODE ELEVATION =   654.80
  DOWNSTREAM NODE ELEVATION =   652.40
  FLOWLENGTH(FEET) =    98.00   MANNING'S N =  .013
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPEFLOW THRU SUBAREA(CFS) =      3.12
  TRAVEL TIME(MIN.) =     .23    TC(MIN.) =  11.40


****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =  11.40
  RAINFALL INTENSITY(INCH/HR) =   1.09
  TOTAL STREAM AREA(ACRES) =    3.13
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.12

  ** CONFLUENCE DATA **
  STREAM      RUNOFF       Tc       INTENSITY       AREA
  NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
     1          1.19     34.38         .556          4.29
     2          3.12     11.40        1.090          3.13

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM      RUNOFF       Tc       INTENSITY
  NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
     1          3.73     11.40        1.090
     2          2.79     34.38         .556

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      3.73   Tc(MIN.) =   11.40
  TOTAL AREA(ACRES) =      7.42


****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.090
  SOIL CLASSIFICATION IS "C"
  MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
  SUBAREA AREA(ACRES) =     2.48   SUBAREA RUNOFF(CFS) =     1.62
  TOTAL AREA(ACRES) =      9.90   TOTAL RUNOFF(CFS) =     5.35
  TC(MIN) =  11.40


****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      4.00 IS CODE =   3
```

```
------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.9 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   8.5
 UPSTREAM NODE ELEVATION =   652.40
 DOWNSTREAM NODE ELEVATION =   648.50
 FLOWLENGTH(FEET) =   141.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      5.35
 TRAVEL TIME(MIN.) =    .28    TC(MIN.) =  11.67


************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   8
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.080
 SOIL CLASSIFICATION IS "C"
 MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
 SUBAREA AREA(ACRES) =      .65   SUBAREA RUNOFF(CFS) =      .42
 TOTAL AREA(ACRES) =    10.55   TOTAL RUNOFF(CFS) =    5.77
 TC(MIN) =  11.67


************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     5.00 IS CODE =   3
------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.7 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   5.9
 UPSTREAM NODE ELEVATION =   648.50
 DOWNSTREAM NODE ELEVATION =   644.85
 FLOWLENGTH(FEET) =   369.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      5.77
 TRAVEL TIME(MIN.) =   1.03    TC(MIN.) =  12.71


************************************************************************
 FLOW PROCESS FROM NODE     5.00 TO NODE     5.00 IS CODE =   8
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.043
 SOIL CLASSIFICATION IS "C"
 MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
 SUBAREA AREA(ACRES) =    2.87   SUBAREA RUNOFF(CFS) =    1.80
 TOTAL AREA(ACRES) =    13.42   TOTAL RUNOFF(CFS) =    7.57
 TC(MIN) =  12.71
========================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =      7.57   Tc(MIN.) =   12.71
 TOTAL AREA(ACRES) =     13.42
========================================================================
 END OF RATIONAL METHOD ANALYSIS
```

SMALL AREA UNIT HYDROGRAPH MODEL

Analysis prepared by:

Robert Bein, William Frost & Associates
14725 Alton Parkway
Irvine, California 92618

RATIONAL METHOD CALIBRATION COEFFICIENT = .90
TOTAL CATCHMENT AREA(ACRES) = 13.42
SOIL-LOSS RATE, Fm,(INCH/HR) = .198
LOW LOSS FRACTION = .570
TIME OF CONCENTRATION(MIN.) = 12.71
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = .21
30-MINUTE POINT RAINFALL VALUE(INCHES) = .39
1-HOUR POINT RAINFALL VALUE(INCHES) = .50
3-HOUR POINT RAINFALL VALUE(INCHES) = .74
6-HOUR POINT RAINFALL VALUE(INCHES) = .95
24-HOUR POINT RAINFALL VALUE(INCHES) = 1.51

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = .76
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = .94

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	5.0	10.0	15.0	20.0
.11	.0005	.11	Q	.	.	.	.
.32	.0024	.11	Q	.	.	.	.
.54	.0044	.11	Q	.	.	.	.
.75	.0063	.11	Q	.	.	.	.
.96	.0083	.11	Q	.	.	.	.
1.17	.0103	.11	Q	.	.	.	.
1.38	.0123	.12	Q	.	.	.	.
1.60	.0144	.12	Q	.	.	.	.
1.81	.0164	.12	Q	.	.	.	.
2.02	.0185	.12	Q	.	.	.	.
2.23	.0206	.12	Q	.	.	.	.
2.44	.0227	.12	Q	.	.	.	.
2.65	.0249	.12	Q	.	.	.	.
2.87	.0270	.12	Q	.	.	.	.
3.08	.0292	.13	Q	.	.	.	.
3.29	.0314	.13	Q	.	.	.	.
3.50	.0337	.13	Q	.	.	.	.
3.71	.0359	.13	Q	.	.	.	.
3.93	.0382	.13	Q	.	.	.	.
4.14	.0405	.13	Q	.	.	.	.
4.35	.0429	.13	Q	.	.	.	.
4.56	.0452	.14	Q	.	.	.	.
4.77	.0476	.14	Q	.	.	.	.
4.98	.0500	.14	Q	.	.	.	.
5.20	.0525	.14	Q	.	.	.	.
5.41	.0550	.14	Q	.	.	.	.
5.62	.0575	.15	Q	.	.	.	.
5.83	.0601	.15	Q	.	.	.	.
6.04	.0627	.15	Q	.	.	.	.
6.26	.0653	.15	Q	.	.	.	.
6.47	.0679	.15	Q	.	.	.	.
6.68	.0706	.16	Q	.	.	.	.
6.89	.0734	.16	Q	.	.	.	.

7.10	.0762	.16	Q	.	.	.	.	.	.
7.31	.0790	.16	Q	.	.	.	.	.	.
7.53	.0819	.16	Q	.	.	.	.	.	.
7.74	.0848	.17	Q	.	.	.	.	.	.
7.95	.0878	.17	Q	.	.	.	.	.	.
8.16	.0908	.17	Q	.	.	.	.	.	.
8.37	.0938	.18	Q	.	.	.	.	.	.
8.59	.0970	.18	Q	.	.	.	.	.	.
8.80	.1002	.18	Q	.	.	.	.	.	.
9.01	.1034	.19	Q	.	.	.	.	.	.
9.22	.1067	.19	Q	.	.	.	.	.	.
9.43	.1101	.20	Q	.	.	.	.	.	.
9.65	.1136	.20	Q	.	.	.	.	.	.
9.86	.1171	.20	Q	.	.	.	.	.	.
10.07	.1207	.21	Q	.	.	.	.	.	.
10.28	.1244	.21	Q	.	.	.	.	.	.
10.49	.1282	.22	Q	.	.	.	.	.	.
10.70	.1320	.23	Q	.	.	.	.	.	.
10.92	.1360	.23	Q	.	.	.	.	.	.
11.13	.1401	.24	Q	.	.	.	.	.	.
11.34	.1443	.24	Q	.	.	.	.	.	.
11.55	.1486	.25	Q	.	.	.	.	.	.
11.76	.1531	.26	Q	.	.	.	.	.	.
11.98	.1577	.27	Q	.	.	.	.	.	.
12.19	.1625	.28	Q	.	.	.	.	.	.
12.40	.1677	.31	Q	.	.	.	.	.	.
12.61	.1732	.32	Q	.	.	.	.	.	.
12.82	.1789	.33	Q	.	.	.	.	.	.
13.03	.1848	.34	Q	.	.	.	.	.	.
13.25	.1910	.36	Q	.	.	.	.	.	.
13.46	.1975	.38	Q	.	.	.	.	.	.
13.67	.2043	.40	Q	.	.	.	.	.	.
13.88	.2115	.42	Q	.	.	.	.	.	.
14.09	.2191	.45	Q	.	.	.	.	.	.
14.31	.2272	.47	Q	.	.	.	.	.	.
14.52	.2359	.52	.Q	.	.	.	.	.	.
14.73	.2454	.55	.Q	.	.	.	.	.	.
14.94	.2558	.64	.Q	.	.	.	.	.	.
15.15	.2674	.69	.Q	.	.	.	.	.	.
15.36	.2808	.84	.Q	.	.	.	.	.	.
15.58	.2965	.96	.Q	.	.	.	.	.	.
15.79	.3171	1.39	. Q	.	.	.	.	.	.
16.00	.3475	2.08	. Q	.	.	.	.	.	.
16.21	.4795	13.00	.	.	.	.	Q	.	.
16.42	.6032	1.13	. Q	.	.	.	.	.	.
16.64	.6197	.76	.Q	.	.	.	.	.	.
16.85	.6315	.59	.Q	.	.	.	.	.	.
17.06	.6410	.50	Q	.	.	.	.	.	.
17.27	.6492	.44	Q	.	.	.	.	.	.
17.48	.6564	.39	Q	.	.	.	.	.	.
17.69	.6629	.35	Q	.	.	.	.	.	.
17.91	.6688	.33	Q	.	.	.	.	.	.
18.12	.6743	.30	Q	.	.	.	.	.	.
18.33	.6793	.26	Q	.	.	.	.	.	.
18.54	.6837	.25	Q	.	.	.	.	.	.
18.75	.6879	.23	Q	.	.	.	.	.	.
18.97	.6919	.22	Q	.	.	.	.	.	.
19.18	.6957	.21	Q	.	.	.	.	.	.
19.39	.6993	.20	Q	.	.	.	.	.	.
19.60	.7028	.19	Q	.	.	.	.	.	.
19.81	.7061	.19	Q	.	.	.	.	.	.
20.02	.7093	.18	Q	.	.	.	.	.	.
20.24	.7123	.17	Q	.	.	.	.	.	.
20.45	.7153	.17	Q	.	.	.	.	.	.
20.66	.7182	.16	Q	.	.	.	.	.	.
20.87	.7210	.16	Q	.	.	.	.	.	.
21.08	.7237	.15	Q	.	.	.	.	.	.
21.30	.7263	.15	Q	.	.	.	.	.	.
21.51	.7289	.14	Q	.	.	.	.	.	.
21.72	.7313	.14	Q	.	.	.	.	.	.
21.93	.7338	.14	Q	.	.	.	.	.	.
22.14	.7361	.13	Q	.	.	.	.	.	.
22.36	.7384	.13	Q	.	.	.	.	.	.
22.57	.7407	.13	Q	.	.	.	.	.	.

22.78	.7429	.12	Q	.	.	.	.
22.99	.7451	.12	Q	.	.	.	.
23.20	.7472	.12	Q	.	.	.	.
23.41	.7493	.12	Q	.	.	.	.
23.63	.7513	.12	Q	.	.	.	.
23.84	.7533	.11	Q	.	.	.	.

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-96 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                    Robert Bein, William Frost & Associates
                              14725 Alton Parkway
                               Irvine, CA  92618


 ************************** DESCRIPTION OF STUDY ************************
* JN 34358 I-15/SR-78 EXTENDED DETENTION BASIN                           *
* 1-YR STORM FREQUENCY                                                   *
* AMW                                                                    *
 **************************************************************************

  FILE NAME: S78I151Y.DAT
  TIME/DATE OF STUDY: 10:33   5/30/1998
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  1.950
   2)  10.000;  1.430
   3)  20.000;   .960
   4)  30.000;   .770
   5)  40.000;   .630
   6)  50.000;   .545
   7)  60.000;   .480
   8) 120.000;   .320
   9) 180.000;   .235
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.01 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "C"
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5000
  INITIAL SUBAREA FLOW-LENGTH =  1800.00
  UPSTREAM ELEVATION =     695.00
  DOWNSTREAM ELEVATION =    652.40
  ELEVATION DIFFERENCE =     42.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   34.384
  *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
     NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) =   .709
  SUBAREA RUNOFF(CFS) =       1.52
  TOTAL AREA(ACRES) =       4.29   TOTAL RUNOFF(CFS) =       1.52


**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  34.38
  RAINFALL INTENSITY(INCH/HR) =    .71
```

```
 TOTAL STREAM AREA(ACRES) =     4.29
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.52


****************************************************************************
 FLOW PROCESS FROM NODE      2.00 TO NODE      2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 INITIAL SUBAREA FLOW-LENGTH =   720.00
 UPSTREAM ELEVATION =    670.00
 DOWNSTREAM ELEVATION =    664.50
 ELEVATION DIFFERENCE =      5.50
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   10.567
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.403
 SUBAREA RUNOFF(CFS) =       .82
 TOTAL AREA(ACRES) =       .65   TOTAL RUNOFF(CFS) =       .82


****************************************************************************
 FLOW PROCESS FROM NODE      2.01 TO NODE      2.02 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   6.7
 UPSTREAM NODE ELEVATION =   659.40
 DOWNSTREAM NODE ELEVATION =   654.00
 FLOWLENGTH(FEET) =    85.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =       .82
 TRAVEL TIME(MIN.) =    .21    TC(MIN.) =  10.78


****************************************************************************
 FLOW PROCESS FROM NODE      2.02 TO NODE      2.02 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.393
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 SUBAREA AREA(ACRES) =    1.16   SUBAREA RUNOFF(CFS) =    1.45
 TOTAL AREA(ACRES) =     1.81   TOTAL RUNOFF(CFS) =    2.28
 TC(MIN) =  10.78


****************************************************************************
 FLOW PROCESS FROM NODE      2.02 TO NODE      3.00 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.5 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   4.9
 UPSTREAM NODE ELEVATION =   656.00
 DOWNSTREAM NODE ELEVATION =   654.80
 FLOWLENGTH(FEET) =   103.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      2.28
 TRAVEL TIME(MIN.) =    .35    TC(MIN.) =  11.13


****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.377
  SOIL CLASSIFICATION IS "C"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
  SUBAREA AREA(ACRES) =     1.32   SUBAREA RUNOFF(CFS) =     1.64
  TOTAL AREA(ACRES) =      3.13   TOTAL RUNOFF(CFS) =     3.91
  TC(MIN) =  11.13


****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      1.01 IS CODE =   3
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS    6.1 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =   7.5
  UPSTREAM NODE ELEVATION =    654.80
  DOWNSTREAM NODE ELEVATION =    652.40
  FLOWLENGTH(FEET) =     98.00   MANNING'S N =  .013
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPEFLOW THRU SUBAREA(CFS) =      3.91
  TRAVEL TIME(MIN.) =     .22    TC(MIN.) =  11.35


****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =  11.35
  RAINFALL INTENSITY(INCH/HR) =   1.37
  TOTAL STREAM AREA(ACRES) =    3.13
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.91

  ** CONFLUENCE DATA **
  STREAM      RUNOFF       Tc       INTENSITY       AREA
  NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
      1         1.52     34.38         .709          4.29
      2         3.91     11.35        1.367          3.13

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM      RUNOFF       Tc       INTENSITY
  NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
      1         4.70     11.35        1.367
      2         3.55     34.38         .709

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      4.70   Tc(MIN.) =   11.35
  TOTAL AREA(ACRES) =      7.42


****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.367
  SOIL CLASSIFICATION IS "C"
  MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
  SUBAREA AREA(ACRES) =     2.48   SUBAREA RUNOFF(CFS) =     2.03
  TOTAL AREA(ACRES) =      9.90   TOTAL RUNOFF(CFS) =     6.73
  TC(MIN) =  11.35


****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      4.00 IS CODE =   3
```

```
------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.9 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   9.1
 UPSTREAM NODE ELEVATION =   652.40
 DOWNSTREAM NODE ELEVATION =   648.50
 FLOWLENGTH(FEET) =   141.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      6.73
 TRAVEL TIME(MIN.) =    .26    TC(MIN.) =  11.61


************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   8
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.355
 SOIL CLASSIFICATION IS "C"
 MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
 SUBAREA AREA(ACRES) =      .65   SUBAREA RUNOFF(CFS) =      .53
 TOTAL AREA(ACRES) =    10.55   TOTAL RUNOFF(CFS) =    7.26
 TC(MIN) =  11.61


************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     5.00 IS CODE =   3
------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   6.3
 UPSTREAM NODE ELEVATION =   648.50
 DOWNSTREAM NODE ELEVATION =   644.85
 FLOWLENGTH(FEET) =   369.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      7.26
 TRAVEL TIME(MIN.) =    .98    TC(MIN.) =  12.59


************************************************************************
 FLOW PROCESS FROM NODE     5.00 TO NODE     5.00 IS CODE =   8
------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.308
 SOIL CLASSIFICATION IS "C"
 MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
 SUBAREA AREA(ACRES) =    2.87   SUBAREA RUNOFF(CFS) =    2.25
 TOTAL AREA(ACRES) =    13.42   TOTAL RUNOFF(CFS) =    9.51
 TC(MIN) =  12.59
========================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =      9.51   Tc(MIN.) =   12.59
 TOTAL AREA(ACRES) =     13.42
========================================================================
 END OF RATIONAL METHOD ANALYSIS
```

