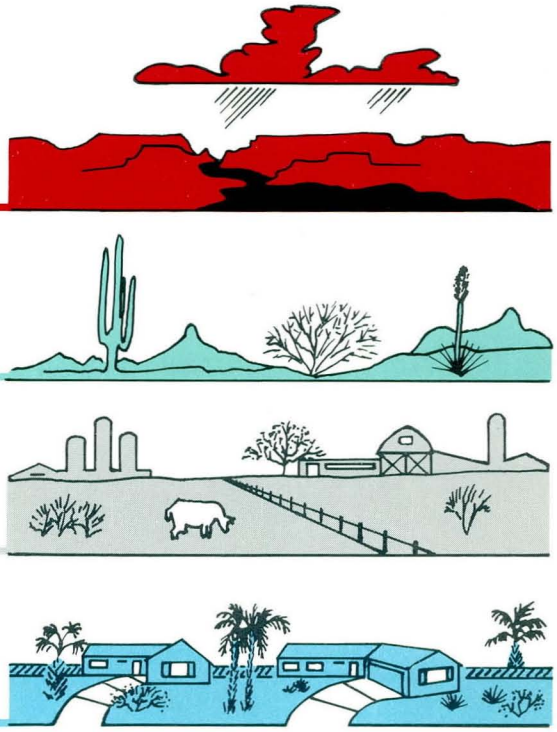

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Cudia City Wash

Hydrological Analysis

March 29th, 1993

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

3/26/93

Jorge

very good report. I think analysis, such as this one, helps all of us better understand the models we are working with, and gives us a better confidence level dealing w/ numbers. Please wait for my analysis to be completed, so we can present the entire package to DRJ.

Thanks

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Cudia City Wash

Hydrological Analysis

March 29th, 1993

Cudia City Wash
Hydrological Analysis

Flood Control District of Maricopa County
2801 W. Durango Street
Phoenix, AZ 85009
(602) 506-1501

Prepared by

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Hydrologist I
Watershed Management Branch
Hydrology Division

Cudia City Wash
Hydrological Analysis

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Appendix A: Surveyed Cross Sections, Predicted Peak Discharges (based upon the surveyed cross sections), and Manning's Roughness Coefficients.

Appendix B: Precipitation Data for the event of June 21-22, 1972 and July 23-24, 1992.

Appendix C: Previous Hydrologic Investigations.

Appendix D: Model "A" HEC-1 Input and Output.

Appendix E: Model "B" HEC-1 Input and Output.

Appendix F: Model "C" HEC-1 Input and Output.

INTRODUCTION

This report presents the hydrologic analysis of the Cudia City Wash Watershed for the existing condition peak flows contributing to the ACDC. The Cudia City Wash Watershed drains approximately 4.8 square miles of moderate to steep mountains having moderate vegetation density. The watershed is bounded by the eastern slopes of the Phoenix Mountains, the southern slope of Mummy Mountain, and the west half of the northern slope of Camelback Mountain.

Three different scenarios were developed for this watershed in order to better evaluate its behavior. The first one, called Model "A", was developed using a real storm event which occurred on July 23-24, 1992 (Ref. 2). The second one, Model "B", used the City of Phoenix point rainfall depth and storm distribution. The third one, Model "C", was generated using the NOAA Atlas isopluvial maps for Arizona and following the procedures and guidelines found in the Flood Control District of Maricopa County (FCDMC) Drainage Design Manual, Volume I, Hydrology (1992) (Ref. 1). Kaminski-Hubbard's sub-basin delineations were used in the three models to develop comparable results.

The intent was to create more alternatives and consequently results, to review and evaluate Kaminski-Hubbard's hydrologic model of Cudia City Wash Watershed in a more precise and efficient manner. A summary of the major differences between previous studies done in this area can be found in Appendix C.

MODEL "A"

After the event of July 23-24, 1992 , Watershed Management Branch's (WSMB) staff members identified High Water Marks (HWM) on Cudia City Wash. Cudia City Wash has sections of well defined earth-trapezoidal channel and therefore cross sections could be generated accurately. The HWM were identified downstream from the 44th Street bridge over Cudia City Wash, where there is a reach that runs straight for approximately 600 feet and has the above mentioned characteristics. Three cross sections were surveyed based on the HWM (Appendix A) and then peak discharges were estimated using the Chezy-Manning equation. The precipitation-runoff model was then calibrated based upon the known rainfall and the estimated peak discharge.

The hydrology was performed using the Clark Unit Hydrograph method as presented in the FCDMC's Drainage Design Manual (Ref. 1). A rainfall depth of 2.83 inches was used based on precipitation records of the rainfall-gauge located in Paradise Valley Country Club (See Appendix B). The Maricopa County Unit Hydrograph Procedure 1 (MCUHP1) program was then used to determine the Time of concentration, Tc, and storage coefficient, R, for each sub-basin.

The sub-basin resistance coefficient, Kb, necessary to determine Tc, was weighted to account for varying roughness conditions associated with mixed land use classifications within each sub-basin. The land use classifications within each sub-basin were categorized into roughness types using the descriptions presented in Table 5.1 of the Drainage Design Manual. All vacant areas were placed under the category of moderately high roughness (Type C). Low and very low density residential areas were labelled as having moderately low roughness (Type B). Medium density and multi-family residential areas were placed under the category of minimal roughness (Type A). Golf courses and parks were also included under areas having minimal roughness. Table 1 summarizes Kb values for each sub-basin.

Manning's roughness coefficients were developed using the Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County (1991) (Ref. 5). The Manning roughness coefficient, n, is a measure of the flow resistance or relative roughness of a channel or overflow area. The flow resistance is affected by many factors including bed material, cross section irregularities, depth of flow, vegetation, channel alignment, channel shape, obstructions, suspended material, and bed load. In general, all factors that cause turbulence and retard flow tend to increase

the roughness coefficient. A common method of selecting the roughness coefficient, n, is to first select a base value of n for the bed material. Cross-section irregularities, channel alignment, obstructions, vegetation, and other factors that increase roughness are accounted for by adding increments of roughness to the base value of n. This method was accomplished using Tables 1 & 2 in reference 5. How roughness coefficients were calculated and assigned to each sub-basin can be found in Appendix A.

Model "A" predicted a peak discharge of 2,111 cubic feet per second (cfs) at the ACDC. Appendix D contains a copy of the HEC-1 input deck and output summary for the computer model. The discharge at the 44th St. bridge was predicted to peak at 1,757 cfs. The peak discharge estimated from the HWM in the Cudia City Wash at the same location 1,806 cfs, which is 3% greater than Model "A" estimate. The low disparity between both results demonstrates that the assumptions made and parameters selected in Model "A" are valid. Therefore, the following models "B" and "C" will be calibrated based on model "A" to insure continuity of the assumptions and of the design.

