HYDROLOGY REPORT

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DAMBREAK STUDY FOR GUADALUPE FLOOD RETARDING STRUCTURE

Submitted to

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FCD 88-65

Submitted by

GREINER, INC.

E124034

APRIL 1990

Greiner

A205.701

Hydrology Report
Dambreak Analysis of Guadalupe Flood Retarding Structure

Prepared for:

Flood Control District of Maricopa County
3335 W. Durango
Phoenix, Arizona 85009

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September 1989
April 1990 (Revised)

Contract FCD 88-65
Project No. E124034

Registered Professional Engineer (Civil)
CERTIFICATE NO.
17756
SHI-EN CHIU
Date Signed 4/15/90
ARIZONA, U.S.A.

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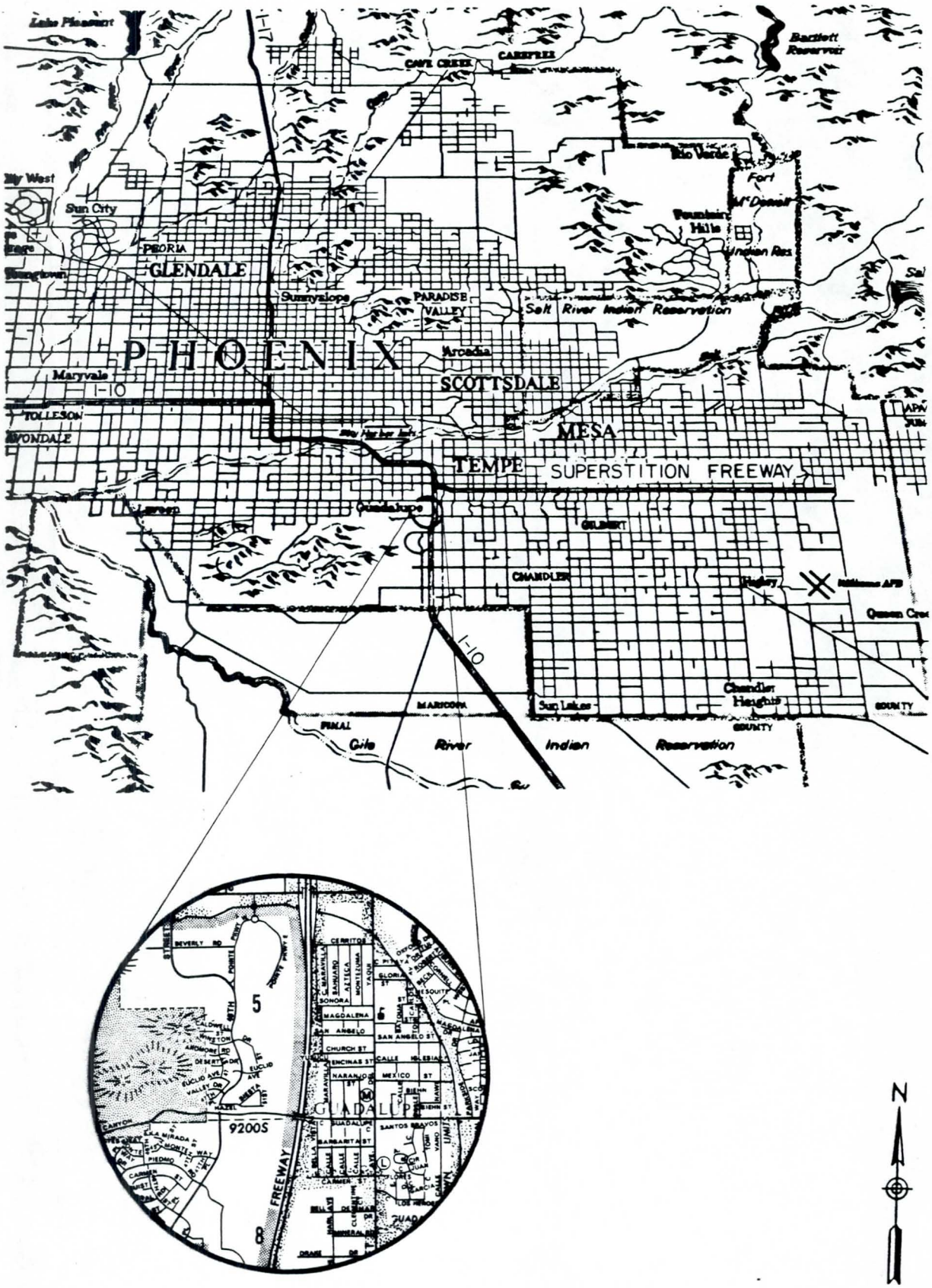
I. INTRODUCTION

A. Project Background

The Guadalupe Flood Retarding Structure (GFRS) is a small flood control structure located midway between Baseline Road and Guadalupe Road just west of Interstate Highway 10 (I-10), Phoenix, Arizona (Figure 1). The GFRS consists of three dams, North Dam No. 1, North Dam No. 2 and East Dam. An emergency spillway is located near North Dam No. 1. The principal spillway is a controlled low level outlet pipe structure located in the golf course area near North Dam No. 2. The pipe conveys floodwater releases from GFRS to the Western Canal, located approximately 5,470 feet to the north (refer to Figure 3). See Figure 2 for the location of these features.

The GFRS was constructed in 1975 by the Soil Conservation Service (SCS) to reduce the potential for floodwater and sediment damage from the 100-year flood to the community of Guadalupe and the surrounding portions of the cities of Phoenix and Tempe. Significant flood damages had been incurred as recently as 1969 (Reference 10).

The GFRS was originally constructed on state-owned land. As the local sponsor, the Flood Control District of Maricopa County (FCD) obtained a perpetual easement from the state for the purpose of maintaining the structure. In 1981, Gosnell Development Corporation, developer of the Pointe at South Mountain, obtained ownership of the site through land trades with the state. Subsequently, the structure was incorporated into the resort's golf course. The FCD still maintains operational control of the GFRS and is responsible for the structural and functional integrity of the facility. The developer is responsible for maintaining the emergency spillway, erosion control of the embankments and landscaping. As part of its Safety of Dams Program, the Arizona Department of Water Resources (ADWR) requested the FCD to prepare Emergency Action Plans for all dams within its jurisdiction. The plans would include maps delineating the area that will be inundated should the dams fail and evacuation plans. The FCD subsequently determined that the dambreak analysis will be performed using the



PROJECT VICINITY MAP

N.T.S.

GREINER

FIGURE 1

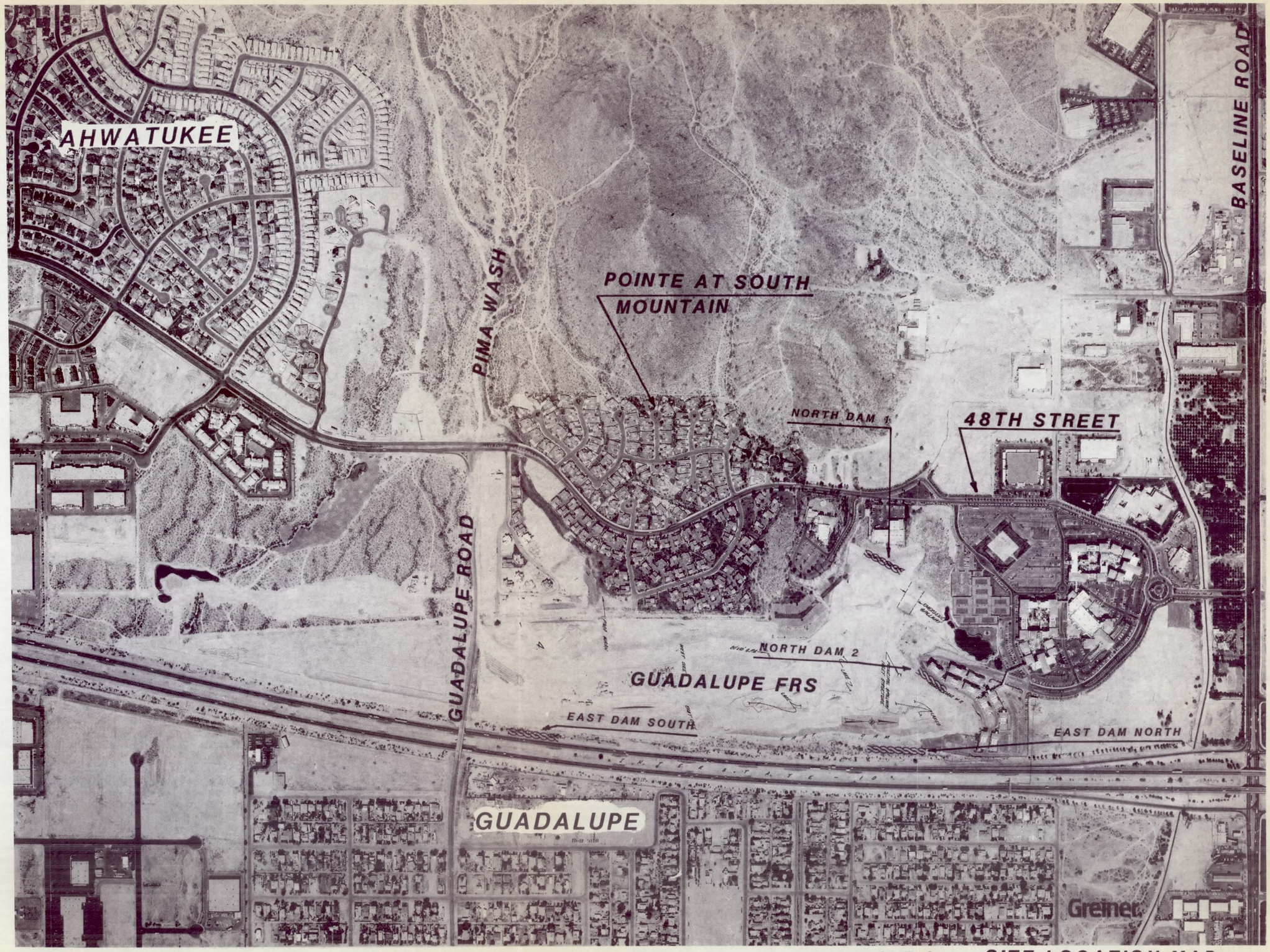


FIGURE 2 SITE LOCATION MAP

National Weather Services (NWS) DAMBRK computer program. Greiner, Inc. was contracted by the FCD in August of 1989 to perform this analysis and to prepare the inundation area maps.