SMALL AREA UNIT HYDROGRAPH MODEL

Analysis prepared by:

Robert Bein, William Frost & Associates
14725 Alton Parkway
Irvine, California 92618

RATIONAL METHOD CALIBRATION COEFFICIENT = .90
TOTAL CATCHMENT AREA(ACRES) = 13.42
SOIL-LOSS RATE, Fm,(INCH/HR) = .198
LOW LOSS FRACTION = .570
TIME OF CONCENTRATION(MIN.) = 12.59
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = .25
30-MINUTE POINT RAINFALL VALUE(INCHES) = .48
1-HOUR POINT RAINFALL VALUE(INCHES) = .62
3-HOUR POINT RAINFALL VALUE(INCHES) = .90
6-HOUR POINT RAINFALL VALUE(INCHES) = 1.18
24-HOUR POINT RAINFALL VALUE(INCHES) = 1.90

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = .91
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 1.22

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	5.0	10.0	15.0	20.0
.05	.0000	.00	Q	.	.	.	.
.26	.0012	.14	Q	.	.	.	.
.47	.0037	.14	Q	.	.	.	.
.68	.0062	.14	Q	.	.	.	.
.89	.0087	.15	Q	.	.	.	.
1.10	.0112	.15	Q	.	.	.	.
1.31	.0138	.15	Q	.	.	.	.
1.52	.0164	.15	Q	.	.	.	.
1.73	.0190	.15	Q	.	.	.	.
1.94	.0216	.15	Q	.	.	.	.
2.15	.0243	.15	Q	.	.	.	.
2.36	.0270	.16	Q	.	.	.	.
2.57	.0297	.16	Q	.	.	.	.
2.78	.0324	.16	Q	.	.	.	.
2.99	.0352	.16	Q	.	.	.	.
3.20	.0380	.16	Q	.	.	.	.
3.41	.0408	.16	Q	.	.	.	.
3.62	.0437	.17	Q	.	.	.	.
3.83	.0466	.17	Q	.	.	.	.
4.04	.0495	.17	Q	.	.	.	.
4.25	.0524	.17	Q	.	.	.	.
4.46	.0554	.17	Q	.	.	.	.
4.67	.0584	.18	Q	.	.	.	.
4.88	.0615	.18	Q	.	.	.	.
5.09	.0646	.18	Q	.	.	.	.
5.30	.0677	.18	Q	.	.	.	.
5.51	.0709	.18	Q	.	.	.	.
5.72	.0741	.19	Q	.	.	.	.
5.93	.0774	.19	Q	.	.	.	.
6.14	.0807	.19	Q	.	.	.	.
6.35	.0840	.19	Q	.	.	.	.
6.56	.0874	.20	Q	.	.	.	.
6.77	.0909	.20	Q	.	.	.	.

6.98	.0944	.20	Q	.	.	.	.
7.19	.0979	.21	Q	.	.	.	.
7.40	.1015	.21	Q	.	.	.	.
7.61	.1052	.21	Q	.	.	.	.
7.82	.1089	.22	Q	.	.	.	.
8.03	.1127	.22	Q	.	.	.	.
8.24	.1166	.22	Q	.	.	.	.
8.45	.1205	.23	Q	.	.	.	.
8.66	.1245	.23	Q	.	.	.	.
8.87	.1285	.24	Q	.	.	.	.
9.08	.1327	.24	Q	.	.	.	.
9.29	.1369	.24	Q	.	.	.	.
9.50	.1412	.25	Q	.	.	.	.
9.70	.1456	.26	Q	.	.	.	.
9.91	.1501	.26	Q	.	.	.	.
10.12	.1547	.27	Q	.	.	.	.
10.33	.1593	.27	Q	.	.	.	.
10.54	.1641	.28	Q	.	.	.	.
10.75	.1691	.29	Q	.	.	.	.
10.96	.1741	.29	Q	.	.	.	.
11.17	.1793	.30	Q	.	.	.	.
11.38	.1846	.31	Q	.	.	.	.
11.59	.1901	.32	Q	.	.	.	.
11.80	.1958	.33	Q	.	.	.	.
12.01	.2016	.34	Q	.	.	.	.
12.22	.2079	.38	Q	.	.	.	.
12.43	.2148	.42	Q	.	.	.	.
12.64	.2222	.43	Q	.	.	.	.
12.85	.2298	.45	Q	.	.	.	.
13.06	.2377	.46	Q	.	.	.	.
13.27	.2459	.49	Q	.	.	.	.
13.48	.2545	.50	.Q	.	.	.	.
13.69	.2636	.54	.Q	.	.	.	.
13.90	.2731	.56	.Q	.	.	.	.
14.11	.2829	.58	.Q	.	.	.	.
14.32	.2927	.55	.Q	.	.	.	.
14.53	.3028	.61	.Q	.	.	.	.
14.74	.3137	.65	.Q	.	.	.	.
14.95	.3258	.75	.Q	.	.	.	.
15.16	.3393	.81	.Q	.	.	.	.
15.37	.3549	1.00	.Q	.	.	.	.
15.58	.3741	1.21	. Q	.	.	.	.
15.79	.4001	1.79	. Q	.	.	.	.
16.00	.4450	3.39	. Q	.	.	.	.
16.21	.5871	13.00	.	.	. Q	.	.
16.42	.7124	1.45	. Q	.	.	.	.
16.63	.7327	.89	.Q	.	.	.	.
16.84	.7464	.69	.Q	.	.	.	.
17.05	.7575	.58	.Q	.	.	.	.
17.26	.7675	.58	.Q	.	.	.	.
17.47	.7770	.52	.Q	.	.	.	.
17.68	.7857	.47	Q	.	.	.	.
17.89	.7936	.44	Q	.	.	.	.
18.10	.8009	.41	Q	.	.	.	.
18.31	.8074	.34	Q	.	.	.	.
18.52	.8130	.32	Q	.	.	.	.
18.73	.8184	.30	Q	.	.	.	.
18.94	.8234	.28	Q	.	.	.	.
19.15	.8282	.27	Q	.	.	.	.
19.36	.8328	.26	Q	.	.	.	.
19.57	.8372	.25	Q	.	.	.	.
19.78	.8414	.24	Q	.	.	.	.
19.99	.8455	.23	Q	.	.	.	.
20.20	.8494	.22	Q	.	.	.	.
20.41	.8532	.21	Q	.	.	.	.
20.62	.8569	.21	Q	.	.	.	.
20.83	.8604	.20	Q	.	.	.	.
21.04	.8639	.20	Q	.	.	.	.
21.25	.8672	.19	Q	.	.	.	.
21.46	.8705	.19	Q	.	.	.	.
21.67	.8737	.18	Q	.	.	.	.
21.88	.8768	.18	Q	.	.	.	.
22.09	.8798	.17	Q	.	.	.	.
22.30	.8827	.17	Q	.	.	.	.