Kb ESTIMATION FOR CUDIA CITY WASH

Sub-Basin	Type D %	Type C %	Type B %	Type A %	Weighted m	Weighted b	Area [acres]	Kb
100	0.0	33.0	33.5	33.5	-0.01495	0.0897	299.52	0.0526
101	0.0	19.1	58.5	22.4	-0.01422	0.08441	408.96	0.0473
102	0.0	21.9	56.8	21.3	-0.01462	0.08681	580.48	0.0464
103	0.0	34.1	65.9	0.0	-0.01759	0.10387	508.80	0.0563
104	0.0	20.7	75.5	3.8	-0.01579	0.09297	331.52	0.0532
105	0.0	32.6	53.9	13.5	-0.01640	0.09742	257.28	0.0579
106	0.0	64.8	34.1	1.1	-0.02085	0.12428	283.52	0.0731
107	0.0	11.9	87.2	0.9	-0.01502	0.08797	411.52	0.0487

MODEL "B"

The entire Cudia City Wash drainage area is contained within the political boundaries of the City of Phoenix and the Town of Paradise Valley. It is common practice to use, when available, the storm used by the design engineers of the municipality within whose the political boundaries the drainage area lies. Therefore, model "B" utilizes a design rainfall depth of 4.04 inches for the 100-year 24-hour event, with a temporal distribution developed by the City of Phoenix. The use of the City of Phoenix storm distribution rather than the SCS Type IIA storm would affect the timing of the peak runoff, but not significantly alter its magnitude. However, the greater storm depth would increase the magnitude of the peak discharge.

The analysis was performed again using the Clark Unit Hydrograph method. The MCUHP1 program was used to determine the Time of concentration, Tc, and the storage coefficient, R, for each sub-basin. Resistant coefficients, Kb, and Manning;s roughness coefficients, n, were taken from model "A" in order to insure the continuity of the physical parameters and of the assumption made for those parameters.

Model "B" predicted a peak discharge of 5,800 cfs at the ACDC. The peak discharge at 44th St. was predicted at 4,600 cfs. Appendix E contains a copy of the HEC-1 input deck and output summary for the computer model.

MODEL "C"

This model was developed using the procedures and guidelines set forth by the FCDMC's Drainage Design Manual, 1992 (Reference 1). A rainfall depth of 3.8 inches was used based on the NOAA Atlas isopluvial maps for Arizona and aerially reduced by a rainfall reduction factor of 0.97 (Ref. 3). The storm distribution SCS Type IIA was used as recommended in the Drainage Design Manual. The MCUHP1 program was once again used to determine the Time of concentration, Tc, and the storage coefficient, R, for each sub-basin. Sub-basins resistance and roughness coefficients were taken from model "A".

Model "C" predicted a peak discharge of 4,297 cfs at the ACDC. The discharge at 44th St. bridge was

predicted to peak at 3,617 cfs. Appendix F contains the HEC-1 input and output summary of the computer model.

COMPARISON OF RESULTS

Following there is a comparison of discharges (cfs) and total basin discharges between models "A", "B", and "C". Model "C" would be the recommended 100-year 24-hour peak discharges for the Cudia City Wash Watershed, because reflects the calibration of the roughness coefficients made in model "A" and used what we consider to be the most appropriate methodologies and design rainfall.

Sub-basin Peak Discharge

Sub-basin	Model "A"		Model "B"		Model "C"	
	Peak Flow [cfs]	Time of Peak [hr]	Peak Flow [cfs]	Time of Peak [hr]	Peak Flow [cfs]	Time of Peak [hr]
100	310	16.25	620	12.50	582	12.07
101	314	16.50	761	12.50	631	12.07
102	628	16.25	1214	12.50	1160	12.07
103	354	16.50	948	12.58	694	12.13
104	296	16.50	652	12.50	566	12.07
105	266	16.50	538	12.50	497	12.07
106	193	16.50	525	12.58	381	12.13
107	449	16.50	884	12.50	796	12.07
TOTAL ROUTED "Q"	2,111	16.75	5,800	12.58	4,297	12.33

REFERENCES

1. Flood Control District of Maricopa County. Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology. June, 1992.

2. Flood Control District of Maricopa County. Storm Report, July 23-24, 1992. July, 1992

3. National Oceanic and Atmospheric Adimistration. Depth-Area Ratios in the Semi-Arid Southwest United States / Technical Memorandum NWS HYDRO-40. August, 1984.

4. U.S. Army Corps of Engineers of Los Angeles District. Report on Flood of 22 June 1972 in Phoenix Metropolitan Area, Arizona. October, 1972

5. U.S. Geological Survey, Water Resources Division. Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona. April, 1991.

Appendix A

As mentioned before, three cross sections were surveyed at the Cudia City Wash. The sections were identified downstream of the 44th Street bridge over the wash, where there is a reach that runs straight for approximately 600 feet. The characteristics of this reach could be describe as an earth-trapezoidal channel with vegetation on the side banks and a well defined channel bed.

The reason to survey three cross sections was to insure the continuity of the slope and to calibrate the HWM for any bias along the reach. However, the hydrologic model was calibrated based upon the peak discharge predicted from cross section #1. Since the concentration point from sub-basin 105 is at the 44th St. bridge, cross section #1 became the best geographic point of comparison for peak discharges between the surveying and the hydrologic model. Also the fact that surveyed cross sections 2 & 3 may have experienced overbank flows and that was not accounted in the HWM, gives cross section 1 the best hydraulic choice among them.