B. Current Land Use

Land uses within the GFRS watershed are either related to the Pointe at South Mountain Resort development or the Phoenix South Mountain Park Preserve. The Pointe at South Mountain, developed by Gosnell Development Corporation, is a high density mixed-use development anchored by a resort complex comprised of hotels, restaurants, golf courses and other related amenities. Commercial and office buildings, detached and multiple residential units are located around the resort core. Through a series of land trades with the State of Arizona, the developer obtained ownership of the GFRS which was then incorporated into one of the golf courses. The major features of this development are found on Figure 2. The Phoenix South Mountain Park Preserve is an undeveloped desert mountain area dedicated for preservation in its current natural state. Improvements within the park are limited to paved and unpaved access roads and trails. A small portion of the Pointe development golf course extends into public lands through a lease agreement with the City of Phoenix which owns the park.

C. Drainage and Topography

The GFRS is located at the mouth of the Pima Wash alluvial fan between Guadalupe Road and Baseline Road and west of I-10. Prior to development of the Pointe Resort and construction of I-10, runoff from Pima Wash and its tributaries would discharge over a wide spread area. The SCS estimated that under no-project conditions, a 2.5 square mile area would be inundated during the 100-year flood (Reference 10). West of the present location of the GFRS, Pima Wash and its tributaries are well defined mountain streams.

The elevations within the watershed range from 2,550 feet (msl) at the upper reaches to 1,190 feet (msl) in the north corner of the watershed. The general land slope is to the northeast.

D. Soils and Vegetation

In the upper, mountainous watershed, soils are shallow to very shallow and rocky. Exposed rock is granite gneiss or schist. According to the General Soil Maps for Maricopa County, these soils belong to Hydrologic Group D (References 5 and 9).

Valley soils on the alluvial fan immediately west of I-10 are relatively deep and fine textured. They have been classified as belonging to Hydrologic Group B.

Natural vegetation over the entire watershed is sparse. Desert shrub and cacti dominate with a minor amount of annual grasses. Dominant desert brush includes creosotebush, mesquite and palo verde. Within the Pointe Resort area, exotic as well as native trees and shrubs have been planted along streets, common areas and within residential areas. The golf courses, within and around the GFRS, are covered by turf.

II. OBJECTIVES

The objective of this hydrologic study is to develop the inflow Probable Maximum Precipitation (PMP) and one-half PMP hydrographs for use in the dambreak analysis of the GFRS. This report documents the results of this investigation.

III. PROCEDURES AND METHODOLOGY

A. Criteria Used for HEC-1 Computer Modeling

The HEC-1 Flood Hydrograph Package computer program developed by the U.S. Army Corps of Engineers was utilized for calculating the inflow hydrographs to the GFRS. The following criteria were used for HEC-1 computer modeling:

Precipitation. Six-hour PMP developed per Hydrometeorological Report No. 49 (Reference 4). The PMP was calculated using the general method (Table 6.1), the average depth method (Table 6.3A), and using areal distribution (Table 6.3B). The method that yielded the greatest total storm depth (areal distribution method) was then used. The results of these computations (Tables 6.1, 6.3A and 6.3B) are found in Appendix A.

Runoff. The SCS Dimensionless Unit Graph method was used. Lag time was calculated using the modified Linsley equation developed by the Corps of Engineers (Reference 1).

$$\text{Lag} = \frac{24n\,(L \times L_{ca})^{0.38}}{S^{0.5}}$$

Where n = basin roughness factor (0.018-0.05)
L = water course length (miles)
L_{ca} = length of watercourse as measured from downstream to opposite of basin centroid (miles)
S = basin slope (ft./mile)

Losses. The SCS Curve Number (CN) Loss Rate Function was used. Curve numbers were based on TR-55 and adjusted to reflect Antecedent Moisture Condition (AMC) III (References 2 and 3). The CN's were further adjusted to reflect the presence of significant rocks outcropping.

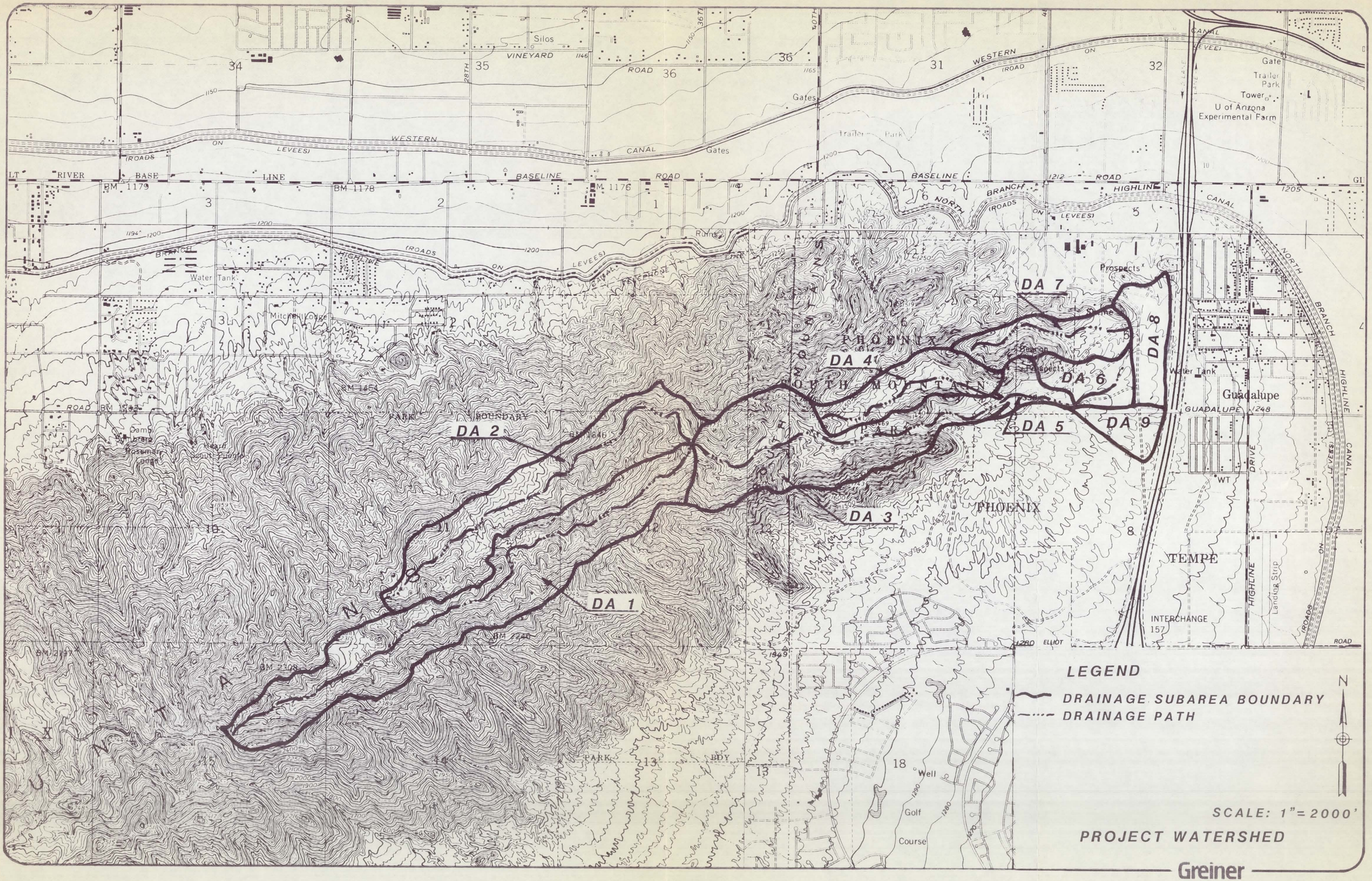
Channel Routing. Hydrographs were routed in channels using the Muskingum method. The validity of the estimates for Muskingum X and K was checked using the procedures outlined in the HEC-1 User's Manual (Reference 11).

Drainage Subarea Delineation. Drainage subareas were delineated on a 1"=2,000′ scale U.S.G.S. topographic map. In the lower, developed watershed area, drainage boundaries were verified through review of aerial photographs and through a field investigation. The results of this investigation were then compared to the original SCS hydrology for the GFRS to determine if any significant changes have occurred due to the development of the Pointe Resort. Project flow patterns were found to have been possibly changed in two areas.

The Pima Wash channel and 15′-7" x 10′-6" structural plate pipe (SPP) culvert located at 48th Street north of Guadalupe Road do not have the capacity to convey the PMP flow. Excess flows will break out from Pima Wash (Subarea DA5) to the south and then flow westward along Guadalupe Road. Guadalupe Road is divided by a median which will divert flows both northward back into the GFRS (Subarea DA6) or southward into the Pointe Resort residential area and golf course currently under construction between I-10 and 48th Street and south of Guadalupe Road (Subarea DA9). Under design conditions, runoff in drainage Subarea DA9 should drain northward through a culvert located under Guadalupe Road into the GFRS. From the field investigation, it appears that runoff from DA9, including any Pima Wash overflows, will pond south of Guadalupe Road.

After consultation with the FCD, it was agreed that these flows may in fact enter the GFRS under ultimate design conditions and the hydrologic model will be developed accordingly. This will assure a conservative approach to the development of the inflow hydrograph.

Calculations used for developing lag time, CN′s and Muskingum routing coefficients are found in Appendix A. Table 1 is a summary of the drainage subarea parameters. The drainage subareas are shown on Figure 3.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TEMPE
Guadalupe
SOUTH MOUNTAIN PARK
WESTERN CANAL
NORTH BRANCH HIGHLINE CANAL
BASELINE ROAD
VINEYARD ROAD
Silos
Gates
Trailer Park
Tower
U of Arizona Experimental Farm
Prospects
Water Tank
Mitchell Lodge
Ruins
Golf Course
Well
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FIGURE 3

Table 1

Summary of Drainage Subarea Characteristics

Drainage Subarea	Area (Sq. Mi.)	Average CN	Lag Time (hours)	PMP Peak Discharge (cfs)
DA1	0.55	95.0	0.60	4,198
DA2	0.36	95.0	0.44	3,456
DA3	0.37	95.0	0.53	3,100
DA4	0.14	95.0	0.28	1,830
DA5	0.05	95.0	0.14	920
DA6	0.07	93.3	0.10	1,405
DA7	0.12	94.0	0.20	1,880
DA8	0.09	81.4	0.16	1,387
DA9	0.06	85.0	0.10	1,131

B. Development of HEC-1 Input

The HEC-1 Flood Hydrograph Package has many input component options. This section documents the input components used for hydrologic modeling in this study.