22.50	.8856	.16	Q	.	.	.	.
22.71	.8885	.16	Q	.	.	.	.
22.92	.8912	.16	Q	.	.	.	.
23.13	.8939	.15	Q	.	.	.	.
23.34	.8966	.15	Q	.	.	.	.
23.55	.8992	.15	Q	.	.	.	.
23.76	.9018	.15	Q	.	.	.	.
23.97	.9043	.14	Q	.	.	.	.

```
****************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
        (c) Copyright 1982-96 Advanced Engineering Software (aes)
            Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                    Robert Bein, William Frost & Associates
                             14725 Alton Parkway
                              Irvine, CA  92618


 ************************** DESCRIPTION OF STUDY **************************
* JN 34358 I-15/SR-78 EXTENDED DETENTION BASIN                            *
* 25-YR STORM FREQUENCY                                                   *
* AMW                                                                     *
 ****************************************************************************

  FILE NAME: S78I1525.DAT
  TIME/DATE OF STUDY: 10:29   5/30/1998
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  3.850
   2)  10.000;  3.000
   3)  20.000;  2.140
   4)  30.000;  1.680
   5)  40.000;  1.420
   6)  50.000;  1.230
   7)  60.000;  1.090
   8) 120.000;   .700
   9) 180.000;   .540
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.01 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  SOIL CLASSIFICATION IS "C"
  SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .5000
  INITIAL SUBAREA FLOW-LENGTH =  1800.00
  UPSTREAM ELEVATION =     695.00
  DOWNSTREAM ELEVATION =     652.40
  ELEVATION DIFFERENCE =      42.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   34.384
  *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
     NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
    25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.566
  SUBAREA RUNOFF(CFS) =       3.36
  TOTAL AREA(ACRES) =       4.29   TOTAL RUNOFF(CFS) =       3.36


****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  34.38
  RAINFALL INTENSITY(INCH/HR) =   1.57
```

```
 TOTAL STREAM AREA(ACRES) =     4.29
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.36


****************************************************************************
 FLOW PROCESS FROM NODE      2.00 TO NODE      2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 INITIAL SUBAREA FLOW-LENGTH =   720.00
 UPSTREAM ELEVATION =     670.00
 DOWNSTREAM ELEVATION =     664.50
 ELEVATION DIFFERENCE =       5.50
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   10.567
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
   25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.951
 SUBAREA RUNOFF(CFS) =       1.73
 TOTAL AREA(ACRES) =        .65   TOTAL RUNOFF(CFS) =       1.73


****************************************************************************
 FLOW PROCESS FROM NODE      2.01 TO NODE      2.02 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   8.3
 UPSTREAM NODE ELEVATION =   659.40
 DOWNSTREAM NODE ELEVATION =   654.00
 FLOWLENGTH(FEET) =    85.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.73
 TRAVEL TIME(MIN.) =    .17    TC(MIN.) =  10.74


****************************************************************************
 FLOW PROCESS FROM NODE      2.02 TO NODE      2.02 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.937
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 SUBAREA AREA(ACRES) =    1.16   SUBAREA RUNOFF(CFS) =    3.07
 TOTAL AREA(ACRES) =     1.81   TOTAL RUNOFF(CFS) =    4.79
 TC(MIN) =  10.74


****************************************************************************
 FLOW PROCESS FROM NODE      2.02 TO NODE      3.00 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.3 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   6.0
 UPSTREAM NODE ELEVATION =   656.00
 DOWNSTREAM NODE ELEVATION =   654.80
 FLOWLENGTH(FEET) =   103.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      4.79
 TRAVEL TIME(MIN.) =    .28    TC(MIN.) =  11.02


****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
  25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.912
 SOIL CLASSIFICATION IS "C"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
 SUBAREA AREA(ACRES) =     1.32   SUBAREA RUNOFF(CFS) =     3.46
 TOTAL AREA(ACRES) =      3.13   TOTAL RUNOFF(CFS) =     8.25
 TC(MIN) =  11.02


****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      1.01 IS CODE =   3
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.2 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   9.1
 UPSTREAM NODE ELEVATION =   654.80
 DOWNSTREAM NODE ELEVATION =   652.40
 FLOWLENGTH(FEET) =    98.00   MANNING'S N =  .013
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      8.25
 TRAVEL TIME(MIN.) =     .18    TC(MIN.) =  11.20


****************************************************************************
 FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  11.20
 RAINFALL INTENSITY(INCH/HR) =   2.90
 TOTAL STREAM AREA(ACRES) =    3.13
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      8.25

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
    1          3.36     34.38       1.566          4.29
    2          8.25     11.20       2.897          3.13

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
    1         10.07     11.20       2.897
    2          7.82     34.38       1.566

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     10.07   Tc(MIN.) =   11.20
 TOTAL AREA(ACRES) =      7.42


****************************************************************************
 FLOW PROCESS FROM NODE      1.01 TO NODE      1.01 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.897
 SOIL CLASSIFICATION IS "C"
 MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
 SUBAREA AREA(ACRES) =     2.48   SUBAREA RUNOFF(CFS) =     4.31
 TOTAL AREA(ACRES) =      9.90   TOTAL RUNOFF(CFS) =    14.38
 TC(MIN) =  11.20


****************************************************************************
 FLOW PROCESS FROM NODE      1.01 TO NODE      4.00 IS CODE =   3
```

```
------------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.7 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =  10.8
  UPSTREAM NODE ELEVATION =   652.40
  DOWNSTREAM NODE ELEVATION =   648.50
  FLOWLENGTH(FEET) =   141.00   MANNING'S N =  .013
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPEFLOW THRU SUBAREA(CFS) =     14.38
  TRAVEL TIME(MIN.) =    .22    TC(MIN.) =  11.42


****************************************************************************
  FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.878
  SOIL CLASSIFICATION IS "C"
  MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
  SUBAREA AREA(ACRES) =      .65   SUBAREA RUNOFF(CFS) =    1.12
  TOTAL AREA(ACRES) =    10.55   TOTAL RUNOFF(CFS) =   15.50
  TC(MIN) =  11.42


****************************************************************************
  FLOW PROCESS FROM NODE     4.00 TO NODE     5.00 IS CODE =   3
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  14.9 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =   7.6
  UPSTREAM NODE ELEVATION =   648.50
  DOWNSTREAM NODE ELEVATION =   644.85
  FLOWLENGTH(FEET) =   369.00   MANNING'S N =  .013
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPEFLOW THRU SUBAREA(CFS) =     15.50
  TRAVEL TIME(MIN.) =    .81    TC(MIN.) =  12.23


****************************************************************************
  FLOW PROCESS FROM NODE     5.00 TO NODE     5.00 IS CODE =   8
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.808
  SOIL CLASSIFICATION IS "C"
  MULTI-UNITS DEVELOPMENT RUNOFF COEFFICIENT = .6000
  SUBAREA AREA(ACRES) =    2.87   SUBAREA RUNOFF(CFS) =    4.84
  TOTAL AREA(ACRES) =    13.42   TOTAL RUNOFF(CFS) =   20.34
  TC(MIN) =  12.23
============================================================================
  END OF STUDY SUMMARY:
  PEAK FLOW RATE(CFS) =     20.34   Tc(MIN.) =   12.23
  TOTAL AREA(ACRES) =     13.42
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

****

SMALL AREA UNIT HYDROGRAPH MODEL

Ver. 6.1 Release Date: 01/01/96 License ID 1264

Analysis prepared by:

Robert Bein, William Frost & Associates
14725 Alton Parkway
Irvine, California 92618

RATIONAL METHOD CALIBRATION COEFFICIENT = .90
TOTAL CATCHMENT AREA(ACRES) = 13.42
SOIL-LOSS RATE, Fm,(INCH/HR) = .198
LOW LOSS FRACTION = .570
TIME OF CONCENTRATION(MIN.) = 12.23
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = .39
30-MINUTE POINT RAINFALL VALUE(INCHES) = .85
1-HOUR POINT RAINFALL VALUE(INCHES) = 1.17
3-HOUR POINT RAINFALL VALUE(INCHES) = 1.93
6-HOUR POINT RAINFALL VALUE(INCHES) = 2.60
24-HOUR POINT RAINFALL VALUE(INCHES) = 4.80

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 2.32
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 3.05

****

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	5.0	10.0	15.0	20.0
.10	.0000	.00	Q	.	.	.	.
.30	.0039	.46	Q	.	.	.	.
.51	.0117	.46	Q	.	.	.	.
.71	.0196	.47	Q	.	.	.	.
.92	.0275	.47	Q	.	.	.	.
1.12	.0355	.48	Q	.	.	.	.
1.32	.0435	.48	Q	.	.	.	.
1.53	.0516	.48	Q	.	.	.	.
1.73	.0598	.49	Q	.	.	.	.
1.94	.0680	.49	Q	.	.	.	.
2.14	.0763	.49	Q	.	.	.	.
2.34	.0846	.50	Q	.	.	.	.
2.55	.0931	.50	.Q	.	.	.	.
2.75	.1016	.51	.Q	.	.	.	.
2.95	.1101	.51	.Q	.	.	.	.
3.16	.1188	.52	.Q	.	.	.	.
3.36	.1275	.52	.Q	.	.	.	.
3.57	.1363	.53	.Q	.	.	.	.
3.77	.1452	.53	.Q	.	.	.	.
3.97	.1542	.54	.Q	.	.	.	.
4.18	.1632	.54	.Q	.	.	.	.
4.38	.1723	.55	.Q	.	.	.	.
4.59	.1816	.55	.Q	.	.	.	.
4.79	.1909	.56	.Q	.	.	.	.
4.99	.2003	.56	.Q	.	.	.	.
5.20	.2098	.57	.Q	.	.	.	.
5.40	.2194	.57	.Q	.	.	.	.
5.60	.2291	.58	.Q	.	.	.	.
5.81	.2389	.58	.Q	.	.	.	.
6.01	.2488	.59	.Q	.	.	.	.
6.22	.2588	.60	.Q	.	.	.	.
6.42	.2690	.61	.Q	.	.	.	.
6.62	.2792	.61	.Q	.	.	.	.

6.83	.2896	.62	.Q
7.03	.3001	.63	.Q
7.24	.3108	.64	.Q
7.44	.3215	.64	.Q
7.64	.3325	.65	.Q
7.85	.3435	.66	.Q
8.05	.3548	.67	.Q
8.25	.3661	.68	.Q
8.46	.3777	.69	.Q
8.66	.3894	.70	.Q
8.87	.4013	.71	.Q
9.07	.4134	.72	.Q
9.27	.4256	.74	.Q
9.48	.4381	.74	.Q
9.68	.4508	.76	.Q
9.89	.4637	.77	.Q
10.09	.4769	.79	.Q
10.29	.4903	.80	.Q
10.50	.5039	.82	.Q
10.70	.5179	.83	.Q
10.90	.5321	.86	.Q
11.11	.5467	.87	.Q
11.31	.5615	.90	.Q
11.52	.5768	.91	.Q
11.72	.5924	.94	.Q
11.92	.6084	.96	.Q
12.13	.6247	.98	.Q
12.33	.6413	.99	.Q
12.53	.6582	1.03	. Q
12.74	.6757	1.05	. Q
12.94	.6939	1.10	. Q
13.15	.7126	1.13	. Q
13.35	.7321	1.19	. Q
13.55	.7525	1.22	. Q
13.76	.7737	1.30	. Q
13.96	.7960	1.35	. Q
14.17	.8201	1.51	. Q
14.37	.8463	1.60	. Q
14.57	.8744	1.74	. Q
14.78	.9047	1.86	. Q
14.98	.9405	2.38	. Q
15.18	.9835	2.72	. Q
15.39	1.0373	3.67	. Q
15.59	1.1056	4.44	. Q
15.80	1.2001	6.78	. Q
16.00	1.3381	9.60	. Q
16.20	1.5537	16.00	. Q
16.41	1.7344	5.45	. Q
16.61	1.8067	3.14	. Q
16.82	1.8508	2.10	. Q
17.02	1.8825	1.66	. Q
17.22	1.9083	1.39	. Q
17.43	1.9307	1.26	. Q
17.63	1.9510	1.16	. Q
17.83	1.9698	1.07	. Q
18.04	1.9874	1.01	. Q
18.24	2.0040	.98	.Q
18.45	2.0201	.93	.Q
18.65	2.0353	.88	.Q
18.85	2.0499	.84	.Q
19.06	2.0638	.81	.Q
19.26	2.0772	.78	.Q
19.47	2.0901	.75	.Q
19.67	2.1026	.73	.Q
19.87	2.1147	.71	.Q
20.08	2.1264	.69	.Q
20.28	2.1378	.67	.Q
20.48	2.1489	.65	.Q
20.69	2.1596	.63	.Q
20.89	2.1702	.62	.Q
21.10	2.1804	.60	.Q
21.30	2.1904	.59	.Q
21.50	2.2003	.58	.Q
21.71	2.2099	.56	.Q

21.91	2.2193	.55	.Q	.	.	.	.
22.11	2.2285	.54	.Q	.	.	.	.
22.32	2.2375	.53	.Q	.	.	.	.
22.52	2.2464	.52	.Q	.	.	.	.
22.73	2.2551	.51	.Q	.	.	.	.
22.93	2.2637	.50	.Q	.	.	.	.
23.13	2.2721	.50	Q	.	.	.	.
23.34	2.2804	.49	Q	.	.	.	.
23.54	2.2886	.48	Q	.	.	.	.
23.75	2.2966	.47	Q	.	.	.	.
23.95	2.3046	.47	Q	.	.	.	.

Loss Rate

$F_p = 0.30$

$a_p = (1.5/5.53) = 0.271$ 72% Road

$\boxed{F_m = a_p F_p = 0.0813}$

$I_a = 0.25$

$S = \frac{1000}{CN} - 10$

CN = 90 Roadway
86 Basin + Slopes } Composite = 98.9

$\therefore \{S = 1.25, I_a = 0.25\}$

$y_i = \frac{(P_{24} - I_a)^2}{(P_{24} - I_a + S) P_{24}} = \frac{(1.34 - 0.25)^2}{(1.34 - 0.25 + 1.25)(1.34)} = 0.379$

$P_{24} = 1.34$ in

$\boxed{\bar{Y} = 1 - y_i = 0.621}$

Mass Curve

5 min — 0.33" 0.30
30 min — 0.52" 0.49
1 hr. — 0.62 0.59
3 hr — 0.80 0.78
6 hr — 0.94
24 hr. — 1.34

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-96 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                        Analysis prepared by:

                    Robert Bein, William Frost & Associates
                              14725 Alton Parkway
                               Irvine, CA  92618


 ************************* DESCRIPTION OF STUDY *************************
* JN 34358 I-5/LA COSTA AVE INFILTRATION BASIN                           *
* 1-YR STORM FREQUENCY                                                   *
* AMW                                                                    *
 **************************************************************************

  FILE NAME: I5LC1Y.DAT
  TIME/DATE OF STUDY: 10:42   5/30/1998
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   1.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  1.950
   2)  10.000;  1.430
   3)  20.000;   .960
   4)  30.000;   .770
   5)  40.000;   .630
   6)  50.000;   .545
   7)  60.000;   .480
   8) 120.000;   .320
   9) 180.000;   .235
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE     1.00 TO NODE     1.01 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "B"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
  INITIAL SUBAREA FLOW-LENGTH =   460.00
  UPSTREAM ELEVATION =     21.50
  DOWNSTREAM ELEVATION =     16.10
  ELEVATION DIFFERENCE =      5.40
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    9.149
     1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.518
  SUBAREA RUNOFF(CFS) =       .81
  TOTAL AREA(ACRES) =       .63   TOTAL RUNOFF(CFS) =       .81


**************************************************************************
  FLOW PROCESS FROM NODE     1.01 TO NODE     1.02 IS CODE =   4
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
==========================================================================
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   2.9 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =   3.7
  UPSTREAM NODE ELEVATION =    13.10
  DOWNSTREAM NODE ELEVATION =     8.40
  FLOWLENGTH(FEET) =   350.00   MANNING'S N =  .013
```

```
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =        .81
 TRAVEL TIME(MIN.) =   1.57    TC(MIN.) =  10.72


****************************************************************************
 FLOW PROCESS FROM NODE     1.02 TO NODE     1.02 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.72
 RAINFALL INTENSITY(INCH/HR) =   1.40
 TOTAL STREAM AREA(ACRES) =      .63
 PEAK FLOW RATE(CFS) AT CONFLUENCE =        .81


****************************************************************************
 FLOW PROCESS FROM NODE     2.00 TO NODE     2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .4500
 INITIAL SUBAREA FLOW-LENGTH =   820.00
 UPSTREAM ELEVATION =     21.50
 DOWNSTREAM ELEVATION =     15.00
 ELEVATION DIFFERENCE =      6.50
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   36.201
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =   .683
 SUBAREA RUNOFF(CFS) =        .18
 TOTAL AREA(ACRES) =        .59   TOTAL RUNOFF(CFS) =        .18


****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     1.02 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   1.1 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   3.7
 UPSTREAM NODE ELEVATION =    12.00
 DOWNSTREAM NODE ELEVATION =     8.40
 FLOWLENGTH(FEET) =    70.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =        .18
 TRAVEL TIME(MIN.) =     .32    TC(MIN.) =  36.52


****************************************************************************
 FLOW PROCESS FROM NODE     1.02 TO NODE     1.02 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  36.52
 RAINFALL INTENSITY(INCH/HR) =    .68
 TOTAL STREAM AREA(ACRES) =      .59
 PEAK FLOW RATE(CFS) AT CONFLUENCE =        .18

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
     1          .81     10.72       1.396           .63
     2          .18     36.52        .679           .59

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.
```

```
 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
    1           .90     10.72       1.396
    2           .58     36.52        .679

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        .90   Tc(MIN.) =   10.72
 TOTAL AREA(ACRES) =       1.22


****************************************************************************
 FLOW PROCESS FROM NODE      1.02 TO NODE      1.02 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.396
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =      .51   SUBAREA RUNOFF(CFS) =      .61
 TOTAL AREA(ACRES) =      1.73   TOTAL RUNOFF(CFS) =     1.51
 TC(MIN) =  10.72


****************************************************************************
 FLOW PROCESS FROM NODE      1.02 TO NODE      1.03 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   5.3 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   2.9
 UPSTREAM NODE ELEVATION =     8.40
 DOWNSTREAM NODE ELEVATION =     6.10
 FLOWLENGTH(FEET) =   565.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.51
 TRAVEL TIME(MIN.) =   3.23    TC(MIN.) =  13.95


****************************************************************************
 FLOW PROCESS FROM NODE      1.03 TO NODE      1.03 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  13.95
 RAINFALL INTENSITY(INCH/HR) =   1.24
 TOTAL STREAM AREA(ACRES) =    1.73
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.51


****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      3.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   580.00
 UPSTREAM ELEVATION =     15.00
 DOWNSTREAM ELEVATION =     12.40
 ELEVATION DIFFERENCE =      2.60
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   14.160
 *CAUTION: SUBAREA SLOPE EXCEEDS COUNTY NOMOGRAPH
  DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
    1 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.234
 SUBAREA RUNOFF(CFS) =      1.55
 TOTAL AREA(ACRES) =      1.48   TOTAL RUNOFF(CFS) =      1.55
```

```
****************************************************************************
 FLOW PROCESS FROM NODE     3.01 TO NODE     1.03 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.1 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   7.5
 UPSTREAM NODE ELEVATION =     9.10
 DOWNSTREAM NODE ELEVATION =     6.10
 FLOWLENGTH(FEET) =    57.40   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.55
 TRAVEL TIME(MIN.) =    .13    TC(MIN.) =  14.29


****************************************************************************
 FLOW PROCESS FROM NODE     1.03 TO NODE     1.03 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  14.29
 RAINFALL INTENSITY(INCH/HR) =   1.23
 TOTAL STREAM AREA(ACRES) =    1.48
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.55

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
    1          1.51     13.95       1.244          1.73
    2          1.55     14.29       1.228          1.48

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
    1          3.04     13.95       1.244
    2          3.04     14.29       1.228

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      3.04   Tc(MIN.) =   14.29
 TOTAL AREA(ACRES) =      3.21


****************************************************************************
 FLOW PROCESS FROM NODE     1.03 TO NODE     1.04 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   7.8 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   3.5
 UPSTREAM NODE ELEVATION =     6.10
 DOWNSTREAM NODE ELEVATION =     5.58
 FLOWLENGTH(FEET) =   140.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      3.04
 TRAVEL TIME(MIN.) =    .67    TC(MIN.) =  14.96
============================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =      3.04   Tc(MIN.) =   14.96
 TOTAL AREA(ACRES) =      3.21
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

SMALL AREA UNIT HYDROGRAPH MODEL

Ver. 6.1 Release Date: 01/01/96 License ID 1264

Analysis prepared by:

Robert Bein, William Frost & Associates
14725 Alton Parkway
Irvine, California 92618

RATIONAL METHOD CALIBRATION COEFFICIENT = .90
TOTAL CATCHMENT AREA(ACRES) = 3.21
SOIL-LOSS RATE, Fm, (INCH/HR) = .081
LOW LOSS FRACTION = .621
TIME OF CONCENTRATION(MIN.) = 14.96
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = .30
30-MINUTE POINT RAINFALL VALUE(INCHES) = .49
1-HOUR POINT RAINFALL VALUE(INCHES) = .59
3-HOUR POINT RAINFALL VALUE(INCHES) = .78
6-HOUR POINT RAINFALL VALUE(INCHES) = .94
24-HOUR POINT RAINFALL VALUE(INCHES) = 1.34

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = .20
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = .16

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
.04	.0000	.00	Q	.	.	.	.
.29	.0002	.02	Q	.	.	.	.
.54	.0005	.02	Q	.	.	.	.
.79	.0008	.02	Q	.	.	.	.
1.04	.0011	.02	Q	.	.	.	.
1.29	.0015	.02	Q	.	.	.	.
1.54	.0018	.02	Q	.	.	.	.
1.79	.0022	.02	Q	.	.	.	.
2.04	.0025	.02	Q	.	.	.	.
2.29	.0029	.02	Q	.	.	.	.
2.54	.0032	.02	Q	.	.	.	.
2.79	.0036	.02	Q	.	.	.	.
3.03	.0040	.02	Q	.	.	.	.
3.28	.0043	.02	Q	.	.	.	.
3.53	.0047	.02	Q	.	.	.	.
3.78	.0051	.02	Q	.	.	.	.
4.03	.0055	.02	Q	.	.	.	.
4.28	.0059	.02	Q	.	.	.	.
4.53	.0063	.02	Q	.	.	.	.
4.78	.0067	.02	Q	.	.	.	.
5.03	.0071	.02	Q	.	.	.	.
5.28	.0076	.02	Q	.	.	.	.
5.53	.0080	.02	Q	.	.	.	.
5.78	.0084	.02	Q	.	.	.	.
6.03	.0089	.02	Q	.	.	.	.
6.28	.0093	.02	Q	.	.	.	.
6.53	.0098	.02	Q	.	.	.	.
6.77	.0103	.02	Q	.	.	.	.
7.02	.0108	.02	Q	.	.	.	.
7.27	.0112	.02	Q	.	.	.	.
7.52	.0117	.02	Q	.	.	.	.
7.77	.0123	.03	Q	.	.	.	.
8.02	.0128	.03	Q	.	.	.	.

8.27	.0133	.03	Q	.	.	.	.
8.52	.0139	.03	Q	.	.	.	.
8.77	.0144	.03	Q	.	.	.	.
9.02	.0150	.03	Q	.	.	.	.
9.27	.0156	.03	Q	.	.	.	.
9.52	.0162	.03	Q	.	.	.	.
9.77	.0168	.03	Q	.	.	.	.
10.02	.0175	.03	Q	.	.	.	.
10.27	.0181	.03	Q	.	.	.	.
10.51	.0188	.03	Q	.	.	.	.
10.76	.0195	.04	Q	.	.	.	.
11.01	.0203	.04	Q	.	.	.	.
11.26	.0210	.04	Q	.	.	.	.
11.51	.0218	.04	Q	.	.	.	.
11.76	.0226	.04	Q	.	.	.	.
12.01	.0235	.04	Q	.	.	.	.
12.26	.0244	.05	Q	.	.	.	.
12.51	.0254	.05	Q	.	.	.	.
12.76	.0264	.05	Q	.	.	.	.
13.01	.0275	.05	Q	.	.	.	.
13.26	.0287	.06	Q	.	.	.	.
13.51	.0299	.06	Q	.	.	.	.
13.76	.0312	.07	Q	.	.	.	.
14.01	.0326	.07	Q	.	.	.	.
14.25	.0341	.07	Q	.	.	.	.
14.50	.0357	.08	Q	.	.	.	.
14.75	.0375	.09	Q	.	.	.	.
15.00	.0395	.10	Q	.	.	.	.
15.25	.0419	.13	Q	.	.	.	.
15.50	.0450	.16	Q	.	.	.	.
15.75	.0510	.42	.Q	.	.	.	.
16.00	.0630	.75	. Q	.	.	.	.
16.25	.1222	5.00	.	.	Q	.	.
16.50	.1765	.27	.Q	.	.	.	.
16.75	.1805	.11	Q	.	.	.	.
17.00	.1826	.09	Q	.	.	.	.
17.25	.1842	.07	Q	.	.	.	.
17.50	.1856	.06	Q	.	.	.	.
17.75	.1869	.06	Q	.	.	.	.
17.99	.1880	.05	Q	.	.	.	.
18.24	.1889	.04	Q	.	.	.	.
18.49	.1898	.04	Q	.	.	.	.
18.74	.1906	.04	Q	.	.	.	.
18.99	.1913	.03	Q	.	.	.	.
19.24	.1920	.03	Q	.	.	.	.
19.49	.1926	.03	Q	.	.	.	.
19.74	.1932	.03	Q	.	.	.	.
19.99	.1938	.03	Q	.	.	.	.
20.24	.1944	.03	Q	.	.	.	.
20.49	.1949	.02	Q	.	.	.	.
20.74	.1954	.02	Q	.	.	.	.
20.99	.1959	.02	Q	.	.	.	.
21.24	.1963	.02	Q	.	.	.	.
21.49	.1968	.02	Q	.	.	.	.
21.73	.1972	.02	Q	.	.	.	.
21.98	.1976	.02	Q	.	.	.	.
22.23	.1980	.02	Q	.	.	.	.
22.48	.1984	.02	Q	.	.	.	.
22.73	.1988	.02	Q	.	.	.	.
22.98	.1992	.02	Q	.	.	.	.
23.23	.1995	.02	Q	.	.	.	.
23.48	.1999	.02	Q	.	.	.	.
23.73	.2002	.02	Q	.	.	.	.
23.98	.2006	.02	Q	.	.	.	.
24.23	.2009	.02	Q	.	.	.	.
24.48	.2011	.00	Q	.	.	.	.