Peak discharges for each cross section were estimated using the Chezy-Manning equation. Manning's roughness coefficients, n, were developed using the Estimated Manning;s Roughness Coefficients for Stream Channels (Ref. 5) guidelines and professional judgement base on field observations. The peak discharges were calculated as follows:

Chezy-Manning $$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

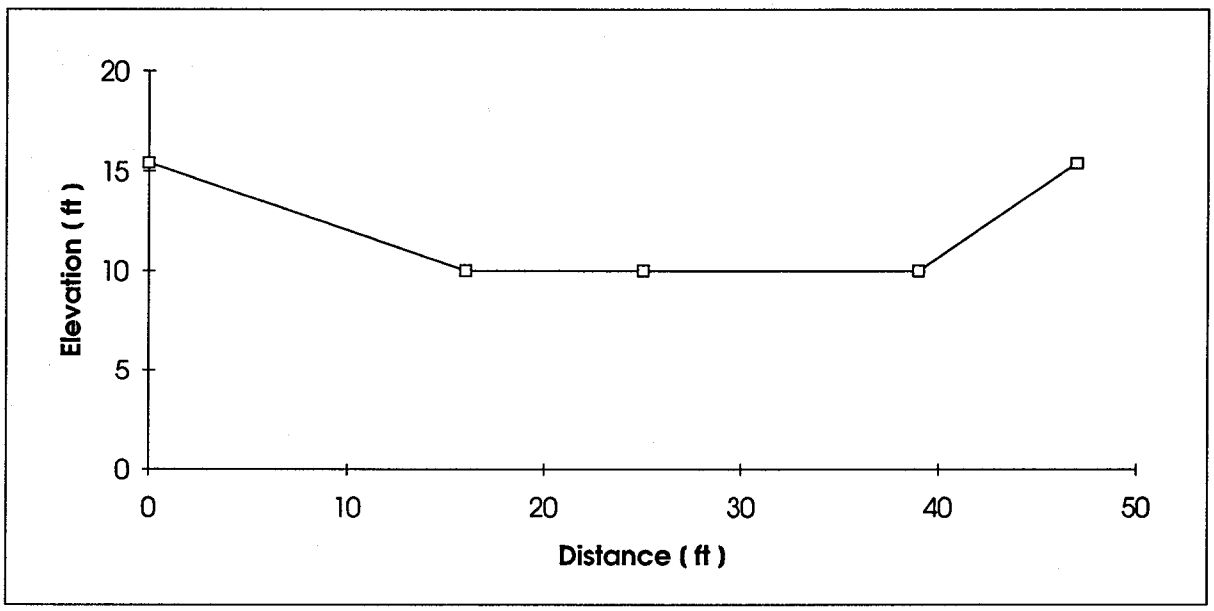
where

Q = peak discharge, in cubic feet per second
A = cross sectional area, in square feet
R = hydraulic radius, in feet
S = slope, in feet per feet
n = roughness coefficient

The computed results can be found after the cross section's profiles as well as the roughness coefficient calculations for each sub-basin.

CROSS SECTION : 1 **LOCATED IN :** CUDIA CITY WASH

CROSS SECTION PROFILE :



Length :
Slope : 0.0066 ft/ft

Maning's :

right bank	0.045
main channel	0.035
left bank	0.045

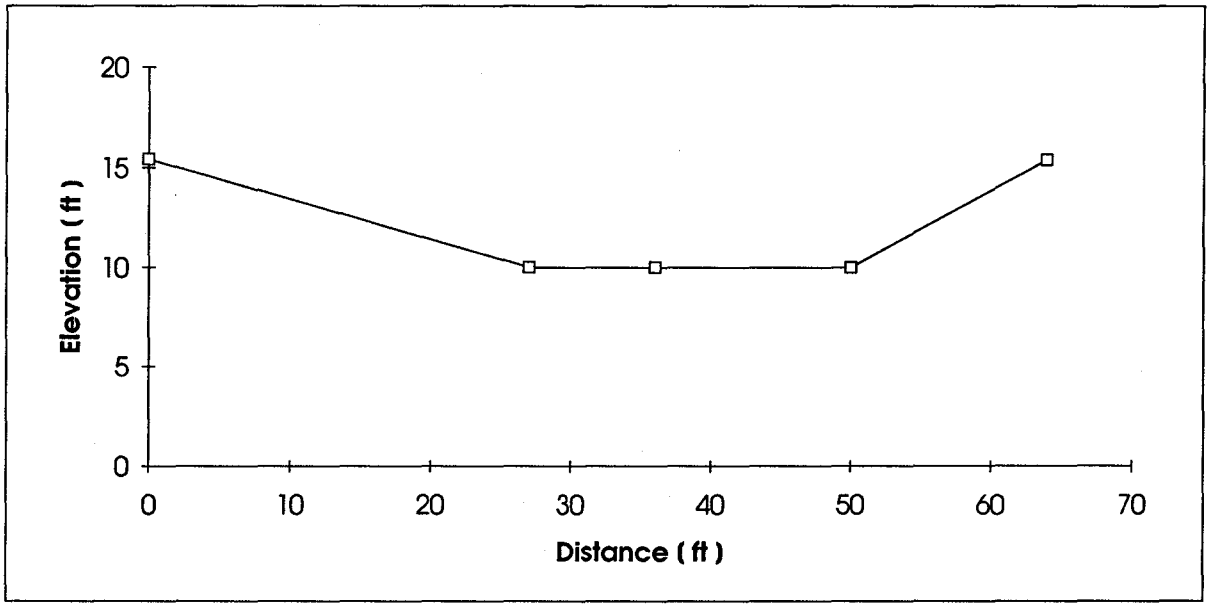
CROSS SECTION DATA :

RX	RY
0	15.4
16	10
25	10
39	10
47	15.4

COMMENTS : This cross section was surveyed at approximately 133 feet downstream of the 44th Street bridge.

CROSS SECTION : 2 **LOCATED IN :** CUDIA CITY WASH

CROSS SECTION PROFILE :



Length :
Slope : 0.005 ft/ft

Manning's :

right bank	0.045
main channel	0.035
left bank	0.045

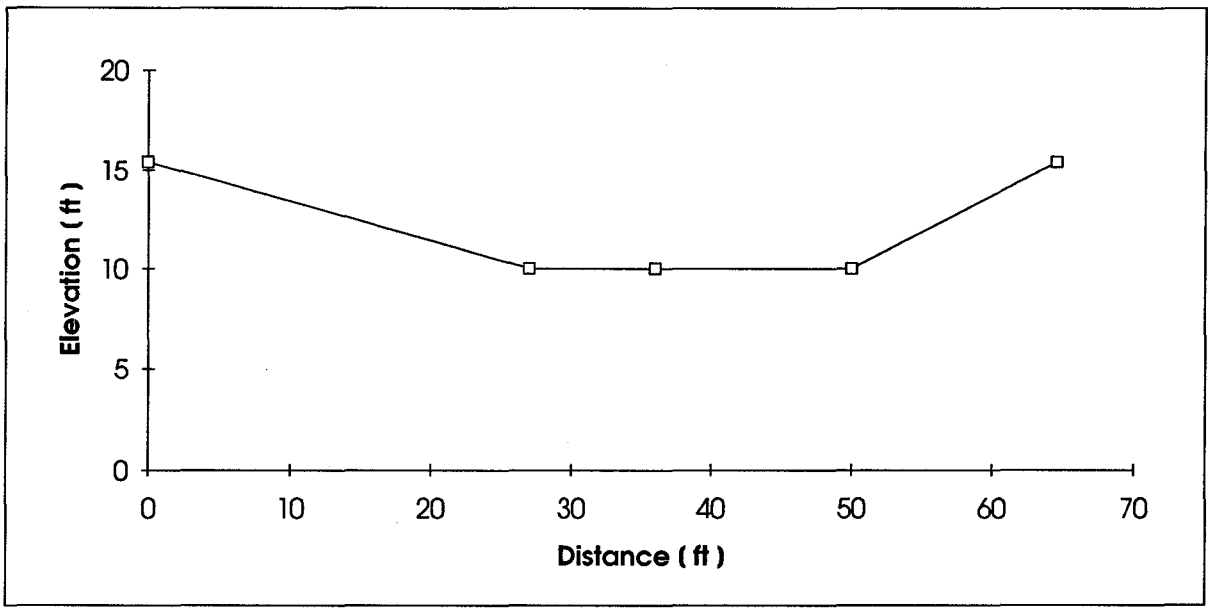
CROSS SECTION DATA :