1. Job Initialization. The "IT" card was used to define the time interval used (2 minutes) and the number of hydrograph coordinates to be computed (200 were used). The "IN" card was used to define the time interval for the precipitation data (15 minutes were used).

2. Precipitation Data. The "PI" card was used to input incremental precipitation data for the PMP.

3. Basin Data. The "BA" card was used for subarea runoff computation and for direct input of hydrographs. The component for this card is the drainage area in square miles.

4. Loss Rate Data. Precipitation loss is calculated based on the Soil Conservation Service CN and is input using the "LS" card.

5. Unit Graph Data. Input data for the Soil Conservation Service dimensionless Unit Hydrograph method was used. The lag time is input using the "UD" card.

6. Hydrograph Combination. The "HC" card was used to calculate hydrograph combination.

7. Routing Data. The Muskingum routing method was used to provide estimation of channel storage and its affect on hydrograph attenuation. The "RM" card was used to perform the Muskingum routing method. Input components are "AMSKK" ("K" value), which is the total travel time through the reach in hours, and "X", which is the Muskingum weighting factor ($0.2 \leq x \leq .5$). An "X" value of 0.2 was used for the upper reaches of Pima Wash. A value of 0.25 was used for the lower reaches. Routing procedures were repeated for several subreaches defining the integer steps equal to the number of subreaches.

8. One-Half PMP. After total PMP inflow into the GFRS was calculated, the "RL" card was used to calculate the one-half PMP hydrograph. Each hydrograph ordinate is reduced by the specified ratio (0.5). This yields the hydrograph that will actually be used in the DAMBRK analysis.

IV. RESULTS SUMMARY

The HEC-1 model was prepared and the combined PMP and one-half PMP inflow hydrographs to the GFRS were developed. Table 2 summarizes the results of the model.

Table 2

Hydrology Summary

Location	Peak Flow	Time of Peak	Basin Area
Pima Wash	11,389 cfs	2.83 hrs	1.54 mi^2
DA7	1,880 cfs	2.37 hrs	0.12 mi^2
DA8	1,387 cfs	2.33 hrs	0.09 mi^2
DA9	1,131 cfs	2.27 hrs	0.06 mi^2
Total PMP Inflow	12,078 cfs	2.80 hrs	1.81 mi^2
One-Half PMP Inflow	6,039 cfs	2.80 hrs	---

A printout of the HEC-1 model output is provided in Appendix B.

V. REFERENCES

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10. Soil Conservation Service, Watershed Work Plan, Guadalupe Watershed, Maricopa County, Arizona, January 1971.

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APPENDIX A

1. Precipitation Calculations

   Table 6.1
   Table 6.3A
   Table 6.3B

2. Hydrology Summary Sheets

3. Muskingum Routing Computations

Table 6.1.--General-storm PMP computations for the Colorado River and Great basin

Drainage Pima Wash/Guadalupe Dam Area _____ mi^2 (km^2)

Latitude 33°21'30", Longitude 112° of basin center

Month August

Step	Duration (hrs) 6	12	18	24	48	72	
A. Convergence PMP							
1. Drainage average value from one of figures 2.5 to 2.16	14.0						in. (mm)
2. Reduction for barrier-elevation [fig. 2.18]	85						%
3. Barrier-elevation reduced PMP [step 1 X step 2]	11.9						in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	75.5						%
5. Convergence PMP for indicated durations [steps 3 X 4]	9.0						in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	9.0						in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	100						%
8. Areally reduced PMP [step 6 X step 7]	9.0						in. (mm)
9. Drainage average PMP [accumulated values of step 8]	9.0						in. (mm)
B. Orographic PMP							
1. Drainage average orographic index from figure 3.11a to d_n (Revised)	2						in. (mm)
2. Areal reduction [figure 3.20]	100						%
3. Adjustment for month [one of figs. 3.12 to 3.17]	100						%
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	2						in. (mm)
5. Durational variation [table 3.6] 3.9]	36						%
6. Orographic PMP for given durations [steps 4 X 5]	0.72						in. (mm)
C. Total PMP							
1. Add steps A9 and B6	9.7						in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.3A.--Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required.

Drainage Pima Wash - Guadalupe Dam Area _____ mi^2 (km^2)
Latitude 33° 21' 30" Longitude 112° Minimum Elevation 1250 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi^2 (2.6-km^2) PMP for drainage [fig. 4.5]. 11.6 in. (mm)

2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

   b. Multiply step 1 by step 2a. 11.6 in. (mm)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.28

	Duration (hr)									
	1/4	1/2	3/4	1	2	3	4	5	6	
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	74	89	95	100	113	120	123	126	128	%
5. 1-mi^2 (2.6-km^2) PMP for indicated durations [step 2b X step 4].	8.6	10.3	11	11.6	13.1	13.9	14.3	14.6	14.8	in. (mm)
6. Areal reduction [fig. 4.9].	95	96	97	98	98	98	98	98	99	%
7. Areal reduced PMP [steps 5 X 6].	8.2	9.9	10.7	11.4	12.8	13.6	14.0	14.3	14.7	in. (mm)
8. Incremental PMP [successive subtraction in step 7].				1: 11.4	2: 1.4	3: 0.8	4: 0.1	5: 0.3	0.4	in. (mm)
	8.2	1.7	0.8	0.7	} 15-min. increments					

9. Time sequence of incremental PMP according to:

   Hourly increments [table 4.7]. 0.4 0.6 11.4 1.4 0.4 0.3 in. (mm)

   Four largest 15-min. increments [table 4.8]. 8.2 1.7 0.8 0.7 in. (mm)

Table 6.3B.—Local-storm PMP computation, Colorado River and Great Basin, and California drainages. (Giving areal distribution of PMP).

Steps correspond to those in sec. 6.3B.

1. Place idealized isohyetal pattern [fig. 4.10] over drainage adjusted to 1:500,000 scale to obtain most critical placement.

2. Note the isohyets within drainage.

3. Average 1-hr 1-mi^2 (2.6-km^2) PMP for drainage [fig. 4.5]. 11.6 in. (mm)

4. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m), 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

   b. Multiply step 3 by step 4a. 11.6 in. (mm)

5. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.28

6. Obtain isohetal labels for 15-min incremental and the highest PMP from table 4.5 corresponding 6/1-hr ratio of step 5.

PMP Increment	Isohyet A	B	C	D	E	F	G	H	I	J	
Highest 1-hr	100										
Highest 15-min.	74										
2nd "	15										
3rd "	6										in %
4th "	5										

7. Obtain isohyetal labels in % of 1-hr PMP for 2nd to 6th highest hourly incremental PMP values from table 4.6 using 6/1-hr ratio of step 5.

2nd Highest 1-hr PMP	14										
3rd "	6										
4th "	5										in %
5th "	3										
6th "	2										

8. Multiply steps 6 and 7 by step 4b to get incremental isohyetal labels of PMP.

Highest 15-min.	8.6										
2nd "	1.7										
3rd "	0.7										
4th "	0.6										
Highest 1-hr	11.6										in in. (mm)
2nd "	1.6										
3rd "	0.7										
4th "	0.6										
5th "	0.3										
6th "	0.2										

9. Arrange values of step 8 in time sequence [tables 4.7 and 4.8].

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Phoenix 602 275-5400

Job E12A034 DAMBREAK

Description DEPTH/DISTRIBUTION VALUES FOR PMP

Calculated by M.C. Date 9-13-89 Sheet No. 1

Checked by _____ Date _____ of 1

Table 6.3B Depth values are distributed per U.S.B.R. method (Tables 4.7 and 4.8) as follows:

Increment	Sequence
Largest Hr. Amt.	3rd
2nd largest	4th
3rd largest	2nd
4th largest	5th
5th largest	1st
least	Last

For Hourly Increments

Largest 15-min. Amt.	First
2nd largest	Second
3rd largest	Third
least	Least

15 minute Incremental

From Table 6.3B

0.3"	4 @ 0.075	
0.7"	4 @ 0.175	8.6"
11.6"	*	1.7"
1.6"	4 @ 0.40	0.7"
0.6"	4 @ 0.15	0.6"
0.2"	4 @ 0.05	

*all other 1-hr depths will be divided into 4 equal 15' incremental depths

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Job GUADALUPE FRS--DAMBREAK

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 1

Checked by _____ Date _____ of 9

Drainage Area Identification DA1

Area 0.55 square miles

Upstream Elevation 2430 Hydraulic Length (L) 2.44 miles

Downstream Elevation 1550 Slope (S) 361 feet/mile

L_c 1.23 miles

$Lag = C_t \left(\frac{L \cdot L_c}{S^{0.5}}\right)^{0.38}$ C_t 1.2 Lag = 0.60 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.55	100		Natural Desert Mountain	D	95	$\bar{n}$= 0.05

Weighted CN 95

HYDROGRAPH ROUTING DATA

Channel Length (L) 8000 feet Channel Slope (S) 0.028 ft./ft.

Channel Roughness (n) 0.04 Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

Routed to outlet of DA3

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Phoenix 602 275-5400

Job GUADALUPE FRS--DAMBREAK

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 2

Checked by _____ Date _____ of 9

Drainage Area Identification DA2

Area 0.36 square miles

Upstream Elevation 2290 Hydraulic Length (L) 1.71 miles

Downstream Elevation 1550 Slope (S) 433 feet/mile

L_c 0.85 miles

$Lag = C_t \left(\frac{L \cdot L_c}{S^{0.5}} \right)^{0.38}$ C_t 1.2 Lag = 0.44 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.36	100		Desert Mountain	D	95	$\bar{n}$=0.05

Weighted CN 95

HYDROGRAPH ROUTING DATA

Channel Length (L) _____ feet Channel Slope (S) _____ ft./ft.

Channel Roughness (n) _____ Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

See DA1

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Phoenix 602 275-5400

Job GUADALUPE FRS--DAMBREAK

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 3

Checked by _____ Date _____ of 9

Drainage Area Identification DA3

Area 0.37 square miles

Upstream Elevation 1550 Hydraulic Length (L) 1.51 miles

Downstream Elevation 1330 Slope (S) 145 feet/mile

L_c 0.95 miles

$Lag = C_t \left(\frac{L \cdot L_c}{S^{0.5}} \right)^{0.38}$ C_t 1.2 Lag = 0.53 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.37	100		Desert Mountain	D	95	$\bar{n}$=0.05

Weighted CN 95

HYDROGRAPH ROUTING DATA

Channel Length (L) 2000 feet Channel Slope (S) 0.0125 ft./ft.