```
**************************************************************************

          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-96 Advanced Engineering Software (aes)
           Ver. 1.5A  Release Date: 01/01/96  License ID 1264

                          Analysis prepared by:

                    Robert Bein, William Frost & Associates
                              14725 Alton Parkway
                               Irvine, CA  92618


 ************************** DESCRIPTION OF STUDY **************************
* JN 34358 I-5/LA COSTA AVE INFILTRATION BASIN                            *
* 25-YR STORM FREQUENCY                                                  *
* AMW                                                                    *
 **************************************************************************

  FILE NAME: I5LC25.DAT
  TIME/DATE OF STUDY: 10:45   5/30/1998
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .95
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  3.850
   2)  10.000;  3.000
   3)  20.000;  2.140
   4)  30.000;  1.680
   5)  40.000;  1.420
   6)  50.000;  1.230
   7)  60.000;  1.090
   8) 120.000;   .700
   9) 180.000;   .540
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED


**************************************************************************
  FLOW PROCESS FROM NODE     1.00 TO NODE     1.01 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  SOIL CLASSIFICATION IS "B"
  INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
  INITIAL SUBAREA FLOW-LENGTH =   460.00
  UPSTREAM ELEVATION =     21.50
  DOWNSTREAM ELEVATION =     16.10
  ELEVATION DIFFERENCE =      5.40
  URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =    9.149
    25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.145
  SUBAREA RUNOFF(CFS) =      1.68
  TOTAL AREA(ACRES) =       .63   TOTAL RUNOFF(CFS) =      1.68


**************************************************************************
  FLOW PROCESS FROM NODE     1.01 TO NODE     1.02 IS CODE =   4
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
==========================================================================
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   4.2 INCHES
  PIPEFLOW VELOCITY(FEET/SEC.) =   4.6
  UPSTREAM NODE ELEVATION =    13.10
  DOWNSTREAM NODE ELEVATION =     8.40
  FLOWLENGTH(FEET) =   350.00   MANNING'S N =  .013
```

```
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      1.68
 TRAVEL TIME(MIN.) =   1.27    TC(MIN.) =  10.42


****************************************************************************
 FLOW PROCESS FROM NODE     1.02 TO NODE     1.02 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.42
 RAINFALL INTENSITY(INCH/HR) =   2.96
 TOTAL STREAM AREA(ACRES) =      .63
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.68


****************************************************************************
 FLOW PROCESS FROM NODE     2.00 TO NODE     2.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 SINGLE FAMILY DEVELOPMENT RUNOFF COEFFICIENT = .4500
 INITIAL SUBAREA FLOW-LENGTH =   820.00
 UPSTREAM ELEVATION =     21.50
 DOWNSTREAM ELEVATION =     15.00
 ELEVATION DIFFERENCE =      6.50
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   36.201
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
   NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
  25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.519
 SUBAREA RUNOFF(CFS) =       .40
 TOTAL AREA(ACRES) =       .59   TOTAL RUNOFF(CFS) =       .40


****************************************************************************
 FLOW PROCESS FROM NODE     2.01 TO NODE     1.02 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   1.5 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   4.8
 UPSTREAM NODE ELEVATION =    12.00
 DOWNSTREAM NODE ELEVATION =     8.40
 FLOWLENGTH(FEET) =    70.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =       .40
 TRAVEL TIME(MIN.) =    .24    TC(MIN.) =  36.45