RX	RY
0	15.4
27	10
36	10
50	10
64	15.4

COMMENTS : This cross section was surveyed at approximately 197 feet from Cross-section # 1.

CROSS SECTION : 3 **LOCATED IN :** CUDIA CITY WASH

CROSS SECTION PROFILE :



Length :
Slope : 0.004 ft/ft

Manning's :

right bank	0.045
main channel	0.055
left bank	0.045

CROSS SECTION DATA :

RX	RY
0	15.4
27	10
36	10
50	10
64.6	15.4

COMMENTS : This cross section was surveyed at approximately 178 feet from Cross-section # 2. The bed of the channel are cobbles of 64-256 mm of size.

Manning's Roughness Coefficients

RM100 :	0.04	+	0.02	+	0.01	+	0.015	=	**0.085**
	bed		irreg.		obs.		veg.		
RM101 :	0.035	+	0.02	+	0.02	+	0.01	=	**0.085**
	bed		irreg.		obs.		veg.		
RM102 :	0.035	+	0.02	+	0.025			=	**0.080**
	bed		obs.		veg.				
RM103 :	0.035	+	0.02	+	0.025			=	**0.080**
	bed		obs.		veg.				
RM104 :	0.035	+	0.01					=	**0.045**
	bed		veg.						
RM105 :	0.035							=	**0.035**
	bed								
RM106 :	0.035	+	0.01	+	0.01	+	0.025	=	**0.080**
	bed		irreg.		obs.		veg.		

where

bed = "n" value for bed material
irreg = adjustmen for degree of irregularity
obs. = " for effects of obstruction
veg. = " for vegetation

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: CCITY WASH -xs1

Comment: Cross Section # 1

Solve For Discharge

Given Input Data:

Bottom Width.....	23.00	ft
Left Side Slope..	5.00:1	(H:V)
Right Side Slope.	1.70:1	(H:V)
Manning's n.....	0.035	
Channel Slope....	0.0066	ft/ft
Depth.....	5.40	ft

Computed Results:

Discharge.....	1806.52	cfs
Velocity.....	8.14	fps
Flow Area.....	221.89	sf
Flow Top Width...	59.18	ft
Wetted Perimeter.	61.19	ft
Critical Depth...	4.59	ft
Critical Slope...	0.0125	ft/ft
Froude Number....	0.74	(flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: CCITY WASH - xs2

Comment: Cross Section # 2

Solve For Discharge

Given Input Data:

Bottom Width.....	23.00	ft
Left Side Slope..	5.00:1	(H:V)
Right Side Slope.	2.60:1	(H:V)
Manning's n.....	0.035	
Channel Slope....	0.0050	ft/ft
Depth.....	5.40	ft

Computed Results:

Discharge.....	1652.23	cfs
Velocity.....	7.03	fps
Flow Area.....	235.01	sf
Flow Top Width...	64.04	ft
Wetted Perimeter.	65.58	ft
Critical Depth...	4.27	ft
Critical Slope...	0.0127	ft/ft
Froude Number....	0.65	(flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: CCITY WASH - xs3

Comment: Cross section # 3

Solve For Discharge

Given Input Data:

Bottom Width.....	23.00	ft
Left Side Slope..	5.00:1	(H:V)
Right Side Slope.	2.70:1	(H:V)
Manning's n.....	0.055	
Channel Slope....	0.0040	ft/ft
Depth.....	5.40	ft

Computed Results:

Discharge.....	945.31	cfs
Velocity.....	4.00	fps
Flow Area.....	236.47	sf
Flow Top Width...	64.58	ft
Wetted Perimeter.	66.08	ft
Critical Depth...	3.12	ft
Critical Slope...	0.0341	ft/ft
Froude Number....	0.37	(flow is Subcritical)

Appendix B

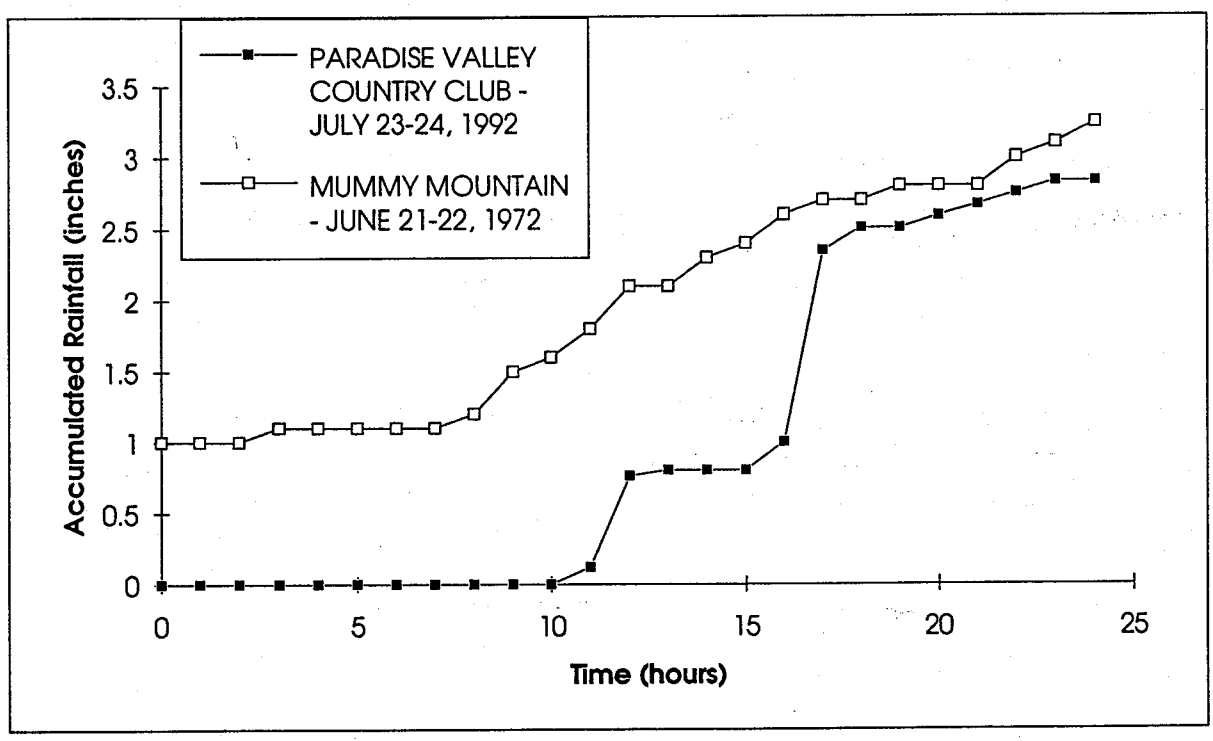
The storm of July 23-24, 1992 (Ref. 2) slowly moved in a south to north direction, and intensified as it moved over the metro area. Thirteen Flood Control District telemetered raingages measured more than 2 inches of rain. Significant runoff events were monitored at Dreamy Draw Dam, Indian Bend Wash, and the Arizona Canal Diversion Channel.