Channel Roughness (n) 0.035 Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

Route to Outlet of DA5

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Phoenix 602 275-5400

Job GUADALUPE FRS--DAMBREAK

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 4

Checked by _____ Date _____ of 9

Drainage Area Identification DA 4

Area 0.14 square miles

Upstream Elevation 1530 Hydraulic Length (L) 0.85 miles

Downstream Elevation 1330 Slope (S) 235 feet/mile

L_c 0.39 miles

$Lag = C_t \left(\frac{L \cdot L_c}{S^{0.5}}\right)^{0.38}$ C_t 1.2 Lag = 0.28 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.14	100		Desert-Mountain	D	95	$\bar{n}$ = 0.05

Weighted CN 95

HYDROGRAPH ROUTING DATA

Channel Length (L) _____ feet Channel Slope (S) _____ ft./ft.

Channel Roughness (n) _____ Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

See DA 4

Job GUADALUPE FRS--DAMBREAK

Greiner

Greiner, Inc.

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Phoenix 602 275-5400

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 5

Checked by _____ Date _____ of 9

Drainage Area Identification D.A. 5

Area 0.05 square miles

Upstream Elevation 1580 Hydraulic Length (L) 0.38 miles

Downstream Elevation 1320 Slope (S) 684 feet/mile

L_c 0.22 miles

$Lag = C_t \left(\frac{L \cdot L_c}{S^{0.5}} \right)^{0.38}$ C_t 1.2 Lag = 0.14 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.05	100		Desert Mountain	D	95	$\bar{n}$=0.05

Weighted CN 95

HYDROGRAPH ROUTING DATA

Channel Length (L) _____ feet Channel Slope (S) _____ ft./ft.

Channel Roughness (n) _____ Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

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Job GUADALUPE FRS--DAMBREAK

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 6

Checked by _____ Date _____ of 9

Drainage Area Identification DA 6

Area 0.07 square miles

Upstream Elevation 1580 Hydraulic Length (L) 0.57 miles

Downstream Elevation 1285 Slope (S) 518 feet/mile

L_c 0.24 miles

Lag = $C_t \left(\frac{L \cdot L_c}{S^{0.5}}\right)^{0.38}$ C_t 0.72 Lag = 0.10 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.05	71		multiple Units	D	92	$\bar{n}$ = 0.022
0.02	29		Desert. mtn	D	95	$\bar{n}$ = 0.05

Weighted CN .71(92) + .29(95) = 93.3

HYDROGRAPH ROUTING DATA

Channel Length (L) _____ feet Channel Slope (S) _____ ft./ft.

Channel Roughness (n) _____ Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

Job GUADALUPE FRS--DAMBREAK

Greiner

Greiner, Inc.

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HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 7

Checked by _____ Date _____ of 9

Drainage Area Identification DA7

Area 0.12 square miles

Upstream Elevation 1560 Hydraulic Length (L) 0.81 miles

Downstream Elevation 1270 Slope (S) 358 feet/mile

L_c 0.38 miles

$Lag = C_t \left(\frac{L \cdot L_c}{S^{0.5}}\right)^{0.38}$ C_t 0.98 Lag = 0.20 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.04	33		Multiple-Units	D	92	$\bar{n}$: 0.022
0.08	67		Desert Mountain	D	95	$\bar{n}$: 0.05

Weighted CN .33(92) + .67(95) = 94

HYDROGRAPH ROUTING DATA

Channel Length (L) _____ feet Channel Slope (S) _____ ft./ft.

Channel Roughness (n) _____ Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

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Phoenix 602 275-5400

Job GUADALUPE FRS--DAMBREAK

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 8

Checked by _____ Date _____ of 9

Drainage Area Identification DA8

Area 0.09 square miles

Upstream Elevation 1290 Hydraulic Length (L) 0.57 miles

Downstream Elevation 1260 Slope (S) 53 feet/mile

L_c 0.28 miles

Lag = $C_t \left(\frac{L \cdot L_c}{S^{0.5}}\right)^{0.38}$ C_t 0.66 Lag = 0.16 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.02	20		Resort	B	96	$\bar{n}$ = 0.018
0.07	80		Golf Course	B	78	$\bar{n}$ = 0.03

Weighted CN .20(96) + .80(78) = 81.4

HYDROGRAPH ROUTING DATA

Channel Length (L) _____ feet Channel Slope (S) _____ ft./ft.

Channel Roughness (n) _____ Shape (Trap, Deep. Circ) _____

Channel Bottom Width/Diameter _____ feet Side Slopes (Z) _____

Greiner

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Phoenix 602 275-5400

Job GUADALUPE FRS--DAMBREAK

HYDROLOGIC SUMMARY SHEET

Calculated by M.C. Date 8-24 Sheet No. 9

Checked by _____ Date _____ of 9

Drainage Area Identification D.A. 9

Area 0.06 square miles

Upstream Elevation 1315 Hydraulic Length (L) 0.39 miles

Downstream Elevation 1280 Slope (S) 90 feet/mile

L_c 0.18 miles

$Lag = C_t \left(\frac{L \cdot L_c}{S^{0.5}}\right)^{0.38}$ C_t 0.62 Lag = 0.10 hours

LAND USE

Subarea Mi^2	% Total Area	Zoning Status	Development Status	Soil Group	CN	Comments
0.03	50		Multi-Residences	B	92	n=0.022
0.03	50		Golf Course	B	78	n=0.03

Weighted CN 0.5(92)+0.5(78)= 85

HYDROGRAPH ROUTING DATA

Channel Length (L)_____ feet Channel Slope (S)_____ ft./ft.

Channel Roughness (n)_____ Shape (Trap, Deep. Circ)_____

Channel Bottom Width/Diameter_____ feet Side Slopes (Z)_____

RC1

NMIN = 2 minutes

$K = \frac{AMSKK}{NSTEPS}$

AMSKK = travel time (hours)

check for : $\frac{1}{2(1-X)} \leq \frac{AMSKK * 60}{NSTPS * NMIN} \leq \frac{1}{2X}$

assume NSTEPS = 1
assume X = 0.20

$AMSKK = \frac{8000 \text{ ft}}{11 \text{ fps} * 3600} = 0.20 \text{ hrs}$

$K = \frac{0.20}{1}$: $\frac{1}{2(1-0.2)} \leq \frac{0.20 * 60}{2 * 1} \leq \frac{1}{2(0.2)}$

$0.63 \leq 6.0 \leq 2.5$ No Good

Need to increase NSTEPS

try NSTEPS = 3 $\frac{0.20 * 60}{2 * 3} = 2.00$ Good

$K = \frac{0.20}{3} = 0.07$

RC2

NMIN = 2

$$AMSKK = \frac{2000}{9 * 3600} = 0.06 \text{ hrs}$$

assume NSTEPS = 1
assume X = 0.2

$$K = \frac{AMSKK}{NSTEPS} = \frac{0.06}{1} = 0.06$$

check for:

$$\frac{1}{2(1-X)} \leq \frac{AMSKK * 60}{NSTPS * NMIN} \leq \frac{1}{2X}$$

$$\frac{1}{2(1-0.2)} \leq \frac{0.06 * 60}{1 * 2} \leq \frac{1}{2(0.2)}$$

$$0.63 \leq 1.80 \leq 2.50$$ Good

RC3

NMIN = 3 assume NSTEPS = 1
assume X = 0.25

$$K = \frac{AMSKK}{NSTEPS}$$

$$AMSKK = \frac{1500\,ft}{9\,fps * 3600} = 0.05$$

$$K = \frac{0.05}{1} = 0.05$$

check $\frac{1}{2(1-0.25)} \leq \frac{0.05 * 60}{1 * 2} \leq \frac{1}{2(0.25)}$

$0.67 \leq 1.5 \leq 2.0$ Good

APPENDIX B

1. HEC-1 Computer Output

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            FEBRUARY 1981              *
*          REVISED 31 JAN 85            *
*                                       *
* RUN DATE 13-SEP-89    TIME  16:48:07  *
*                                       *
*****************************************
```

```
*************************************
*
*   U.S. ARMY CORPS OF ENGINEERS
*  THE HYDROLOGIC ENGINEERING CENTER
*         609 SECOND STREET
*       DAVIS, CALIFORNIA 95616
*  (916) 440-3285 OR (FTS) 448-3285
*
*************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X       X     X        XX
X     X  X       X               X
XXXXXXX  XXXX    X       XXXXX   X
X     X  X       X               X
X     X  X       X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THE VERSION RELEASED 31JAN85 CONTAINS NEW OPTIONS ON RL AND BA RECORDS, AND ADDS THE HL RECORD. SEE JANUARY 1985 INPUT DESCRIPTION FOR NEW DEFINITIONS.

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID       GUADALUPE FR5---DAMBREAK HYDROLOGY
  2           ID       GREINER, INC., PHOENIX, AZ   SEPTEMBER 1989
  3           ID       ONE-HALF PMF--6HR STORM DURATION
  4           IT       2                    200
  5           IO       4
              *DIAGRAM

  6           KK    QDA1
  7           KM    CALCULATE RUNOFF FROM DA1
  8           BA    0.55
  9           IN      15
 10           PB      15
 11           PI   0.075   0.075   0.075   0.075   0.175   0.175   0.175   0.175     8.6     1.7
 12           PI     0.7     0.6     0.4     0.4     0.4     0.4    0.15    0.15    0.15    0.15
 13           PI    0.05    0.05    0.05    0.05
 14           LS              95
 15           UD    0.60

 16           KK    QDA2
 17           KM    CALCULATE RUNOFF FROM DA2
 18           BA    0.36
 19           LS              95
 20           UD    0.44

 21           KK      C1
 22           KM    COMBINE HYDROGRAPHS QDA1 AND QDA2
 23           HC       2

 24           KK     RC1
 25           KM    ROUTE HYDROGRAPH C1 THRU DA3
 26           RM       3    0.07    0.20

 27           KK    QDA3
 28           KM    CALCULATE RUNOFF FROM DA3
 29           BA    0.37
 30           LS              95
 31           UD    0.53

 32           KK    QDA4
 33           KM    CALCULATE RUNOFF FROM DA4
 34           BA    0.14
 35           LS              95
 36           UD    0.28

 37           KK      C2
 38           KM    COMBINE HYDROGRAPHS RC1, QDA3 AND QDA4
 39           HC       3

 40           KK     RC2
 41           KM    ROUTE HYDROGRAPH C2 THRU DA5
 42           RM       1    0.06    0.20
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  43          KK    QDA5
  44          KM    CALCULATE RUNOFF FROM DA5
  45          BA    0.05
  46          LS              95
  47          UD    0.14