****************************************************************************
 FLOW PROCESS FROM NODE     1.02 TO NODE     1.02 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  36.45
 RAINFALL INTENSITY(INCH/HR) =   1.51
 TOTAL STREAM AREA(ACRES) =      .59
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       .40

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
    1          1.68     10.42       2.964           .63
    2           .40     36.45       1.512           .59

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.
```

```
 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc       INTENSITY
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)
    1         1.89     10.42       2.964
    2         1.26     36.45       1.512

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      1.89   Tc(MIN.) =   10.42
 TOTAL AREA(ACRES) =      1.22


****************************************************************************
 FLOW PROCESS FROM NODE      1.02 TO NODE      1.02 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.964
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 SUBAREA AREA(ACRES) =      .51   SUBAREA RUNOFF(CFS) =    1.28
 TOTAL AREA(ACRES) =     1.73   TOTAL RUNOFF(CFS) =    3.17
 TC(MIN) =  10.42


****************************************************************************
 FLOW PROCESS FROM NODE      1.02 TO NODE      1.03 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   7.7 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   3.6
 UPSTREAM NODE ELEVATION =     8.40
 DOWNSTREAM NODE ELEVATION =     6.10
 FLOWLENGTH(FEET) =   565.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      3.17
 TRAVEL TIME(MIN.) =   2.60    TC(MIN.) =  13.02


****************************************************************************
 FLOW PROCESS FROM NODE      1.03 TO NODE      1.03 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  13.02
 RAINFALL INTENSITY(INCH/HR) =   2.74
 TOTAL STREAM AREA(ACRES) =    1.73
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.17


****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      3.01 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 SOIL CLASSIFICATION IS "B"
 INDUSTRIAL DEVELOPMENT RUNOFF COEFFICIENT = .8500
 INITIAL SUBAREA FLOW-LENGTH =   580.00
 UPSTREAM ELEVATION =     15.00
 DOWNSTREAM ELEVATION =     12.40
 ELEVATION DIFFERENCE =      2.60
 URBAN SUBAREA OVERLAND TIME OF FLOW(MINUTES) =   14.160
 *CAUTION: SUBAREA SLOPE EXCEEDS COUNTY NOMOGRAPH
  DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
 *CAUTION: SUBAREA FLOWLENGTH EXCEEDS COUNTY
    NOMOGRAPH DEFINITION. EXTRAPOLATION OF NOMOGRAPH USED.
   25 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.642
 SUBAREA RUNOFF(CFS) =      3.32
 TOTAL AREA(ACRES) =      1.48   TOTAL RUNOFF(CFS) =      3.32
```

```
****************************************************************************
 FLOW PROCESS FROM NODE     3.01 TO NODE     1.03 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.6 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   9.4
 UPSTREAM NODE ELEVATION =     9.10
 DOWNSTREAM NODE ELEVATION =     6.10
 FLOWLENGTH(FEET) =    57.40   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      3.32
 TRAVEL TIME(MIN.) =    .10    TC(MIN.) =  14.26


****************************************************************************
 FLOW PROCESS FROM NODE     1.03 TO NODE     1.03 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  14.26
 RAINFALL INTENSITY(INCH/HR) =   2.63
 TOTAL STREAM AREA(ACRES) =    1.48
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.32

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
    1          3.17     13.02       2.740          1.73
    2          3.32     14.26       2.633          1.48

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
    1          6.37     13.02       2.740
    2          6.37     14.26       2.633

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      6.37   Tc(MIN.) =   14.26
 TOTAL AREA(ACRES) =      3.21


****************************************************************************
 FLOW PROCESS FROM NODE     1.03 TO NODE     1.04 IS CODE =   4
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPEFLOW TRAVELTIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE<<<<<
============================================================================
 DEPTH OF FLOW IN  24.0 INCH PIPE IS  11.6 INCHES
 PIPEFLOW VELOCITY(FEET/SEC.) =   4.2
 UPSTREAM NODE ELEVATION =     6.10
 DOWNSTREAM NODE ELEVATION =     5.58
 FLOWLENGTH(FEET) =   140.00   MANNING'S N =  .013
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPEFLOW THRU SUBAREA(CFS) =      6.37
 TRAVEL TIME(MIN.) =    .55    TC(MIN.) =  14.81
============================================================================
 END OF STUDY SUMMARY:
 PEAK FLOW RATE(CFS) =      6.37   Tc(MIN.) =   14.81
 TOTAL AREA(ACRES) =      3.21
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

APPENDIX B HYDRAULIC CALCULATIONS

USDA-SCS-Md

July 1975

Riser Inflow Curves

Legend

Weir flow, $Q_w = 9.739\ D_r H^{3/2}$

Orifice flow, $Q_o = 3.782\ D_r^2 H^{1/2}$

Q, cubic feet per second

Head in feet, measured from crest of riser

Riser Diameter, inches

JN 34358
CALTRANS STORM WATER MANAGEMENT SERVICES
I-5/SR-56 EXTENDED DETENTION BASIN
BASIN DESIGN AND VOLUME CALCULATIONS

		METRIC				ENGLISH				
LOCATION	BASE AREA	DEPTH	TOP SURFACE AREA	VOLUME		DEPTH	AREA	VOLUME		
	m^2	m	m^2	m^3		FT	FT^2	FT^3	AC-FT	
6.5	663.9723	0	663.9723	0	BASIN INVERT	0.00	7143.28	0		
		0.1	704.18446	68.40784		0.33	7575.898	2413.945141	0.06	
		0.2	744.39662	140.8369		0.66	8008.517	4969.78915	0.11	
		0.25	764.5027	178.5594		0.82	8224.826	6300.92323	0.14	
		0.34	800.693644	248.9932		1.12	8614.182	8786.360862	0.20	
		0.45	844.92702	339.5023	6-MOS WQ	1.48	9090.063	11980.20672	0.28	VOL ESTIMATED
7	865.0331	0.5	865.0331	382.2514		1.64	9306.372	13488.71439	0.31	
		0.51	869.687315	390.925	1-YR WQ	1.67	9356.444	13794.78457	0.32	
		0.7	958.1174	564.5664		2.30	10307.81	19922.1662	0.46	
		0.8	1004.65955	662.7052		2.62	10808.53	23385.24588	0.54	
		1	1097.74385	872.9456	25-YR WSE	3.28	11809.97	30804.11281	0.71	
7.6	1144.286	1.1	1144.286	985.0471	BASIN RIM	3.61	12310.69	34759.90006	0.80	

VOL ESTIMATED: Floating point error in AES Unit Hydrograph computer program. The 6-month volume was calculated using a ratio based on the 1-YR volume and discharge.
6-MOS VOLUME=4.58CFS(0.32 AC-FT)/5.3 CFS
=0.28 AC-FT

RISER INFLOW		
MAX Q25(CFS)=	20.34	
RISER DIA (IN)=	48	
Q25 HW (FT)=	0.65	WEIR FLOW

Calc. By: _____ Date: 5/30/98
Chkd. By: _____ Date: _____
Backchkd. By: _____ Date: _____

JN 34358
CALTRANS STORMWATER MANAGEMENT SERVICES
I-5/SR-56 EXTENDED DETENTION BASIN
6- MONTH Orifice Sizing Calculation

Note: Orifice Sizing Calculation based on procedure for 40 hour drawdown time in Caltrans Storm Water Quality Handbooks Planning and Design Staff Guide. September 1997, PD11B(1) Detention Basin, pg. 6 of 12.

a = area of orifice (ft^2)

a = $(7x10^{-5})$ x A x $(H-Ho)^{0.5}$ / CT

A = Average surface area of the pond (ft^2)

A = 8,117 ft^2

6-Month H = Elevation when the pond is full (ft)

H = 1.48 ft

Ho = Final Elevation when pond is empty (ft)

Ho = 0.00 ft

C = Orifice Coefficient

C = 0.66 for thin materials

T=Drawdown time of full pond (hrs)

T= 72

a = 0.0145 ft^2 Total area required

a = 0.0073 ft^2 Area of each orifice (Two orifices required.)

d = diameter of orifice = $(4 \times a / \pi)^{0.5}$

d = 0.10 ft

d = 1.15 in = 29.3 mm

6-MOS. **Use d = 1.15 in (29.3mm) for each orifice to ensure a 72 hour drawdown time.**

Informational Calculations:

T (hrs)	a (ft^2)	d (in)
48	0.0218	2.00
72	0.0145	1.63

Calc. By: _____ Date: 5/30/98
Chkd. By: _____ Date: _____
Backchkd. By: _____ Date: _____

JN 34358
CALTRANS STORMWATER MANAGEMENT SERVICES
I-5/SR-56 EXTENDED DETENTION BASIN
1-YEAR Orifice Sizing Calculation

Note: Orifice Sizing Calculation based on procedure for 40 hour drawdown time in Caltrans Storm Water Quality Handbooks Planning and Design Staff Guide. September 1997, PD11B(1) Detention Basin, pg. 6 of 12.

a = area of orifice (ft^2)

$a = (7x10^{-5}) \times A \times (H-Ho)^{0.5} / CT$

A = Average surface area of the pond (ft^2)
A = 8,250 ft^2

1-YR H = Elevation when the pond is full (ft)
H = 1.67 ft

Ho = 6-Month Water Surface Elevation (ft)
Ho = 1.48 ft

C = Orifice Coefficient
C = 0.66 for thin materials

T=Drawdown time of full pond (hrs)
T= 72

a = 0.0054 ft^2 Total area required

a = 0.0027 ft^2 Area of each orifice (Two orifices required.)

d = diameter of orifice = $(4 \times a / \pi)^{0.5}$

d = 0.06 ft

d = 0.70 in = 17.9 mm

1-YEAR **Use d = 0.70 in (17.9mm) for each orifice to ensure a 72 hour drawdown time.**

Informational Calculations:

T (hrs)	a (ft^2)	d (in)
48	0.0081	1.22
72	0.0054	0.99

JN 34358

CALTRANS STORMWATER MANAGEMENT SERVICES

I-15/SR-78 EXTENDED DETENTION BASIN

BASIN DESIGN AND VOLUME CALCULATIONS

		METRIC				ENGLISH			
LOCATION	BASE AREA	+ ELEV	TOP SURFACE AREA	VOLUME		DEPTH	AREA	VOLUME	
	m^2	m	m^2	m^3		FT	FT^2	FT^3	AC-FT
196.5	481.9033	0	481.9033	0	BASIN INVERT	0.00	5184.508	0	0.00
		0.2	613.09946	109.5003		0.66	6595.969	3863.996683	0.09
		0.4	613.09946	219.0006		1.31	6595.969	7727.993367	0.18
		0.5	809.8937	322.9493		1.64	8713.16	11396.08845	0.26
		0.6	1217.13601	424.3007		1.97	13094.44	14972.53427	0.34
		0.8	1375.63983	650.7793		2.62	14799.68	22964.40767	0.53
197	1137.8841	1	1534.14365	908.9586		3.28	16504.93	32074.92342	0.74
		1.02	1549.994032	936.5201	6-MOS WQ	3.35	16675.46	33047.50033	0.76
		1.15	1653.021515	1123.397	1-YR WQ	3.77	17783.87	39641.91929	0.91
198	1930.4032	1.5	1930.4032	1693.098		4.92	20768.05	59745.27313	1.37
		2.04	2418.435652	2867.284	25-YR WSE	6.69	26018.5	101179.44	2.32
199	2834.167	2.5	2834.167	4075.383		8.20	30491.1	143810.2825	3.30

RISER INFLOW		
MAX Q25(CFS)=	20.34	
RISER DIA (IN)=	48	
Q25 HW (FT)=	0.65	WEIR FLOW

Calc. By: _____ Date: 5/30/98
Chkd. By: _____ Date: _____
Backchkd. By: _____ Date: _____

JN 34358
CALTRANS STORMWATER MANAGEMENT SERVICES
I-15/SR-78 EXTENDED DETENTION BASIN
6-MONTH Orifice Sizing Calculation

Note: Orifice Sizing Calculation based on procedure for 40 hour drawdown time in Caltrans Storm Water Quality Handbooks Planning and Design Staff Guide. September 1997, PD11B(1) Detention Basin, pg. 6 of 12.

a = area of orifice (ft^2)

$a = (7x10^{-5}) \times A \times (H-Ho)^{0.5} / CT$

A = Average surface area of the pond (ft^2)
A = 10,930 ft^2

6-Month H = Elevation when the pond is full (ft)
H = 3.35 ft

Ho = Final Elevation when pond is empty (ft)
Ho = 0.00 ft

C = Orifice Coefficient
C = 0.66 for thin materials

T=Drawdown time of full pond (hrs)
T= 72

a = 0.0294 ft^2 Total area required

a = 0.0147 ft^2 Area of each orifice (Two orifices required.)

d = diameter of orifice = $(4 \times a / \pi)^{0.5}$

d = 0.14 ft

d = 1.64 in = 41.7 mm

6-MOS. **Use d = 1.64 in (41.7mm) for each orifice to ensure a 72 hour drawdown time.**

Informational Calculations:

T (hrs)	a (ft^2)	d (in)
48	0.0442	2.85
72	0.0294	2.32

Calc. By: _____ Date: 5/30/98
Chkd. By: _____ Date: _____
Backchkd. By: _____ Date: _____

JN 34358
CALTRANS STORMWATER MANAGEMENT SERVICES
I-15/SR-78 EXTENDED DETENTION BASIN
1-YEAR Orifice Sizing Calculation