In order to evaluate the magnitude of this storm over the watershed, the event of June 21-22, 1972 (Ref. 4) was used to create a comparison between both. The storm of June 21-22, 1972 was part of a series of moderate to heavy early summer thunderstorms affecting Arizona, Nevada, and Utah. The maximum unofficial intensity reported was 5.25 inches during an estimated 2 hours in the vicinity of 24th St. and Camelback Rd. in Phoenix. An unofficial station of the National Weather Service located in Mummy Mountain recorded a total precipitation of 4.24 inches over the entire duration of the event.

A graph was developed using the recorded data from the station at Mummy Mountain for the Storm of June 21-22, 1972 and the data from Paradise Valley Country Club for the storm of July 23-24, 1992, to compare the two storm patterns. Inspection of the storm patterns in the graph indicated that the peak rainfall intensities were much greater for the July 23-24, 1992 than the June 21-22, 1972 event, but the second one precipitated more than the first one over the entire duration. Therefore, the hydrograph over the basin were developed much faster and so the response of the Cudia City Wash in handling the discharges.

Once again, this comparison is merely a measure of the overall magnitude of the July 23-24, 1992 storm and there have been not intent of making the two events meteorologically similar, although they both occurred in the summer season.

TIME	CUMULATIVE PRECIP. Paradise Valley	CUMULATIVE PRECIP. Mummy Mtn.
0	0	1
1	0	1
2	0	1
3	0	1.1
4	0	1.1
5	0	1.1
6	0	1.1
7	0	1.1
8	0	1.2
9	0	1.5
10	0	1.6
11	0.12	1.8
12	0.76	2.1
13	0.8	2.1
14	0.8	2.3
15	0.8	2.4
16	1	2.6
17	2.35	2.7
18	2.51	2.7
19	2.51	2.8
20	2.59	2.8
21	2.67	2.8
22	2.75	3
23	2.83	3.1
24	2.83	3.24



Appendix C

FLOOD CONTROL DISTRICT *of Maricopa County*

Interoffice Memorandum

CMT Nº	SUBJECT : Cudia City Wash - ACDC ADMS

TO : **Amir Motamedi** FROM : **Jorge R. Garré** DATE : 2/18/93

As requested, here are the peak discharges for Cudia City wash at ACDC from previous studies and the new values generated by Kaminski-Hubbard :

	Rainfall Depth (inches)	**Drainage Area** (sq. mi.)	**Peak Discharge** (cfs)
Corps of Engineers (1982)	---	4.91	6,800
W.S. Gookin (1986)	3.80	5.12	4,422
FCDMC (1987)	3.80	5.12	5,094
FCDMC (1987)	4.04	4.91	6,540
K-H (1993)	3.69	4.82	4,728
K-H (1993)	3.80	4.82	4,952
K-H (1993)	4.04	4.82	5,410

I have not reviewed yet Kaminski-Hubbard's model, so these are just numbers for your info. As soon as I get into this I will let you know why there are such differencies.

FLOOD CONTROL DISTRICT *of Maricopa County*

Interoffice Memorandum

CMT Nº	SUBJECT : Cudia City Wash - ACDC ADMS
	TO : **Amir Motamedi** FROM : **Jorge R. Garré** DATE : 2/19/93
	I have reviewed Kaminski-Hubbard's model and compared it against previous studies (Gookin & Associates, and C.O.E.) done in the same watershed. Following are the discrepancies between them that conducted to different results :
1	W.S. Gookin & Associates (WSG) used a total depth of 3.80 in. and a Soil Conservation Service (SCS) Type IIA temporal distribution. The first FCDCM's model used the same total depth and same temporal distribution and changed the routing method to kinematic wave. WSG's model used the Lotus Spreadsheet to combined and route hydrographs. The change in routing techniques lead to higher peaks in the FCDMC's model and revealed the first major discrepancy between both. Kaminski-Hubbard's (K-H) model used Munskingum-Cunge as routing method and since this method accounts for hydrograph diffusion (based on physical channel properties) one could expects results lower than FCDMC's model. C.O.E.'s model was based in only one basin, therefore there was no routing methods involved.
2	A second model done by the FCDMC used 4.04 in. as the 100yr-24hr total storm depth and the City of Phoenix temporal distribution. Based on this changes, plus the routing methodology, the results were higher. K-H's model using 4.04 in. as total rainfall depth showed a peak discharge at ACDC lower than FCDMC's model and the reason of this could be attributed to the different rouitng and rainfall losses methods used and smaller drainage area. The C.O.E. argues that there is no assurance that runoff frequency is equivalent to rainfall frequency unless the rainfall-runoff model is calibrated to discharge frequency relationships developed from streamflow data, therefore Type IIA distribution along with the NOAA 100yr-24hr rainfall would probably not yield 100-year peak discharge. As a result, C.O.E. used a design storm of 7-hour duration (Quenn Creek) with most of the rain ocurring in the maximun 3 hours. This storm has a total rainfall depth of 5.65 in. which is not aerally reduced. It is evident that C.O.E. results must be the highest, among the other studies, for the above mentioned reasons.
3	K-H's model using the procedures outlined in the FCDMC's hydrology manual showed the lowest results among the other studies but this is attributable to the difference in total rainfall depth (3.69 in. after being reduced), the difference in drainage area, the routing methodology (which accounts for more attenuation) and, the losses using Green-Ampt method. K-H's results for the 100-year frequency seem to be reasonable to this point in comparison with previous studies done in the same area, but still there are some concerns in relation to sub-basin delineation (which will not affect drastically the actual results).