  48          KK      C3
  49          KM    COMBINE HYDROGRAPHS C2 & QDA5--TOTAL PIMA WASH FLOW AT 48TH STREET
  50          HC      2

  51          KK     RC3
  52          KM    ROUTE HYDROGRAPH C3 THRU DA6
  53          RM      1    0.05    0.25

  54          KK    QDA6
  55          KM    CALCULATE RUNOFF FROM DA6
  56          BA    0.07
  57          LS            93.3
  58          UD    0.10

  59          KK      C4
  60          KM    COMBINE HYDROGRAPHS C3 AND QDA6--TOTAL PIMA WASH FLOW INTO FRS
  61          HC      2

  62          KK    QDA7
  63          KM    CALCULATE RUNOFF FROM DA7
  64          BA    0.12
  65          LS              94
  66          UD    0.20

  67          KK    QDA8
  68          KM    CALCULATE RUNOFF FROM DA8
  69          BA    0.09
  70          LS            81.4
  71          UD    0.16

  72          KK      C5
  73          KM    COMBINE HYDROGRAPHS C4, QDA7 & QDA8--TOTAL FLOW INTO FRS N. OF GUADALUPE RD.
  74          HC      3

  75          KK    QDA9
  76          KM    CALCULATE RUNOFF FROM DA9
  77          BA    0.06
  78          LS              85
  79          UD    0.10

  80          KK      C6
  81          KM    COMBINE HYDROGRAPHS C5 AND QDA9--TOTAL FRS INFLOW
  82          HC      2
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  83          KK  0.5PMF
  84          KM    CALCULATE ONE-HALF PMF FOR BASIN ROUTING AND DAMBREAK
  85          KO       1       2     800
  86          RL       0     0.5
  87          RM       1       0      .5
  88          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   6        QDA1
               .
               .
  16           .        QDA2
               .          .
               .          .
  21          C1............
               V
               V
  24         RC1
               .
               .
  27           .        QDA3
               .          .
               .          .
  32           .          .        QDA4
               .          .          .
               .          .          .
  37          C2........................
               V
               V
  40         RC2
               .
               .
  43           .        QDA5
               .          .
               .          .
  48          C3............
               V
               V
  51         RC3
               .
               .
  54           .        QDA6
               .          .
               .          .
  59          C4............
               .
               .
  62           .        QDA7
               .          .
               .          .
  67           .          .        QDA8
               .          .          .
               .          .          .
  72          C5........................
               .
               .
  75           .        QDA9
               .          .
               .          .
  80          C6............
               V
```

```
              V
  83      0.5PMF

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981              *
*          REVISED 31 JAN 85            *
*                                       *
*  RUN DATE 13-SEP-89    TIME  16:48:07 *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*  THE HYDROLOGIC ENGINEERING CENTER *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*  (916) 440-3285 OR (FTS) 448-3285 *
*                                   *
*************************************
```

```
                         GUADALUPE FRS---DAMBREAK HYDROLOGY
                         GREINER, INC., PHOENIX, AZ   SEPTEMBER 1989
                         ONE-HALF PMF--6HR STORM DURATION

  5 IO         OUTPUT CONTROL VARIABLES
                    IPRNT          4  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                     NMIN          2  MINUTES IN COMPUTATION INTERVAL
                    IDATE     1    0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     1    0  ENDING DATE
                   NDTIME       0638  ENDING TIME

               COMPUTATION INTERVAL    0.03 HOURS
                    TOTAL TIME BASE    6.63 HOURS

        ENGLISH UNITS
            DRAINAGE AREA         SQUARE MILES
            PRECIPITATION DEPTH   INCHES
            LENGTH, ELEVATION     FEET
            FLOW                  CUBIC FEET PER SECOND
            STORAGE VOLUME        ACRE-FEET
            SURFACE AREA          ACRES
            TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  6 KK    *     QDA1   *
          *            *
          **************
                         CALCULATE RUNOFF FROM DA1

  9 IN         TIME DATA FOR INPUT TIME SERIES
                    JXMIN         15  TIME INTERVAL IN MINUTES
                   JXDATE     1    0  STARTING DATE
                   JXTIME          0  STARTING TIME
```

SUBBASIN RUNOFF DATA

8 BA SUBBASIN CHARACTERISTICS

TAREA 0.55 SUBBASIN AREA

PRECIPITATION DATA

10 PB STORM 15.00 BASIN TOTAL PRECIPITATION

11 PI INCREMENTAL PRECIPITATION PATTERN

0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
1.15	1.15	1.15	1.15	1.15	1.15	1.15	0.69	0.23	0.23
0.23	0.23	0.23	0.23	0.23	0.09	0.09	0.09	0.09	0.09
0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

14 LS SCS LOSS RATE

STRTL 0.11 INITIAL ABSTRACTION

CRVNBR 95.00 CURVE NUMBER

RTIMP 0.00 PERCENT IMPERVIOUS AREA

15 UD SCS DIMENSIONLESS UNITGRAPH

TLAG 0.60 LAG

***

UNIT HYDROGRAPH

92 END-OF-PERIOD ORDINATES

7.	15.	32.	49.	70.	94.	122.	156.	193.	236.
280.	318.	355.	380.	403.	417.	427.	430.	430.	427.
417.	403.	388.	371.	353.	334.	310.	286.	258.	232.
209.	189.	173.	158.	144.	132.	121.	112.	104.	95.
87.	80.	73.	66.	61.	56.	51.	47.	43.	39.
36.	33.	30.	28.	25.	23.	21.	19.	18.	16.
15.	14.	12.	11.	11.	10.	9.	8.	7.	7.
6.	6.	5.	5.	4.	4.	4.	4.	3.	3.
3.	3.	2.	2.	2.	2.	1.	1.	1.	1.
0.	0.								

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          **************
          *            *
16 KK     *     QDA2   *
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*            *
***************
                CALCULATE RUNOFF FROM DA2

          SUBBASIN RUNOFF DATA

18 BA        SUBBASIN CHARACTERISTICS
                TAREA        0.36  SUBBASIN AREA

             PRECIPITATION DATA

10 PB           STORM       15.00  BASIN TOTAL PRECIPITATION

11 PI          INCREMENTAL PRECIPITATION PATTERN
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                1.15      1.15      1.15      1.15      1.15      1.15      1.15      0.69      0.23      0.23
                0.23      0.23      0.23      0.23      0.23      0.09      0.09      0.09      0.09      0.09
                0.09      0.09      0.09      0.08      0.08      0.08      0.08      0.08      0.08      0.08
                0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01

19 LS        SCS LOSS RATE
                STRTL        0.11  INITIAL ABSTRACTION
                CRVNBR      95.00  CURVE NUMBER
                RTIMP        0.00  PERCENT IMPERVIOUS AREA

20 UD        SCS DIMENSIONLESS UNITGRAPH
                TLAG         0.44  LAG

                                        ***

                                   UNIT HYDROGRAPH
                              68 END-OF-PERIOD ORDINATES
          8.       24.       45.       70.      102.      141.      187.      240.      286.      325.
        355.      371.      379.      380.      377.      361.      343.      323.      301.      274.
        244.      211.      183.      161.      143.      126.      112.      101.       90.       80.
         72.       63.       55.       50.       44.       39.       35.       31.       27.       24.
         21.       19.       17.       15.       13.       12.       11.        9.        8.        7.
          7.        6.        5.        5.        4.        4.        3.        3.        3.        2.
          2.        2.        2.        1.        1.        1.        0.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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21 KK     *       C1  *
          *           *
          ***************
                        COMBINE HYDROGRAPHS QDA1 AND QDA2

23 HC          HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          ***************
          *           *
24 KK     *      RC1  *
          *           *
          ***************
                        ROUTE HYDROGRAPH C1 THRU DA3

             HYDROGRAPH ROUTING DATA

26 RM          MUSKINGUM ROUTING
                    NSTPS          3 NUMBER OF SUBREACHES
                    AMSKK       0.07 MUSKINGUM K
                        X       0.20 MUSKINGUM X

                                                          ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          ***************
          *           *
27 KK     *     QDA3  *
          *           *
          ***************
                        CALCULATE RUNOFF FROM DA3

             SUBBASIN RUNOFF DATA

29 BA          SUBBASIN CHARACTERISTICS
                    TAREA        0.37  SUBBASIN AREA

               PRECIPITATION DATA

10 PB               STORM       15.00  BASIN TOTAL PRECIPITATION

11 PI            INCREMENTAL PRECIPITATION PATTERN
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   1.15      1.15      1.15      1.15      1.15      1.15      1.15      0.69      0.23      0.23
```

0.23	0.23	0.23	0.23	0.23	0.09	0.09	0.09	0.09	0.09
0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

30 LS SCS LOSS RATE

STRTL	0.11	INITIAL ABSTRACTION
CRVNBR	95.00	CURVE NUMBER
RTIMP	0.00	PERCENT IMPERVIOUS AREA

31 UD SCS DIMENSIONLESS UNITGRAPH

TLAG	0.53	LAG

***

UNIT HYDROGRAPH
81 END-OF-PERIOD ORDINATES

6.	15.	29.	46.	64.	88.	115.	147.	184.	221.
253.	279.	301.	315.	324.	326.	326.	324.	312.	300.
286.	270.	254.	234.	213.	189.	168.	149.	135.	122.
110.	100.	90.	83.	76.	68.	62.	56.	50.	46.
42.	38.	34.	31.	28.	25.	23.	21.	18.	17.
15.	14.	13.	11.	10.	9.	8.	8.	7.	6.
6.	5.	5.	4.	4.	4.	3.	3.	3.	3.
2.	2.	2.	2.	1.	1.	1.	1.	1.	0.
0.									