Note: Orifice Sizing Calculation based on procedure for 40 hour drawdown time in Caltrans Storm Water Quality Handbooks Planning and Design Staff Guide. September 1997, PD11B(1) Detention Basin, pg. 6 of 12.

a = area of orifice (ft^2)

$a = (7x10^{-5}) \times A \times (H-Ho)^{0.5} / CT$

A = Average surface area of the pond (ft^2)

A = 11,484 ft^2

6-Month H = Elevation when the pond is full (ft)

H = 3.77 ft

Ho = 6-Month Water Surface Elevation (ft)

Ho = 3.35 ft

C = Orifice Coefficient

C = 0.66 for thin materials

T=Drawdown time of full pond (hrs)

T= 72

a = 0.0110 ft^2 Total area required

a = 0.0055 ft^2 Area of each orifice (Two orifices required.)

d = diameter of orifice = $(4 \times a / \pi)^{0.5}$

d = 0.08 ft

d = 1.01 in = 25.6 mm

1-YEAR **Use d = 1.01 in (25.6mm) for each orifice to ensure a 72 hour drawdown time.**

Informational Calculations:

T (hrs)	a (ft^2)	d (in)
48	0.0166	1.74
72	0.0110	1.42

CH (1)

SYS 50 UNIT ✓

REACH (1)

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 10, 1998

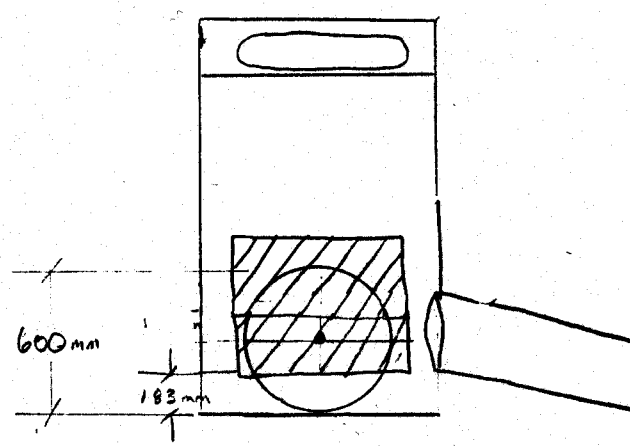
PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.013
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	300.0
Invert Elevation at Downstream end of Culvert (ft)	9.74
Invert Elevation at Upstream end of Culvert (ft)	15.49
Culvert Slope (ft/ft)	0.0192
Starting Flow Rate (cfs)	1.71
Incremental Flow Rate (cfs)	0.0
Ending Flow Rate (cfs)	1.71
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.5
Ending Tailwater Depth (ft)	5.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
~~1.71~~ 1.71	~~0.0~~ 0.0	~~0.6~~ 0.6	~~0.6~~ 0.6	0.0	0.32	0.45	0.32	5.32
1.71	0.5	0.6	0.0	0.32	0.45	0.32	5.32
1.71	1.0	0.6	0.0	0.32	0.45	0.32	5.32
1.71	1.5	0.6	0.0	0.32	0.45	0.32	5.32
1.71	2.0	0.6	-3.73	0.32	0.45	0.32	5.32
1.71	2.5	0.6	-3.23	0.32	0.45	0.32	5.32
1.71	3.0	0.6	-2.73	0.32	0.45	0.32	5.32
1.71	3.5	0.6	-2.23	0.32	0.45	0.32	5.32
1.71	4.0	0.6	-1.73	0.32	0.45	0.32	5.32
1.71	4.5	0.6	-1.23	0.32	0.45	0.32	5.32
1.71	5.0	0.6	-0.73	0.32	0.45	0.32	5.32

Water depth = 0.6' above invert of pipe. (7.2")
= 182.88 mm



EACH (2)

SYS 50 UNIT K

REACH (2)

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 10, 1998

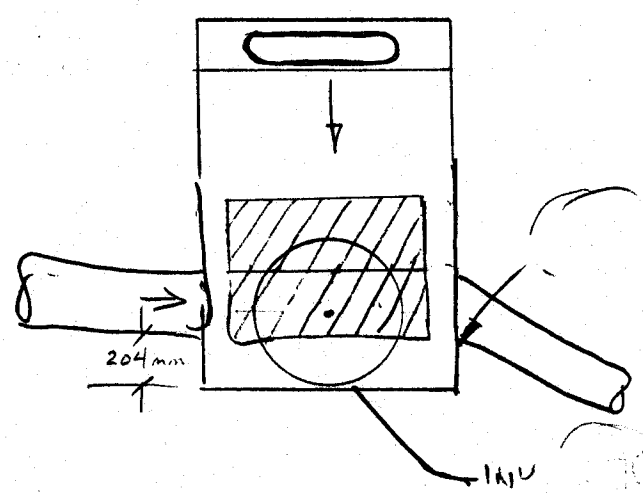
PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.013
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	300.0
Invert Elevation at Downstream end of Culvert (ft)	8.28
Invert Elevation at Upstream end of Culvert (ft)	9.74
Culvert Slope (ft/ft)	0.0049
Starting Flow Rate (cfs)	2.01
Incremental Flow Rate (cfs)	0.0
Ending Flow Rate (cfs)	2.01
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.5
Ending Tailwater Depth (ft)	5.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
~~2.01~~ 2.01	~~0.0~~ 0.0	~~0.67~~ 0.67	~~0.0~~ 0.0	0.48	0.49	0.48	3.44
2.01	0.5	0.67	0.0	0.48	0.49	0.48	3.44
2.01	1.0	0.67	0.76	0.48	0.49	1.0	1.28
2.01	1.5	0.67	0.76	0.48	0.49	1.5	0.8
2.01	2.0	0.67	0.57	0.48	0.49	0.48	3.44
2.01	2.5	0.67	1.07	0.48	0.49	2.0	0.64
2.01	3.0	0.67	1.57	0.48	0.49	2.0	0.64
2.01	3.5	0.67	2.07	0.48	0.49	2.0	0.64
2.01	4.0	0.67	2.57	0.48	0.49	2.0	0.64
2.01	4.5	0.67	3.07	0.48	0.49	2.0	0.64
2.01	5.0	0.67	3.57	0.48	0.49	2.0	0.64

Water depth = 0.67' above INV. of pipe
= 204.22



Branch (2) · SYS 50 UNIT K 3/10 REACH (2)

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 10, 1998

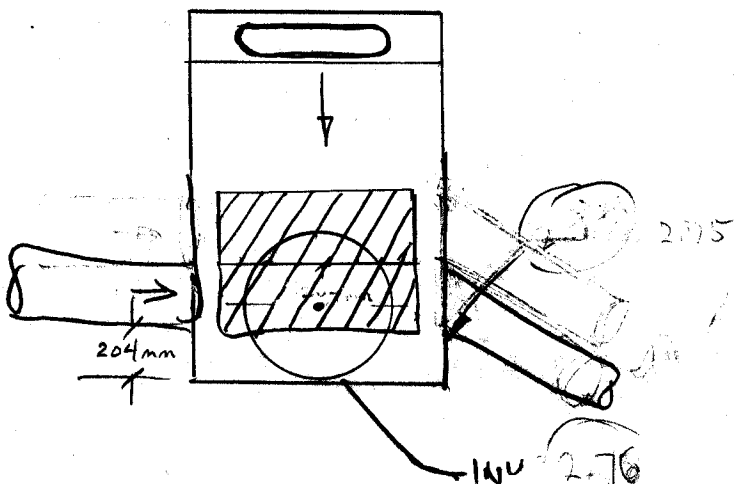
PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.013
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	300.0
Invert Elevation at Downstream end of Culvert (ft)	8.28
Invert Elevation at Upstream end of Culvert (ft)	9.74
Culvert Slope (ft/ft)	0.0049
Starting Flow Rate (cfs)	2.01
Incremental Flow Rate (cfs)	0.0
Ending Flow Rate (cfs)	2.01
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.5
Ending Tailwater Depth (ft)	5.0

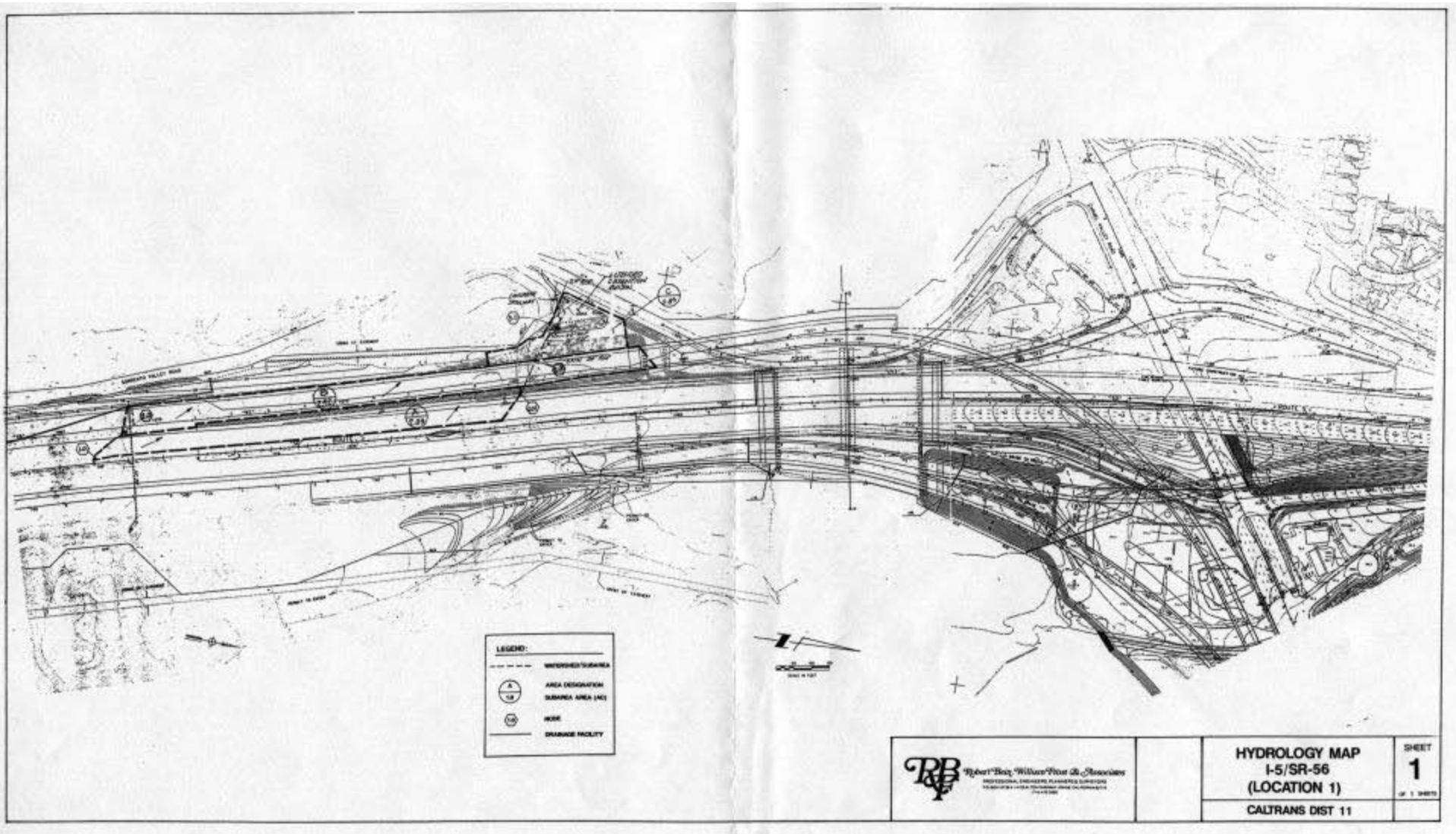
COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
~~2.01~~	~~0.0~~	~~0.67~~	~~0.0~~	0.48	0.49	0.48	3.44
2.01	0.5	0.67	0.0	0.48	0.49	0.48	3.44
2.01	1.0	0.67	0.76	0.48	0.49	1.0	1.28
2.01	1.5	0.67	0.76	0.48	0.49	1.5	0.8
2.01	2.0	0.67	0.57	0.48	0.49	0.48	3.44
2.01	2.5	0.67	1.07	0.48	0.49	2.0	0.64
2.01	3.0	0.67	1.57	0.48	0.49	2.0	0.64
2.01	3.5	0.67	2.07	0.48	0.49	2.0	0.64
2.01	4.0	0.67	2.57	0.48	0.49	2.0	0.64
2.01	4.5	0.67	3.07	0.48	0.49	2.0	0.64
2.01	5.0	0.67	3.57	0.48	0.49	2.0	0.64