Appendix D

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1****************************************
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 *                                      *                                                    *
 *                                      *                                                    *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS
 *                                      *                                                    *
 *              MAY   1991              *                                                    *    HYDROLOGIC ENGINEERING CENTER
 *                                      *                                                    *
 *           VERSION 4.0.1E             *                                                    *          609 SECOND STREET
 *                                      *                                                    *
 *                                      *                                                    *        DAVIS, CALIFORNIA 95616
 *                                      *                                                    *
 *  RUN DATE  03/12/93  TIME  08:31:19  *                                                    *            (916) 551-1748
 *                                      *                                                    *
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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. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


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

  1           ID       ACDC AREA DRAINAGE MASTER STUDY
  2           ID       FILENAME:   REAL24.DAT
  3           ID       CUDIA CITY WASH WATERSHED
  4           ID       100-YEAR 24-HOUR DURATION STORM
  5           ID       ACTUAL DISTRIBUTION OF THE 07/23-24/92 EVENT
              *                                                                    *
              *    PRELIMINARY HEC-1 RUN FOR CUDIA CITY WASH WATERSHED             *
              *                    JORGE R. GARRE - FCDMC                          *
              *DIAGRAM
  6           IT       15 23JUL92    1205         24JUL92    1205
  7           IO        5
              *    *    *    *    *    *    *    *
              *                                   *
              *        CUDIA CITY WASH            *
              *      SUB-BASINS 100 - 107         *
              *                                   *
              *    *    *    *    *    *    *    *

  8           KK  SUB100
  9           KM   SUB-BASIN S100
 10           BA    .468
 11           IN       5
 12           KM    THE FOLLOWING PC RECORD USED A REAL RAINFALL DATA FROM THE EVENT OF
 13           KM    JULY 23TH-24TH, 1992.
 14           PC       0       0       0       0       0       0       0       0       0       0
 15           PC       0       0       0       0       0       0       0       0       0       0
 16           PC       0       0       0       0       0       0       0       0       0       0
 17           PC       0       0       0       0       0       0       0       0       0       0
 18           PC       0       0       0       0       0       0       0       0       0       0
 19           PC       0       0       0       0       0       0       0       0       0       0
 20           PC       0       0       0       0       0       0       0       0       0       0
 21           PC       0       0       0       0       0       0       0       0       0       0
 22           PC       0       0       0       0       0       0       0       0       0       0
 23           PC       0       0       0       0       0       0       0       0       0       0
 24           PC       0       0       0       0       0       0       0       0       0       0
 25           PC       0       0       0       0       0       0       0       0       0    0.04
 26           PC    0.04    0.04    0.04    0.04    0.04    0.04    0.08    0.08    0.12    0.12
 27           PC    0.12     0.2    0.24    0.24    0.28    0.36     0.4    0.48    0.56    0.72
 28           PC    0.76     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8
 29           PC     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8
 30           PC     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8
 31           PC     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8     0.8
 32           PC     0.8     0.8     0.8    0.84    0.92    0.96    0.96    0.96       1    1.11
 33           PC    1.31    1.47    1.59    1.71    1.95    2.11    2.23    2.31    2.35    2.35
 34           PC    2.35    2.35    2.35    2.35    2.39    2.39    2.43    2.47    2.47    2.47
 35           PC    2.51    2.51    2.51    2.51    2.51    2.51    2.51    2.51    2.51    2.51
 36           PC    2.51    2.51    2.51    2.51    2.51    2.51    2.51    2.51    2.51    2.51
 37           PC    2.51    2.51    2.51    2.51    2.55    2.59    2.59    2.59    2.59    2.59
 38           PC    2.59    2.59    2.59    2.59    2.59    2.67    2.67    2.67    2.67    2.67
 39           PC    2.67    2.67    2.67    2.67    2.67    2.67    2.67    2.75    2.75    2.75
 40           PC    2.75    2.79    2.79    2.83    2.83    2.83    2.83    2.83    2.83    2.83
 41           PC    2.83    2.83    2.83    2.83    2.83    2.83    2.83    2.83    2.83    2.83
 42           PC    2.83    2.83    2.83    2.83    2.83
 43           LG    .122    .283   4.190    .458  30.770
 44           UC    .408    .238
```

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

 45           UA       0       5      16      30      65      77      84      90      94      97
 46           UA     100
              *

 47           KK   RM100
 48           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 100 THROUGH 102
 49           KM              1) Reach Length = 3025 ft.
 50           RD    3025   .0073    .085            TRAP      15       2
              *

 51           KK  SUB101
 52           KM   SUB-BASIN S101
 53           BA    .639
 54           LG    .159    .269   4.240    .510  17.830
 55           UC    .525    .362
 56           UA       0       5      16      30      65      77      84      90      94      97
 57           UA     100
              *

 58           KK   RM101
 59           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 101 THROUGH 102
 60           KM              1) Reach Length = 1692 ft.
 61           RD    1692   .0089    .085            TRAP       5       2
              *

 62           KK  SUB102
 63           KM   SUB-BASIN S102
 64           BA    .907
 65           LG    .143    .272   4.190    .456  31.540
 66           UC    .433    .213
 67           UA       0       5      16      30      65      77      84      90      94      97
 68           UA     100
              *

 69           KK   HC102
 70           KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 102 WITH ROUTED FLOW FROM 100 & 101
 71           HC       3
              *

 72           KK   RM102
 73           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 102 TO 103
 74           KM              1) Reach Length = 720 ft.
 75           RD
 76           RC     .08     .08     .08     720    .008
 77           RX       0      25      35      70     100     125     155     200
 78           RY      14      12      10       6       6      10      12      14
              *

 79           KK  SUB103
 80           KM   SUB-BASIN S103
 81           BA    .795
 82           LG    .150    .284   4.140    .431  21.010
 83           UC    .658    .543
 84           UA       0       5      16      30      65      77      84      90      94      97
 85           UA     100
              *
```



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

 86           KK   HC103
 87           KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 103 WITH ROUTED FLOW FROM 102
 88           HC       2
              *