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**************
*            *
*     QDA4   *
*            *
**************
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32 KK

CALCULATE RUNOFF FROM DA4

SUBBASIN RUNOFF DATA

34 BA SUBBASIN CHARACTERISTICS

TAREA	0.14	SUBBASIN AREA

PRECIPITATION DATA

10 PB

STORM	15.00	BASIN TOTAL PRECIPITATION

11 PI INCREMENTAL PRECIPITATION PATTERN

0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
1.15	1.15	1.15	1.15	1.15	1.15	1.15	0.69	0.23	0.23
0.23	0.23	0.23	0.23	0.23	0.09	0.09	0.09	0.09	0.09
0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

```
35 LS        SCS LOSS RATE
                 STRTL       0.11  INITIAL ABSTRACTION
                CRVNBR      95.00  CURVE NUMBER
                 RTIMP       0.00  PERCENT IMPERVIOUS AREA

36 UD        SCS DIMENSIONLESS UNITGRAPH
                 TLAG       0.28  LAG

                                        ***

                                   UNIT HYDROGRAPH
                              44 END-OF-PERIOD ORDINATES
      9.     28.     53.     89.    134.    177.    209.    225.    228.    222.
    206.    187.    164.    135.    108.     89.     74.     62.     53.     44.
     36.     30.     25.     21.     17.     15.     12.     10.      8.      7.
      6.      5.      4.      3.      3.      2.      2.      2.      1.      1.
      1.      1.      0.      0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

         ***************
         *             *
37 KK    *        C2   *
         *             *
         ***************
                   COMBINE HYDROGRAPHS RC1, QDA3 AND QDA4

39 HC        HYDROGRAPH COMBINATION
                 ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                        ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

         ***************
         *             *
40 KK    *       RC2   *
         *             *
         ***************
```

ROUTE HYDROGRAPH C2 THRU DA5

HYDROGRAPH ROUTING DATA

42 RM MUSKINGUM ROUTING

NSTPS	1	NUMBER OF SUBREACHES
AMSKK	0.06	MUSKINGUM K
X	0.20	MUSKINGUM X

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*** ***

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          **************
          *            *
43 KK     *     QDA5   *
          *            *
          **************
```

CALCULATE RUNOFF FROM DA5

SUBBASIN RUNOFF DATA

45 BA SUBBASIN CHARACTERISTICS

TAREA	0.05	SUBBASIN AREA

PRECIPITATION DATA

10 PB

STORM	15.00	BASIN TOTAL PRECIPITATION

11 PI INCREMENTAL PRECIPITATION PATTERN

0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
1.15	1.15	1.15	1.15	1.15	1.15	1.15	0.69	0.23	0.23
0.23	0.23	0.23	0.23	0.23	0.09	0.09	0.09	0.09	0.09
0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

46 LS SCS LOSS RATE

STRTL	0.11	INITIAL ABSTRACTION
CRVNBR	95.00	CURVE NUMBER
RTIMP	0.00	PERCENT IMPERVIOUS AREA

47 UD SCS DIMENSIONLESS UNITGRAPH

TLAG	0.14	LAG

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                                                  ***

                                              UNIT HYDROGRAPH
                                          23 END-OF-PERIOD ORDINATES
            17.      54.     111.     148.     153.     135.     107.      71.      50.      36.
            25.      18.      13.       9.       6.       4.       3.       2.       2.       1.
             1.       0.       0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


         **************
         *            *
 48 KK   *       C3   *
         *            *
         **************
                       COMBINE HYDROGRAPHS C2 & QDA5--TOTAL PIMA WASH FLOW AT 48TH STREET

 50 HC         HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


         **************
         *            *
 51 KK   *      RC3   *
         *            *
         **************
                       ROUTE HYDROGRAPH C3 THRU DA6

            HYDROGRAPH ROUTING DATA

 53 RM         MUSKINGUM ROUTING
                    NSTPS          1 NUMBER OF SUBREACHES
                    AMSKK       0.05 MUSKINGUM K
                        X       0.25 MUSKINGUM X

                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


         **************
         *            *
 54 KK   *     QDA6   *
         *            *
         **************
                       CALCULATE RUNOFF FROM DA6

            SUBBASIN RUNOFF DATA
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56 BA          SUBBASIN CHARACTERISTICS
                    TAREA        0.07  SUBBASIN AREA

               PRECIPITATION DATA

10 PB               STORM       15.00  BASIN TOTAL PRECIPITATION

11 PI            INCREMENTAL PRECIPITATION PATTERN
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   1.15      1.15      1.15      1.15      1.15      1.15      1.15      0.69      0.23      0.23
                   0.23      0.23      0.23      0.23      0.23      0.09      0.09      0.09      0.09      0.09
                   0.09      0.09      0.09      0.08      0.08      0.08      0.08      0.08      0.08      0.08
                   0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                   0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                   0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01

57 LS          SCS LOSS RATE
                    STRTL        0.14  INITIAL ABSTRACTION
                   CRVNBR       93.30  CURVE NUMBER
                    RTIMP        0.00  PERCENT IMPERVIOUS AREA

58 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG        0.10  LAG

                                                    ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                          UNIT HYDROGRAPH
                                     17 END-OF-PERIOD ORDINATES
            51.      176.      280.      280.      218.      131.       81.       53.       33.       21.
            13.        8.        5.        3.        2.        1.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          ***************
          *             *
59 KK     *        C4   *
          *             *
          ***************
                    COMBINE HYDROGRAPHS C3 AND QDA6--TOTAL PIMA WASH FLOW INTO ERS

61 HC          HYDROGRAPH COMBINATION
                    ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

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          **************
          *            *
62 KK     *     QDA7   *
          *            *
          **************
                    CALCULATE RUNOFF FROM DA7

            SUBBASIN RUNOFF DATA

64 BA          SUBBASIN CHARACTERISTICS
                    TAREA        0.12  SUBBASIN AREA

               PRECIPITATION DATA

10 PB               STORM       15.00  BASIN TOTAL PRECIPITATION

11 PI            INCREMENTAL PRECIPITATION PATTERN
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   1.15      1.15      1.15      1.15      1.15      1.15      1.15      0.69      0.23      0.23
                   0.23      0.23      0.23      0.23      0.23      0.09      0.09      0.09      0.09      0.09
                   0.09      0.09      0.09      0.08      0.08      0.08      0.08      0.08      0.08      0.08
                   0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                   0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                   0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                   0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01

65 LS          SCS LOSS RATE
                    STRTL        0.13  INITIAL ABSTRACTION
                    CRVNBR      94.00  CURVE NUMBER
                    RTIMP        0.00  PERCENT IMPERVIOUS AREA

66 UD          SCS DIMENSIONLESS UNITGRAPH
                    TLAG         0.20  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          32 END-OF-PERIOD ORDINATES
            18.       53.      109.      183.      240.      266.      266.      243.      212.      170.
           125.       97.       75.       60.       47.       36.       28.       22.       17.       13.
            10.        8.        6.        5.        4.        3.        2.        2.        1.        1.
             1.        0.
```

*** ***

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          **************
          *            *
67 KK     *     QDA8   *
          *            *
          **************
                    CALCULATE RUNOFF FROM DA8

        SUBBASIN RUNOFF DATA

69 BA       SUBBASIN CHARACTERISTICS
                TAREA        0.09  SUBBASIN AREA

            PRECIPITATION DATA

10 PB           STORM       15.00  BASIN TOTAL PRECIPITATION

11 PI         INCREMENTAL PRECIPITATION PATTERN
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                1.15      1.15      1.15      1.15      1.15      1.15      1.15      0.69      0.23      0.23
                0.23      0.23      0.23      0.23      0.23      0.09      0.09      0.09      0.09      0.09
                0.09      0.09      0.09      0.08      0.08      0.08      0.08      0.08      0.08      0.08
                0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02      0.02
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01

70 LS       SCS LOSS RATE
                STRTL        0.46  INITIAL ABSTRACTION
                CRVNBR      81.40  CURVE NUMBER
                RTIMP        0.00  PERCENT IMPERVIOUS AREA

71 UD       SCS DIMENSIONLESS UNITGRAPH
                TLAG         0.16  LAG

                                        ***

                                   UNIT HYDROGRAPH
                              26 END-OF-PERIOD ORDINATES
          23.       70.      147.      217.      245.      239.      208.      165.      114.       83.
          62.       46.       34.       25.       18.       13.       10.        7.        5.        4.
           3.        2.        2.        1.        1.        0.
```

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          ***************
          *             *
72 KK     *        C5   *
          *             *
          ***************
                         COMBINE HYDROGRAPHS C4, QDA7 & QDA8--TOTAL FLOW INTO FRS N. OF GUADALUPE RD.

74 HC          HYDROGRAPH COMBINATION
                    ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          ***************
          *             *
75 KK     *      QDA9   *
          *             *
          ***************
                         CALCULATE RUNOFF FROM DA9

            SUBBASIN RUNOFF DATA

77 BA          SUBBASIN CHARACTERISTICS
                    TAREA       0.06  SUBBASIN AREA

               PRECIPITATION DATA

10 PB               STORM      15.00  BASIN TOTAL PRECIPITATION

11 PI            INCREMENTAL PRECIPITATION PATTERN
                   0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01
                   0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01
                   0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01
                   0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02
                   0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02
                   0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02
                   1.15       1.15       1.15       1.15       1.15       1.15       1.15       0.69       0.23       0.23
                   0.23       0.23       0.23       0.23       0.23       0.09       0.09       0.09       0.09       0.09
                   0.09       0.09       0.09       0.08       0.08       0.08       0.08       0.08       0.08       0.08
                   0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05
                   0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05
                   0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05       0.05
                   0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02
                   0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02
                   0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02
                   0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01
                   0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01
                   0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01

78 LS          SCS LOSS RATE
                    STRTL       0.35  INITIAL ABSTRACTION
                   CRVNBR      85.00  CURVE NUMBER
                    RTIMP       0.00  PERCENT IMPERVIOUS AREA

79 UD          SCS DIMENSIONLESS UNITGRAPH
```

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                    TLAG        0.10  LAG

                                                                  ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                                        UNIT HYDROGRAPH
                                                   17 END-OF-PERIOD ORDINATES
              44.      151.      240.      240.      187.      112.       70.       45.       28.       16.
              11.        7.        4.        3.        2.        1.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  80 KK   *        C6  *
          *            *
          **************
                         COMBINE HYDROGRAPHS C5 AND QDA9--TOTAL FRS INFLOW

  82 HC         HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  83 KK   *    0.5PMF  *
          *            *
          **************
                         CALCULATE ONE-HALF PMF FOR BASIN ROUTING AND DAMBREAK

  85 KO         OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          2  PLOT CONTROL
                     QSCAL        800.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

  86 RL         ROUTING LOSSES
                     QLOSS       0.00  INITIAL LOSS
                     CLOSS       0.50  ADDITIONAL FRACTION LOST

  87 RM         MUSKINGUM ROUTING
                     NSTPS          1 NUMBER OF SUBREACHES
                     AMSKK       0.00 MUSKINGUM K
                         X       0.50 MUSKINGUM X

                                                                  ***

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HYDROGRAPH AT STATION 0.5PMF