Water depth = 0.67' above INV. of pipe
= 204.22



APPENDIX C HYDROLOGY MAPS

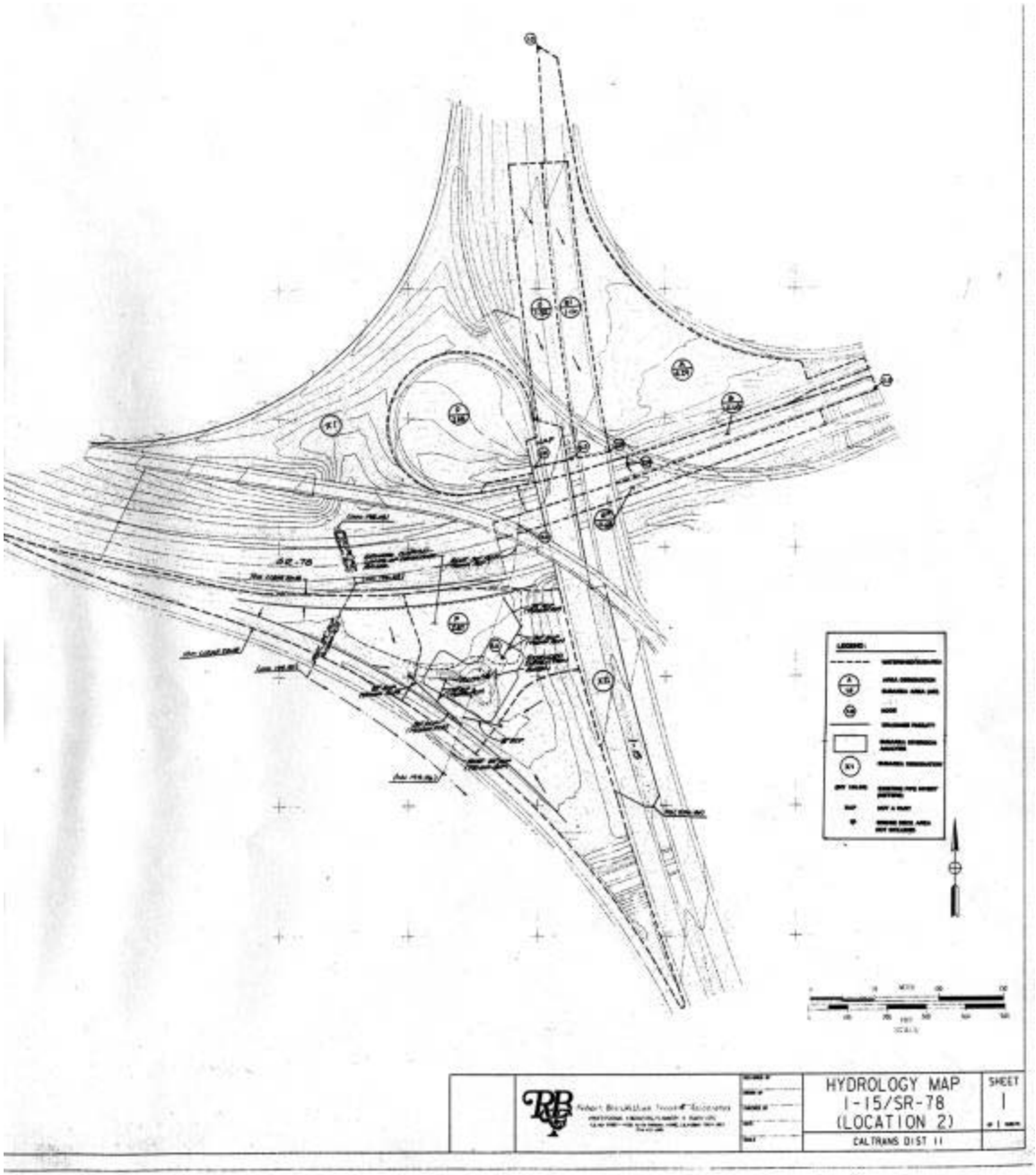


Robert Bein, William Frost & Associates

HYDROLOGY MAP
I-5/SR-56
(LOCATION 1)

CALTRANS DIST 11

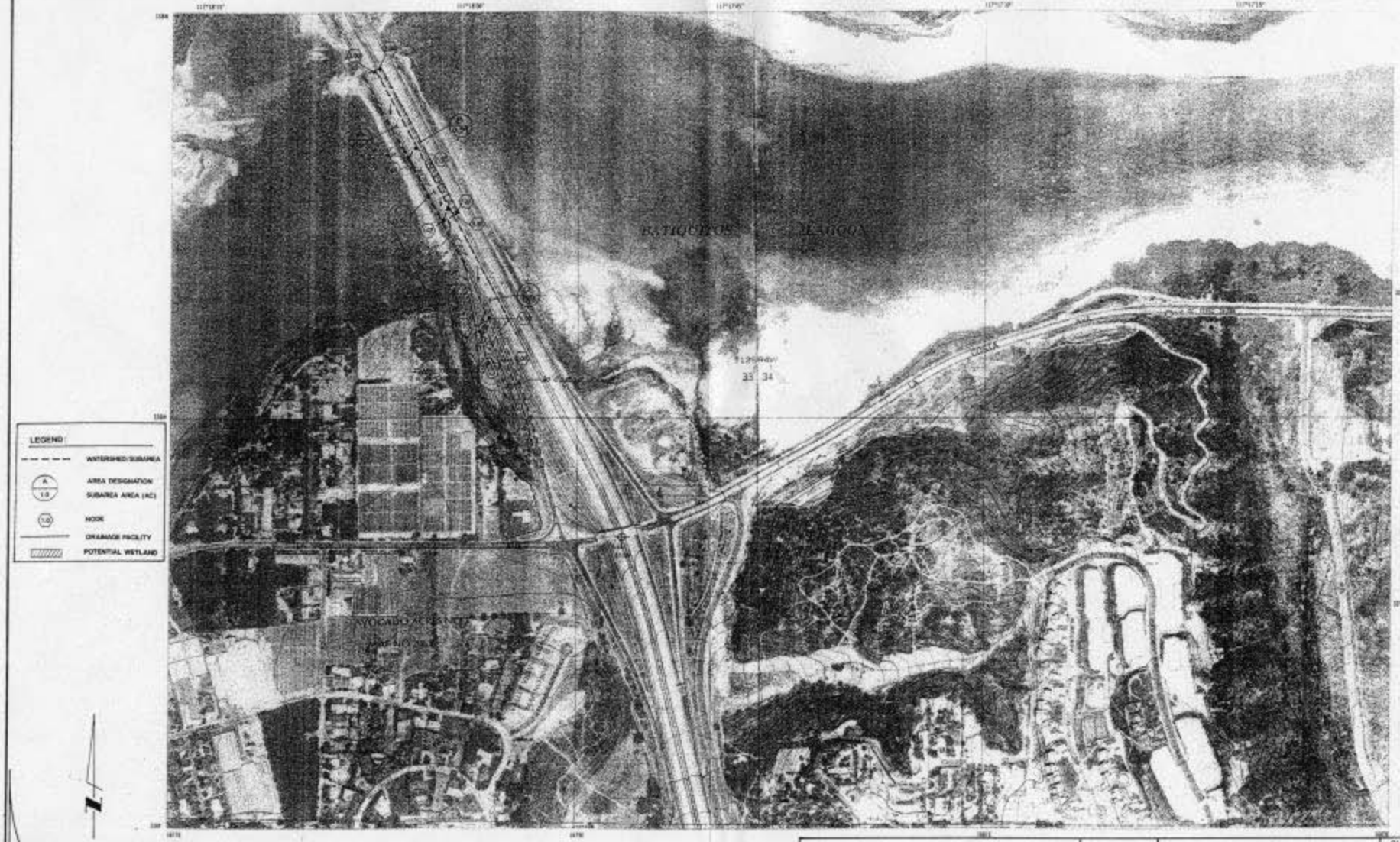
SHEET 1



HYDROLOGY MAP
I-15/SR-78
(LOCATION 2)

CALTRANS DIST 11

SHEET
1



Robert Berg, William Frost & Associates

HYDROLOGY MAP
I-5/LA COSTA
(LOCATION 3)

CALTRANS DIST 11

SHEET 1 OF 1 SHEETS

APPENDIX D HYDROSEED MIX RECOMMENDATIONS

CALTRANS STORM WATER MANAGEMENT - BMP RETROFIT PILOT PROGRAM

DESIGN DIRECTIVE MEMORANDUM NO. 6

To:	William Wiedenbacher, Montgomery Watson	Fax No. (619) 239-3895
	Gary Friedman, Montgomery Watson	Fax No. (619) 239-3895
	Glen Grant, Montgomery Watson	Fax No. (209) 547-9344
	Robert Finn, Brown and Caldwell	Fax No. (714) 474-0940
	Douglas Robison, Brown and Caldwell	Fax No. (714) 474-0940
	Ceazar Aguilar, AEI CASC	Fax No. (909) 783-0108
	Erwin Fogerson, AEI CASC	Fax No. (909) 783-0108
From:	Mike Chesney, RBF	
Copies to:	Steve Borroum, Caltrans HQ	Scott Taylor, RBF MS 140
	Kim Noonan, Caltrans HQ	Tom Ryan, RBF MS 140
	Pete Van Riper, Caltrans District 7	Bruce Cooke, RBF MS 210
	Cid Tesoro, Caltrans District 11	Rhonda Tijerina, RBF MS 210
	Christian Herencia, Caltrans District 11	Scott Sawyer, MS 425
	Yulya Davidova, Caltrans District 11	Nicole Walker, RBF MS 420
	Michael Reader, LKR Group	Ann Walker, RBF MS 140
	Steve Huff, RBF MS 425	Sal Sheikh, RBF MS 400
Date:	March 11, 1998	
Subject:	**DESIGN ISSUES AND DIRECTIVES**	

Please incorporate the following design directives/elements into your BMP designs:

1. The suggested seed mix for landscaping all exposed/graded areas (excluding the biofiltration strips and swales), and the infiltration basins is as follows:

Botanical Name	Common Name	lbs/acre
Trifolium Willdenovii	Tomcat Clover	3
Vulpia Microstachys	Zorro Grass	5
Lotus Scoparius	Deerweed	3
Hordeum Californicum	California Barley	10
Hordeum Vulgare	Barley	9
Eschschoizia Californica	California Poppy	2
Lupinus Bicolor	Miniature Lupine	4
Nassella Pulchra	Purple Needlegrass	4
Bromus Carinatus "Cucamonga"	Brome Grass	2
Encelia Californica	California Encelia	2

2. As stated previously, the suggested seed mix for the vegetated biofiltration swales and strips is as follows:

   - Trifolium Willdenovii (botanical name), Tomcat Clover (common name) used at 25 lbs/acre.

3. Refugio Dominguez of District 7 stated on Wednesday, March 11, 1998 that the specifications for the District 7 projects being designed by Montgomery Watson and Brown and Caldwell will not require a Traffic Handling section. Refugio stated the District will prepare the traffic handling specifications in-house. The consultants must still prepare traffic handling/stage construction plans.

4. Enclosed you will find RBF's design package with most of the design elements and plan types required. Additionally, we are including RBF's preliminary specifications package for use as a guideline.

Please call me at (714) 855-5792 should you have any comments, questions, or require any additional information.

Martha Blane & Associates
Habitat Restoration Consulting

May 12, 1998

Bill Whittenberg
RBF & Associates
14725 Alton Parkway
Irvine, CA 92618

Project: Caltrans Storm Water Management - Retrofit Pilot Study

Subject: Planting Recommendations for Bio-Filter Strips

Dear Bill:

In response to your request, enclosed herein is information on candidate plant species for planting within the bio-filter strips. Per our discussions and the background information you provided, the species chosen must perform certain functions and meet specific criteria, as follows:

- Filter suspended solids within runoff from paved areas
- Withstand one-year storm events
- Adapt to climate conditions within Caltrans Districts 7 and 11
- Tolerate periods of both high and low moisture
- Be low-growing
- Require little or no maintenance

Species that meet these criteria are shown on Table 1 (attached), along with information on plant life form, height, origin, beneficial/detrimental characteristics and comments. *Trifolium willdenovii* (tomcat clover), which was recommended previously by others, is also included on Table 1 for the purpose of comparison.

Leguminous plant species were researched because of their ability to add nitrogen to soils. Few legume species are available that meet the criteria listed above, particularly adaptability (i.e., drought tolerance) and low maintenance (most are annuals that may require replanting). To obtain some benefit from the use of nitrogen-fixing species, it is recommended that annual leguminous species be planted initially, but without expectation for natural reseeding.

P.O. Box 4093 • San Marcos, CA 92069 • Phone: (760) 471-1245 • Fax: (760) 471-7671

In order to increase the likelihood of adequate plant cover in the shortest possible time, while fulfilling the criteria above, it is recommended that a mixture of species be planted together. This approach is also beneficial in reducing the potential for damage from diseases and pests that could occur with a one-species, monoculture type planting.

A recommended mixture of species for planting within the bio-filter strips is shown on Table 2 (attached). The table shows the preferred planting method, material application rates for seeds and container plant densities for plants.

The availability of suitable plant species grown as sod was researched. None of the species shown in Table 1 or 2 are grown as sod since there is not an established market for them and most species are not sod forming. It may be possible to request that some species be contract grown (e.g., saltgrass and creeping wildrye) as sod. However, even if a grower agreed to grow sod, there is high risk for failure since it is not a usual practice.

The plant material that can be obtained in a sod-like form is saltgrass. It is grown in flats (±18" x 18") and may be purchased at Tree of Life Nursery in San Juan Capistrano (714.728.0685). However, as shown in Table 2 and described above, planting "plugs" from cut-up flats, along with other species, is recommended.

All seed and plant materials should be ordered well in advance of need to ensure availability. For example, Tree of Life Nursery currently has ±15 flats of saltgrass available. They indicated that it takes about three months (during the warm season) to grow a flat of saltgrass. The needlegrass species are also currently available, but, availability changes on a daily basis.