 89           KK   RM103
 90           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 103 TO 104
 91           KM              1) Reach Length = 1125 ft.
 92           RD
 93           RC     .08     .08     .08    1125   .0080
 94           RX       0      25      35      70     100     125     155     200
 95           RY      14      12      10       6       6      10      12      14
              *

 96           KK  SUB104
 97           KM   SUB-BASIN S104
 98           BA    .518
 99           LG    .110    .271   4.240    .454  19.350
100           UC    .479    .313
101           UA       0       5      16      30      65      77      84      90      94      97
102           UA     100
              *

103           KK   HC104
104           KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 104 WITH ROUTED FLOW FROM 103
105           HC       2
              *

106           KK   RM104
107           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 104 THROUGH 105
108           KM              1) Reach Length = 2631 ft.
109           RD
110           RC    .045    .045    .045    2631   .0068
111           RX       0      50      60      75      90     115     150     200
112           RY      20      18      14       9       9      14      14      15
              *

113           KK  SUB105
114           KM   SUB-BASIN S105
115           BA    .402
116           LG    .116    .283   4.240    .454  32.870
```

```
 117          UC    .417    .254
 118          UA       0       5      16      30      65      77      84      90      94      97
 119          UA     100
              *

 120          KK   HC105
 121          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 105 WITH ROUTED FLOW FROM 104
 122          HC       2
              *
1                                          HEC-1 INPUT                                          PAGE  4

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

 123          KK   RM105
 124          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 105 THROUGH 107
 125          KM              1) Reach Lenght = 2732 ft.
 126          RD
 127          RC    .045    .035    .045    2732   .0066
 128          RX       0      55      80      90     110     130     190     250
 129          RY      20      18      16      10      10      16      18      20
              *

 130          KK   RM105A
 131          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 105 THROUGH 107
 132          KM              1) Reach Length = 2730 FT.
 133          RD
 134          RC    .045    .035    .045    2730   .0066
 135          RX       0      55      80      90     110     130     190     250
 136          RY      20      18      16      10      10      16      18      20
              *

 137          KK   SUB106
 138          KM    SUB-BASIN S106
 139          BA    .443
 140          LG    .132    .315   4.080    .419  21.450
 141          UC    .667    .560
 142          UA       0       5      16      30      65      77      84      90      94      97
 143          UA     100
              *

 144          KK   RM106
 145          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 106 THROUGH 107
 146          KM              1) Reach Length = 5946 ft.
 147          RD
 148          RC     .08     .08     .08    5946   .0145
 149          RX       0     100     150     170     185     205     215     325
 150          RY      18      16      14      10      10      14      16      18
              *

 151          KK   SUB107
 152          KM    SUB-BASIN S107
 153          BA    .643
 154          LG    .106    .262   3.770    .349  20.900
 155          UC    .508    .270
 156          UA       0       5      16      30      65      77      84      90      94      97
 157          UA     100
              *

 158          KK   HC107
 159          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 107 WITH ROUTED FLOW FROM 105 & 106
 160          HC       3
 161          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

     8     SUB100
               V
               V
    47      RM100
               .
               .
    51          .      SUB101
               .           V
               .           V
    58          .       RM101
               .           .
               .           .
    62          .           .      SUB102
               .           .           .
               .           .           .
    69      HC102........................
               V
               V
    72      RM102
               .
               .
    79          .      SUB103
               .           .
               .           .
    86      HC103............
               V
               V
    89      RM103
               .
               .
    96          .      SUB104
               .           .
               .           .
   103      HC104............
```

```
                V
                V
  106       RM104
                .
                .
  113           .      SUB105
                .           .
                .           .
  120       HC105............
                V
                V
  123       RM105
                V
                V
  130      RM105A
                .
                .
  137           .      SUB106
                .           V
                .           V
  144           .       RM106
                .           .
                .           .
  151           .           .      SUB107
                .           .           .
                .           .           .
  158       HC107........................
 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
****************************************
 *                                      *                                          *
 *                                      *                                          *   U.S. ARMY CORPS OF ENGINEERS
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                          *   HYDROLOGIC ENGINEERING CENTER
 *                                      *                                          *         609 SECOND STREET
 *              MAY   1991              *                                          *      DAVIS, CALIFORNIA 95616
 *           VERSION 4.0.1E             *                                          *          (916) 551-1748
 *                                      *                                          *
 *                                      *
 *  RUN DATE  03/12/93  TIME  08:31:19  *
 *                                      *
 *                                      *
 *****************************************
****************************************
```

```
                              ACDC AREA DRAINAGE MASTER STUDY
                              FILENAME:   REAL24.DAT
                              CUDIA CITY WASH WATERSHED
                              100-YEAR 24-HOUR DURATION STORM
                              ACTUAL DISTRIBUTION OF THE 07/23-24/92 EVENT

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

     IT          HYDROGRAPH TIME DATA
                        NMIN          15  MINUTES IN COMPUTATION INTERVAL
                       IDATE     23JUL92  STARTING DATE
                       ITIME        1205  STARTING TIME
                          NQ          97  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     24JUL92  ENDING DATE
                      NDTIME        1205  ENDING TIME
                      ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL    0.25 HOURS
                       TOTAL TIME BASE   24.00 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
1
                                                  RUNOFF SUMMARY
                                            FLOW IN CUBIC FEET PER SECOND
                                          TIME IN HOURS,  AREA IN SQUARE MILES

                                     PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION    FLOW     PEAK                                          AREA      STAGE     MAX STAGE
+                                                        6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                         SUB100     310.   16.25         54.         16.         16.       0.47