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0140	51	142.	1		0320	101	3167.	1		0500	151	486.
1		0002	2	0.	1		0142	52	151.	1		0322	102	2989.	1		0502	152	472.
1		0004	3	0.	1		0144	53	161.	1		0324	103	2823.	1		0504	153	458.
1		0006	4	0.	1		0146	54	170.	1		0326	104	2670.	1		0506	154	441.
1		0008	5	0.	1		0148	55	179.	1		0328	105	2529.	1		0508	155	425.
1		0010	6	0.	1		0150	56	188.	1		0330	106	2398.	1		0510	156	409.
1		0012	7	0.	1		0152	57	196.	1		0332	107	2277.	1		0512	157	394.
1		0014	8	0.	1		0154	58	204.	1		0334	108	2165.	1		0514	158	380.
1		0016	9	0.	1		0156	59	213.	1		0336	109	2061.	1		0516	159	368.
1		0018	10	0.	1		0158	60	220.	1		0338	110	1966.	1		0518	160	356.
1		0020	11	0.	1		0200	61	228.	1		0340	111	1877.	1		0520	161	345.
1		0022	12	0.	1		0202	62	293.	1		0342	112	1795.	1		0522	162	335.
1		0024	13	0.	1		0204	63	507.	1		0344	113	1720.	1		0524	163	325.
1		0026	14	0.	1		0206	64	902.	1		0346	114	1650.	1		0526	164	314.
1		0028	15	0.	1		0208	65	1425.	1		0348	115	1587.	1		0528	165	304.
1		0030	16	0.	1		0210	66	1999.	1		0350	116	1528.	1		0530	166	294.
1		0032	17	0.	1		0212	67	2562.	1		0352	117	1475.	1		0532	167	284.
1		0034	18	0.	1		0214	68	3107.	1		0354	118	1426.	1		0534	168	274.
1		0036	19	1.	1		0216	69	3600.	1		0356	119	1382.	1		0536	169	264.
1		0038	20	1.	1		0218	70	3966.	1		0358	120	1341.	1		0538	170	254.
1		0040	21	2.	1		0220	71	4164.	1		0400	121	1304.	1		0540	171	245.
1		0042	22	2.	1		0222	72	4234.	1		0402	122	1268.	1		0542	172	235.
1		0044	23	3.	1		0224	73	4265.	1		0404	123	1230.	1		0544	173	226.
1		0046	24	4.	1		0226	74	4330.	1		0406	124	1188.	1		0546	174	217.
1		0048	25	5.	1		0228	75	4456.	1		0408	125	1146.	1		0548	175	209.
1		0050	26	6.	1		0230	76	4637.	1		0410	126	1105.	1		0550	176	201.
1		0052	27	8.	1		0232	77	4856.	1		0412	127	1068.	1		0552	177	194.
1		0054	28	9.	1		0234	78	5086.	1		0414	128	1033.	1		0554	178	187.
1		0056	29	11.	1		0236	79	5306.	1		0416	129	1001.	1		0556	179	181.
1		0058	30	13.	1		0238	80	5507.	1		0418	130	972.	1		0558	180	175.
1		0100	31	15.	1		0240	81	5683.	1		0420	131	944.	1		0600	181	170.
1		0102	32	17.	1		0242	82	5829.	1		0422	132	917.	1		0602	182	164.
1		0104	33	20.	1		0244	83	5939.	1		0424	133	890.	1		0604	183	158.
1		0106	34	23.	1		0246	84	6009.	1		0426	134	864.	1		0606	184	151.
1		0108	35	27.	1		0248	85	6039.	1		0428	135	837.	1		0608	185	144.
1		0110	36	32.	1		0250	86	6027.	1		0430	136	811.	1		0610	186	137.
1		0112	37	37.	1		0252	87	5971.	1		0432	137	784.	1		0612	187	131.
1		0114	38	42.	1		0254	88	5875.	1		0434	138	758.	1		0614	188	125.
1		0116	39	48.	1		0256	89	5742.	1		0436	139	731.	1		0616	189	120.
1		0118	40	54.	1		0258	90	5579.	1		0438	140	706.	1		0618	190	115.
1		0120	41	60.	1		0300	91	5390.	1		0440	141	681.	1		0620	191	110.
1		0122	42	67.	1		0302	92	5181.	1		0442	142	656.	1		0622	192	105.
1		0124	43	74.	1		0304	93	4956.	1		0444	143	633.	1		0624	193	101.
1		0126	44	81.	1		0306	94	4719.	1		0446	144	610.	1		0626	194	96.
1		0128	45	89.	1		0308	95	4477.	1		0448	145	589.	1		0628	195	91.
1		0130	46	98.	1		0310	96	4236.	1		0450	146	568.	1		0630	196	86.
1		0132	47	106.	1		0312	97	4003.	1		0452	147	549.	1		0632	197	82.
1		0134	48	115.	1		0314	98	3777.	1		0454	148	532.	1		0634	198	77.
1		0136	49	124.	1		0316	99	3562.	1		0456	149	515.	1		0636	199	72.
1		0138	50	133.	1		0318	100	3359.	1		0458	150	500.	1		0638	200	67.

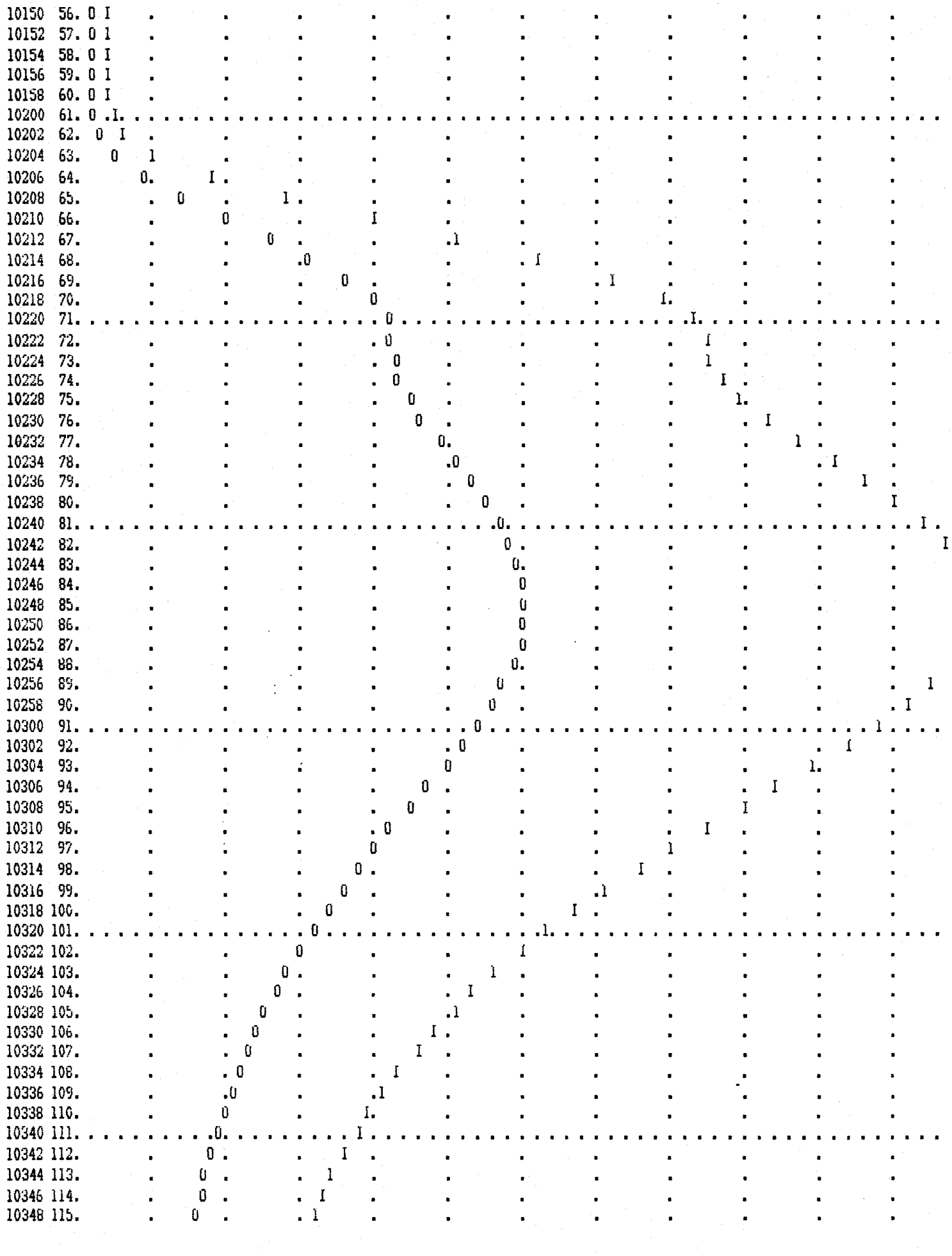
PEAK FLOW TIME MAXIMUM AVERAGE FLOW

(CFS)	(HR)		6-HR	24-HR	72-HR	6.63-HR
6039.	2.80	(CFS)	1381.	1250.	1250.	1250.
		(INCHES)	7.096	7.096	7.096	7.096
		(AC-FT)	685.	685.	685.	685.