TABLE 1
PLANT SPECIES SUITABLE FOR BIO-FILTER PLANTINGS

Genus species	Common Name	Life Form	Height	Origin/Range
Bromus carinatus	California brome	grass, perennial, short-lived (± 2 years)	18" - 36"	Western US, British Columbia to Central America
Deschampsia caespitosa	Tufted hairgrass	grass, perennial, clumping	12" - 30"	North America
Distichlis spicata	Saltgrass	grass, perennial, rhizome/stolon forming	6" - 20"	North America to South America
Elymus glaucus	Blue wildrye	grass, perennial, clumping	18" - 36"	Alaska to Baja California
Hordeum brachyantherum	Meadow barley	grass, perennial, clumping	12" - 18"	North America to Baja California
Leymus triticoides "Rio"	Creeping wildrye	grass, perennial, creeping rhizomes	18" - 36"+	Western US and Baja California
Lupinus bicolor	Pygmy-leaf lupine	legume, annual	4" - 12"	California deserts, mountains and coastal areas
Nasella lepida	Foothill needlegrass	grass, perennial, clumping	12" - 24"	Northern California to Baja California
Nasella pulchra	Purple needlegrass	grass, perennial, clumping	12" - 24"	Northern California to Baja California
Trifolium willdenovii	Tomcat clover	legume, annual	4" - 16"	Western North America

TABLE 1
(Continued)

Genus species	Common Name	Benefits	Detriments	Comments
Bromus carinatus	California brome	Fast-growing, adapted to drought and poor soils.	Short-lived, may be too tall	Often used for soil stabilization and revegetation.
Deschampsia caespitosa	Tufted hairgrass	Grows in dense stands, adapted to moist soils, recovers well from disturbance.	May be too tall, too dense and require too much moisture.	Important range species, widely distributed, sometimes used for erosion control.
Distichlis spicata	Saltgrass	Stout, hardy, adapts to harsh soil conditions (wet or dry) and silt build-up, recovers well from disturbance.	Foliage may turn brown during coldest months.	Spreads by creeping stolons (similar to Bermuda grass in appearance, but not as vigorous), can form a tough mat-like cover.
Elymus glaucus	Blue wildrye	Fast-growing, fast-spreading, good for erosion control.	May be too tall.	Foliage is bluish-green.
Hordeum brachyantherum	Meadow barley	Fast-growing, begins spring growth early, tolerates moist soils.	May be short-lived.	Can provide cover while slower-growing species become established.
Leymus triticoides "Rio"	Creeping wildrye	Tolerates harsh conditions, heavy soils, forms a dense ground cover, long-lived.	May be too tall and too dense.	Stays green late into summer.
Lupinus bicolor	Pygmy-leaf lupine	Nitrogen-fixing, adapts to many soils, germinates early.	Annual, may not reseed if other vegetation is present.	Frequently included in erosion control and revegetation seed mixes.
Nasella lepida	Foothill needlegrass	Adapted to drought and poor/disturbed soils, long-lived, low fuel.	Best in well-drained soils.	Common component of California grasslands; often used for revegetation.
Nasella pulchra	Purple needlegrass	Adapted to drought and poor/disturbed soils, long-lived, low fuel.	Best in clayey soils.	Major component of California grasslands; often used for revegetation.
Trifolium willdenovii	Tomcat clover	Nitrogen-fixing, adapts to heavy soils, germinates early.	Annual, may not reseed.	Seed recently became available for erosion control and revegetation plantings.

TABLE 2
RECOMMENDED SPECIES MIXTURE FOR BIO-FILTER PLANTINGS(1)

Genus species	Common Name	Seed Application Rate Per Acre %Purity/%Germination	Container Plant Spacing and Container Size/Type
Bromus carinatus	California brome	6.0 pounds per acre 95/80	--
Distichlis spicata	Saltgrass	--	12" on-center spacing of "plugs" from cut-up flats
Deschampsia caespitosa	Tufted hairgrass	1.0 pound per acre 80/60	--
Hordeum brachyantherum	Meadow barley	5.0 pounds per acre 90/80	--
Lupinus bicolor	Pygmy-leaf lupine	3.0 pounds per acre 98/80	--
Nasella lepida	Foothill needlegrass	--	12" on-center spacing of groove tubes (2" deep x 3/4" wide)
Nasella pulchra	Purple needlegrass	--	12" on-center spacing of groove tubes (2" deep x 3/4" wide)
Trifolium willdenovii	Tomcat clover	1.5 pounds per acre 95/75	--

1. Seed and container plant recommendations based on which material will provide the most reliable and fastest cover. Some container species are also available as seed.

References and Sources of Information

Beauchamp, M.R. 1986.
A Flora of San Diego County, California. Sweetwater River Press: National City, California.

Bohn, J. 1998.
Tree of Life Nursery, San Juan Capistrano, California. [Personal communication April 20].

Crampton, B. 1974.
Grasses in California. University of California Press: Berkeley.

Gould, F. W. and Moran, R. 1981.
The grasses of Baja California, Mexico. San Diego Society of Natural History: Memoir 12.

Graves, W. L., Kay, B. L., Ham, T., and Breece, J. R. 1983.
Legumes for Erosion Control in Southern California. Cooperative Extension, University of California, San Diego.

Graves, W. L., Kay, B. L., Ham, T., Koenigs, R. L. 1983.
Stabilizing Highway Rights-of-Way With Rose Clover in Southern California. Cooperative Extension, University of California, San Diego.

Hickman, J.C. (ed.). 1993.
The Jepson Manual: Higher Plants of California. University of California Press: Berkeley.

Kay, B. L. and Slayback, R. D. 1985.
California Interagency Guide for Erosion Control Plantings.

Munz, P. 1974.
A Flora of Southern California. University of California Press: Berkeley, California.

RBF & Associates. 1998.
Design Directive Memorandum No. 6 (March 11). Memo from Mike Chesney.

Schaff, V. 1998.
S &S Seeds, Carpinteria, California. [Personal communication April 24].

S & S Seeds. 1992.
Seed Selection Guide: Seeds for Reclamation and Landscape.

Watershed Management Institute, Inc. 1997.
Operation, Maintenance and Management of Storm Water Management Systems (selected sections).

APPENDIX E ENGINEERING COST ESTIMATES

ENGINEER'S ESTIMATE

Item	Item Code	Item	Unit of Measure	Estimated Quantity	Unit Price (In Figures)	Item Total (In Figures)
1	074019	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	LUMP SUM	LUMP SUM	40,000.00
2	070420	WATER POLLUTION CONTROL	LS	LUMP SUM	LUMP SUM	15,000.00
3 (S)	120090	CONSTRUCTION AREA SIGNS	LS	LUMP SUM	LUMP SUM	7,000.00
4	120100	TRAFFIC CONTROL SYSTEM	LS	LUMP SUM	LUMP SUM	10,000.00
5	120199A	TRAFFIC PLASTIC DRUMS	EA	18	50.00	900.00
6	129000	TEMPORARY RAILING (TYPE K)	M	520	30.00	15,600.00
7	129100	TEMPORARY CRASH CUSHION MODULE	EA	2	250.00	500.00
8	150802	REMOVE DRAINAGE FACILITIES	LS	LUMP SUM	LUMP SUM	9,500.00
9	150806	REMOVE PIPE	M	54	60.00	3,240.00
10	150821	REMOVE HEADWALL	EA	3	600.00	1,800.00
11	151540	RECONSTRUCT CHAIN LINK FENCE	M	55	50.00	2,750.00
12	160101	CLEARING AND GRUBBING	LS	LUMP SUM	LUMP SUM	20,000.00
13	190101	ROADWAY EXCAVATION	M^3	15,000	12.00	180,000.00
14	193118	CONCRETE BACKFILL	M^3	55	200.00	11,000.00
15 (S)	203016	EROSION CONTROL (TYPE D)	HA	10	5,000.00	50,000.00
16	260201	CLASS 2 AGGREGATE BASE	M^3	270	25.00	6,750.00
17	390155	ASPHALT CONCRETE (TYPE A)	TONN	170	35.00	5,950.00
18 (F)	510502	MINOR CONCRETE (MINOR STRUCTURE)	M^3	40	800.00	32,000.00
19	650069	450 MM REINFORCED CONCRETE PIPE	M	60	175.00	10,500.00

ENGINEER'S ESTIMATE

20	650075	600 MM REINFORCED CONCRETE PIPE	M	360	150.00	54,000.00
21	650075A	750 MM REINFORCED CONCRETE PIPE	M	85	200.00	17,000.00
22	664015A	450 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	20	300.00	6,000.00
23	664035	900 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	3	500.00	1,500.00
24	664045	1200 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	7	600.00	4,200.00
25	705525A	CANAL GATE	LS	LUMP SUM	LUMP SUM	50,000.00
26	707133A	900 MM PRECAST CONCRETE PIPE RISER	M	30	1,800.00	54,000.00
27	721007	ROCK SLOPE PROTECTION (1/4 TON, METHOD B)	M^3	20	75.00	1,500.00
28	721009	ROCK SLOPE PROTECTION (FACING, METHOD B)	M^3	74	110.00	8,140.00
29	721430A	CONCRETE (BASIN LINING)	M^3	740	350.00	259,000.00
30	729010	ROCK SLOPE PROTECTION FABRIC	M^2	20	4.00	80.00
31 (S-F)	750001	MISCELLANEOUS IRON AND STEEL	KG	5,600	12.00	67,200.00
32	820132	OBJECT MARKER (TYPE L)	EA	2	40.00	80.00
33	999990	MOBILIZATION	LS	LUMP SUM	LUMP SUM	94,519.00
					SUBTOTAL CONTRACT ITEMS:	1,039,709.00
					SUPPLEMENTAL WORK:	
					5% CONTINGENCIES:	51,985.00
					GRAND TOTAL:	1,091,694.00

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

MARGINAL ESTIMATE - MISCELLANEOUS STRUCTURE OTHER THAN BRIDGE

STRUCTURE				BR NO	CHARGE	EA	DESIGN SECT
BMP RETROFIT PILOT PROGRAM							
DISTRICT	COUNTY	ROUTE	POST MILE	TYPE		LENGTH	WIDTH
11	SD	5,15,76,78					

CODE	CONTRACT ITEMS	UNIT	QUANTITY	CHECK	USE	PRICE	AMOUNT
074019	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS					40,000.00
070420	WATER POLLUTION CONTROL	LS					15,000.00
120090 (S)	CONSTRUCTION AREA SIGNS	LS					7,000.00
120100	TRAFFIC CONTROL SYSTEM	LS					10,000.00
120199A	TRAFFIC PLASTIC DRUMS	EA	18			50.00	900.00
129000	TEMPORARY RAILING (TYPE K)	M	520			30.00	15,600.00
129100	TEMPORARY CRASH CUSHION MODULE	EA	2			250.00	500.00
150802	REMOVE DRAINAGE FACILITIES	LS					9,500.00
150806	REMOVE PIPE	M	54			60.00	3,240.00
150821	REMOVE HEADWALL	EA	3			600.00	1,800.00
151540	RECONSTRUCT CHAIN LINK FENCE	M	55			50.00	2,750.00
160101	CLEARING AND GRUBBING	LS					20,000.00
190101	ROADWAY EXCAVATION	M^3	15,000			12.00	180,000.00
193118	CONCRETE BACKFILL	M^3	55			200.00	11,000.00
203016 (S)	EROSION CONTROL (TYPE D)	HA	10			5,000.00	50,000.00
260201	CLASS 2 AGGREGATE BASE	M^3	270			25.00	6,750.00
390155	ASPHALT CONCRETE (TYPE A)	TONN	170			35.00	5,950.00
510502 (F)	MINOR CONCRETE (MINOR STRUCTURE)	M^3	40			800.00	32,000.00
650069	450 MM REINFORCED CONCRETE PIPE	M	60			175.00	10,500.00
650075	600 MM REINFORCED CONCRETE PIPE	M	360			150.00	54,000.00
650075A	750 MM REINFORCED CONCRETE PIPE	M	85			200.00	17,000.00
664015A	450 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	20			300.00	6,000.00
664035	900 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	3			500.00	1,500.00
664045	1200 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	7			600.00	4,200.00
705525A	CANAL GATE	LS					50,000.00
707133A	900 MM PRECAST CONCRETE PIPE RISER	M	30			1,800.00	54,000.00
721007	ROCK SLOPE PROTECTION (1/4 TON, METHOD B)	M^3	20			75.00	1,500.00
721009	ROCK SLOPE PROTECTION (FACING, METHOD B)	M^3	74			110.00	8,140.00
721430A	CONCRETE (BASIN LINING)	M^3	740			350.00	259,000.00
729010	ROCK SLOPE PROTECTION FABRIC	M^2	20			4.00	80.00
750001 (S-F)	MISCELLANEOUS IRON AND STEEL	KG	5,600			12.00	67,200.00
820132	OBJECT MARKER (TYPE L)	EA	2			40.00	80.00

		SUBTOTAL	$ 945,190.00
RECEIVED IN ESTIMATE SECTION BY	DATE	MOBILIZATION 10%	94,519.00
		SUBTOTAL CONTRACT ITEMS	1,039,709.00
QUANTITIES BY: Ann Walker	DATE: 4/6/98	SUPPLEMENTAL WORK	
		CONTINGENCIES 5%	51,985.00
CHECKED BY: Mike Chesney	DATE: 4/6/98	TOTAL	$ 1,091,694.00
		FOR BUDGET PURPOSES USE	$
REVISED BY: Mike Chesney	DATE: 4/27/98		
MARGINAL ESTIMATE BY: Sal Sheikh	DATE: 4/6/98		
COST INDEX	COMMENT		