CUMULATIVE AREA = 1.81 SQ MI

STATION 0.5PMF

```
                                 (I) INFLOW,  (O) OUTFLOW
         0.     1000.     2000.     3000.     4000.     5000.     6000.     7000.     8000.     9000.    10000.    11000.     120
DAHRMN PER
10000    1I---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.-------
10002    2I         .         .         .         .         .         .         .         .         .         .         .
10004    3I         .         .         .         .         .         .         .         .         .         .         .
10006    4I         .         .         .         .         .         .         .         .         .         .         .
10008    5I         .         .         .         .         .         .         .         .         .         .         .
10010    6I         .         .         .         .         .         .         .         .         .         .         .
10012    7I         .         .         .         .         .         .         .         .         .         .         .
10014    8I         .         .         .         .         .         .         .         .         .         .         .
10016    9I         .         .         .         .         .         .         .         .         .         .         .
10018   10I         .         .         .         .         .         .         .         .         .         .         .
10020   11I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10022   12I         .         .         .         .         .         .         .         .         .         .         .
10024   13I         .         .         .         .         .         .         .         .         .         .         .
10026   14I         .         .         .         .         .         .         .         .         .         .         .
10028   15I         .         .         .         .         .         .         .         .         .         .         .
10030   16I         .         .         .         .         .         .         .         .         .         .         .
10032   17I         .         .         .         .         .         .         .         .         .         .         .
10034   18I         .         .         .         .         .         .         .         .         .         .         .
10036   19I         .         .         .         .         .         .         .         .         .         .         .
10038   20I         .         .         .         .         .         .         .         .         .         .         .
10040   21I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10042   22I         .         .         .         .         .         .         .         .         .         .         .
10044   23I         .         .         .         .         .         .         .         .         .         .         .
10046   24I         .         .         .         .         .         .         .         .         .         .         .
10048   25I         .         .         .         .         .         .         .         .         .         .         .
10050   26I         .         .         .         .         .         .         .         .         .         .         .
10052   27I         .         .         .         .         .         .         .         .         .         .         .
10054   28I         .         .         .         .         .         .         .         .         .         .         .
10056   29I         .         .         .         .         .         .         .         .         .         .         .
10058   30I         .         .         .         .         .         .         .         .         .         .         .
10100   31I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10102   32I         .         .         .         .         .         .         .         .         .         .         .
10104   33I         .         .         .         .         .         .         .         .         .         .         .
10106   34I         .         .         .         .         .         .         .         .         .         .         .
10108   350I        .         .         .         .         .         .         .         .         .         .         .
10110   360I        .         .         .         .         .         .         .         .         .         .         .
10112   370I        .         .         .         .         .         .         .         .         .         .         .
10114   380I        .         .         .         .         .         .         .         .         .         .         .
10116   390I        .         .         .         .         .         .         .         .         .         .         .
10118   40.I        .         .         .         .         .         .         .         .         .         .         .
10120   41.I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10122   42.I        .         .         .         .         .         .         .         .         .         .         .
10124   43.I        .         .         .         .         .         .         .         .         .         .         .
10126   44.0I       .         .         .         .         .         .         .         .         .         .         .
10128   45.0I       .         .         .         .         .         .         .         .         .         .         .
10130   46.0I       .         .         .         .         .         .         .         .         .         .         .
10132   47.0I       .         .         .         .         .         .         .         .         .         .         .
10134   48.0I       .         .         .         .         .         .         .         .         .         .         .
10136   49.0I       .         .         .         .         .         .         .         .         .         .         .
10138   50.0 I      .         .         .         .         .         .         .         .         .         .         .
10140   51.0.I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10142   52. 0I      .         .         .         .         .         .         .         .         .         .         .
10144   53. 0I      .         .         .         .         .         .         .         .         .         .         .
10146   54. 0I      .         .         .         .         .         .         .         .         .         .         .
10148   55. 0 I     .         .         .         .         .         .         .         .         .         .         .
```



```
10350 116.         .    0    .         .I        .         .         .         .         .         .         .         .
10352 117.         .    0    .        I.         .         .         .         .         .         .         .         .
10354 118.         .   0     .        I.         .         .         .         .         .         .         .         .
10356 119.         .   0     .       I .         .         .         .         .         .         .         .         .
10358 120.         .  0      .      I  .         .         .         .         .         .         .         .         .
10400 121.............0............I..........................................................................................
10402 122.         .  0      .    I    .         .         .         .         .         .         .         .         .
10404 123.         . 0       .    I    .         .         .         .         .         .         .         .         .
10406 124.         . 0       .   I     .         .         .         .         .         .         .         .         .
10408 125.         .0        .  I      .         .         .         .         .         .         .         .         .
10410 126.         .0        . I       .         .         .         .         .         .         .         .         .
10412 127.         .0        .I        .         .         .         .         .         .         .         .         .
10414 128.         0         .I        .         .         .         .         .         .         .         .         .
10416 129.         0         I         .         .         .         .         .         .         .         .         .
10418 130.         0        I.         .         .         .         .         .         .         .         .         .
10420 131.........0.........I.................................................................................................
10422 132.        0.       I .         .         .         .         .         .         .         .         .         .
10424 133.        0.       I .         .         .         .         .         .         .         .         .         .
10426 134.        0.      I  .         .         .         .         .         .         .         .         .         .
10428 135.       0 .      I  .         .         .         .         .         .         .         .         .         .
10430 136.       0 .     I   .         .         .         .         .         .         .         .         .         .
10432 137.       0 .     I   .         .         .         .         .         .         .         .         .         .
10434 138.       0 .    I    .         .         .         .         .         .         .         .         .         .
10436 139.      0  .    I    .         .         .         .         .         .         .         .         .         .
10438 140.      0  .   I     .         .         .         .         .         .         .         .         .         .
10440 141.......0......I......................................................................................................
10442 142.      0  .  I      .         .         .         .         .         .         .         .         .         .
10444 143.     0   .  I      .         .         .         .         .         .         .         .         .         .
10446 144.     0   . I       .         .         .         .         .         .         .         .         .         .
10448 145.     0   . I       .         .         .         .         .         .         .         .         .         .
10450 146.     0   .I        .         .         .         .         .         .         .         .         .         .
10452 147.    0    .I        .         .         .         .         .         .         .         .         .         .
10454 148.    0    .I        .         .         .         .         .         .         .         .         .         .
10456 149.    0    I         .         .         .         .         .         .         .         .         .         .
10458 150.    0    I         .         .         .         .         .         .         .         .         .         .
10500 151.....0....I..........................................................................................................
10502 152.    0   I.         .         .         .         .         .         .         .         .         .         .
10504 153.    0   I.         .         .         .         .         .         .         .         .         .         .
10506 154.   0    I.         .         .         .         .         .         .         .         .         .         .
10508 155.   0   I .         .         .         .         .         .         .         .         .         .         .
10510 156.   0   I .         .         .         .         .         .         .         .         .         .         .
10512 157.   0   I .         .         .         .         .         .         .         .         .         .         .
10514 158.   0   I .         .         .         .         .         .         .         .         .         .         .
10516 159.   0  I  .         .         .         .         .         .         .         .         .         .         .
10518 160.   0  I  .         .         .         .         .         .         .         .         .         .         .
10520 161...0...I.............................................................................................................
10522 162.  0   I  .         .         .         .         .         .         .         .         .         .         .
10524 163.  0  I   .         .         .         .         .         .         .         .         .         .         .
10526 164.  0  I   .         .         .         .         .         .         .         .         .         .         .
10528 165.  0  I   .         .         .         .         .         .         .         .         .         .         .
10530 166.  0  I   .         .         .         .         .         .         .         .         .         .         .
10532 167.  0  I   .         .         .         .         .         .         .         .         .         .         .
10534 168.  0 I    .         .         .         .         .         .         .         .         .         .         .
10536 169.  0 I,   .         .         .         .         .         .         .         .         .         .         .
10538 170.  0 I    .         .         .         .         .         .         .         .         .         .         .
10540 171. 0 .I...............................................................................................................
10542 172. 0  I    .         .         .         .         .         .         .         .         .         .         .
10544 173. 0  I    .         .         .         .         .         .         .         .         .         .         .
10546 174. 0 I     .         .         .         .         .         .         .         .         .         .         .
10548 175. 0 I     .         .         .         .         .         .         .         .         .         .         .
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10550 176. 0 I     .         .         .         .         .         .         .         .         .         .         .
10552 177. 0 I     .         .         .         .         .         .         .         .         .         .         .
10554 178. 0 I     .         .         .         .         .         .         .         .         .         .         .
10556 179. 0 I     .         .         .         .         .         .         .         .         .         .         .
10558 180. 0I      .         .         .         .         .         .         .         .         .         .         .
10600 181. 0I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10602 182. 0I      .         .         .         .         .         .         .         .         .         .         .
10604 183. 0I      .         .         .         .         .         .         .         .         .         .         .
10606 184. 0I      .         .         .         .         .         .         .         .         .         .         .
10608 185.0 I      .         .         .         .         .         .         .         .         .         .         .
10610 186.0 I      .         .         .         .         .         .         .         .         .         .         .
10612 187.0 I      .         .         .         .         .         .         .         .         .         .         .
10614 188.0 I      .         .         .         .         .         .         .         .         .         .         .
10616 189.0I       .         .         .         .         .         .         .         .         .         .         .
10618 190.0I       .         .         .         .         .         .         .         .         .         .         .
10620 191.0I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10622 192.0I       .         .         .         .         .         .         .         .         .         .         .
10624 193.0I       .         .         .         .         .         .         .         .         .         .         .
10626 194.0I       .         .         .         .         .         .         .         .         .         .         .
10628 195.0I       .         .         .         .         .         .         .         .         .         .         .
10630 196.0I       .         .         .         .         .         .         .         .         .         .         .
10632 197.0I       .         .         .         .         .         .         .         .         .         .         .
10634 198.0I       .         .         .         .         .         .         .         .         .         .         .
10636 199.I        .         .         .         .         .         .         .         .         .         .         .
10638 200.I--------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.-------
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	QDA1	4198.	2.80	848.	767.	767.	0.55		
HYDROGRAPH AT	QDA2	3456.	2.60	556.	503.	503.	0.36		
2 COMBINED AT	C1	7390.	2.70	1404.	1270.	1270.	0.91		
ROUTED TO	RC1	7354.	2.77	1403.	1269.	1269.	0.91		
HYDROGRAPH AT	QDA3	3100.	2.70	571.	517.	517.	0.37		
HYDROGRAPH AT	QDA4	1830.	2.43	217.	196.	196.	0.14		
3 COMBINED AT	C2	11300.	2.73	2191.	1982.	1982.	1.42		
ROUTED TO	RC2	11192.	2.80	2190.	1981.	1981.	1.42		
HYDROGRAPH AT	QDA5	920.	2.30	77.	70.	70.	0.05		
2 COMBINED AT	C3	11311.	2.77	2267.	2051.	2051.	1.47		
ROUTED TO	RC3	11264.	2.83	2266.	2050.	2050.	1.47		
HYDROGRAPH AT	QDA6	1405.	2.27	107.	97.	97.	0.07		
2 COMBINED AT	C4	11389.	2.83	2373.	2146.	2146.	1.54		
HYDROGRAPH AT	QDA7	1880.	2.37	184.	166.	166.	0.12		
HYDROGRAPH AT	QDA8	1387.	2.33	122.	110.	110.	0.09		
3 COMBINED AT	C5	11967.	2.80	2679.	2423.	2423.	1.75		
HYDROGRAPH AT	QDA9	1131.	2.27	84.	76.	76.	0.06		
2 COMBINED AT	C6	12078.	2.80	2763.	2499.	2499.	1.81		
ROUTED TO	0.5PMF	6039.	2.80	1381.	1250.	1250.	1.81		

*** NORMAL END OF HEC-1 ***