          ROUTED TO
+                          RM100     315.   16.50         54.         16.         16.       0.47

          HYDROGRAPH AT
+                         SUB101     314.   16.50         54.         16.         16.       0.64

          ROUTED TO
+                          RM101     297.   16.50         54.         16.         16.       0.64
```

+	HYDROGRAPH AT	SUB102	628.	16.25	106.	32.	32.	0.91
+	3 COMBINED AT	HC102	1221.	16.50	212.	64.	64.	2.01
+	ROUTED TO	RM102	1178.	16.50	212.	64.	64.	2.01
+	HYDROGRAPH AT	SUB103	354.	16.50	75.	23.	23.	0.80
+	2 COMBINED AT	HC103	1532.	16.50	285.	87.	87.	2.81
+	ROUTED TO	RM103	1431.	16.50	286.	87.	87.	2.81
+	HYDROGRAPH AT	SUB104	296.	16.50	49.	14.	14.	0.52
+	2 COMBINED AT	HC104	1727.	16.50	335.	102.	102.	3.33
+	ROUTED TO	RM104	1596.	16.75	333.	102.	102.	3.33
+	HYDROGRAPH AT	SUB105	266.	16.50	47.	14.	14.	0.40
+	2 COMBINED AT	HC105	1757.	16.50	379.	116.	116.	3.73
+	ROUTED TO	RM105	1738.	16.75	378.	116.	116.	3.73
+	ROUTED TO	RM105A	1685.	16.75	378.	116.	116.	3.73
+	HYDROGRAPH AT	SUB106	193.	16.50	42.	13.	13.	0.44
+	ROUTED TO	RM106	185.	17.00	42.	13.	13.	0.44
+	HYDROGRAPH AT	SUB107	449.	16.50	73.	21.	21.	0.64
+	3 COMBINED AT	HC107	2111.	16.75	486.	150.	150.	4.82

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

							INTERPOLATED TO COMPUTATION INTERVAL		
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RM100	MANE	7.50	314.61	990.00	1.27	15.00	314.61	990.00	1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3174E+02 EXCESS=0.0000E+00 OUTFLOW=0.3182E+02 BASIN STORAGE=0.2313E-01 PERCENT ERROR= -0.3

RM101	MANE	7.08	299.69	990.74	0.93	15.00	297.27	990.00	0.93

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3170E+02 EXCESS=0.0000E+00 OUTFLOW=0.3172E+02 BASIN STORAGE=0.1480E-01 PERCENT ERROR= -0.1

RM102	MANE	3.00	1189.74	991.07	1.18	15.00	1177.60	990.00	1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1263E+03 EXCESS=0.0000E+00 OUTFLOW=0.1263E+03 BASIN STORAGE=0.8960E-02 PERCENT ERROR= 0.0

```
          RM103  MANE        4.23   1488.62    993.08      1.15     15.00   1430.79    990.00        1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1724E+03 EXCESS=0.0000E+00 OUTFLOW=0.1725E+03 BASIN STORAGE=0.6064E-01 PERCENT ERROR=  -0.1

          RM104  MANE        6.00   1679.50   1001.25      1.14     15.00   1595.86   1005.00        1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2014E+03 EXCESS=0.0000E+00 OUTFLOW=0.2014E+03 BASIN STORAGE=0.1531E+00 PERCENT ERROR=  -0.1

          RM105  MANE        4.73   1760.68    997.38      1.15     15.00   1738.10   1005.00        1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2295E+03 EXCESS=0.0000E+00 OUTFLOW=0.2294E+03 BASIN STORAGE=0.2643E+00 PERCENT ERROR=  -0.1

         RM105A  MANE        4.74   1712.88   1009.21      1.16     15.00   1685.29   1005.00        1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2301E+03 EXCESS=0.0000E+00 OUTFLOW=0.2300E+03 BASIN STORAGE=0.4696E+00 PERCENT ERROR=  -0.1

          RM106  MANE        9.00    190.13   1026.00      1.09     15.00    185.13   1020.00        1.08

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2555E+02 EXCESS=0.0000E+00 OUTFLOW=0.2570E+02 BASIN STORAGE=0.2075E+00 PERCENT ERROR=  -1.4


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

Appendix E

```
1*****************************************
****************************************
 *                                      *
 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *                                      *
 *              MAY   1991              *
 *                                      *
 *           VERSION 4.0.1E             *
 *                                      *
 *                                      *
 *                                      *
 *  RUN DATE  03/22/93  TIME  13:47:17  *
 *                                      *
 *                                      *
 *                                      *
 *****************************************
****************************************
```

```
*
*   U.S. ARMY CORPS OF ENGINEERS
*   HYDROLOGIC ENGINEERING CENTER
*         609 SECOND STREET
*      DAVIS, CALIFORNIA 95616
*          (916) 551-1748
*
```

```
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. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                    HEC-1 INPUT                                    PAGE  1

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

  1           ID       ACDC AREA DRAINAGE MASTER STUDY
  2           ID       FILENAME:   PHOENIX.DAT
  3           ID       CUDIA CITY WASH WATERSHED
  4           ID       100-YEAR 24-HOUR DURATION STORM
  5           ID       CITY OF PHOENIX DITRIBUTION AND POINT RAINFALL DEPTH OF 4.04 INCHES
              *                                                                  *
              *    PRELIMINARY HEC-1 RUN FOR CUDIA CITY WASH WATERSHED           *
              *                  JORGE R. GARRE - FCDMG                          *
              *DIAGRAM
  6           IT       5                    800
  7           IO       5
              *    *    *    *    *    *    *    *
              *                                  *
              *        CUDIA CITY WASH           *
              *      SUB-BASINS 100 - 107        *
              *                                  *
              *    *    *    *    *    *    *    *

  8           KK  SUB100
  9           KM   SUB-BASIN S100
 10           BA    .468
 11           IN      30
 12           KM    THE FOLLOWING PC RECORD USED CITY OF PHOENIX STORM DISTRIBUTION AND
 13           KM    A POINT RAINFALL DEPTH OF 4.04 INCHES
 14           PC       0    0.02    0.03    0.05    0.07    0.09    0.11    0.13    0.14    0.16
 15           PC    0.18    0.19    0.21    0.23    0.25    0.27    0.29    0.30    0.32    0.38
 16           PC    0.43    0.48    0.57    0.69    2.02    3.35    3.47    3.56    3.61    3.66
 17           PC    3.72    3.73    3.75    3.77    3.79    3.81    3.83    3.84    3.86    3.88
 18           PC    3.89    3.91    3.93    3.95    3.97    3.99       4    4.02    4.04    4.04
 19           LG    .122    .283   4.190    .458  30.770
 20           UC    .250    .138
 21           UA       0       5      16      30      65      77      84      90      94      97
 22           UA     100
              *

 23           KK   RM100
 24           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 100 THROUGH 102
 25           KM             1) Reach Length = 3025 ft.
 26           RD    3025   .0073    .085            TRAP      15       2
              *

 27           KK  SUB101
 28           KM   SUB-BASIN S101
 29           BA    .639
 30           LG    .159    .269   4.240    .510  17.830
 31           UC    .304    .198
 32           UA       0       5      16      30      65      77      84      90      94      97
 33           UA     100
              *
1                                    HEC-1 INPUT                                    PAGE  2

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

 34           KK   RM101
 35           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 101 THROUGH 102
 36           KM             1) Reach Length = 1692 ft.
```

```
 37          RD    1692   .0089    .085            TRAP       5       2
             *

 38          KK  SUB102
 39          KM   SUB-BASIN S102
 40          BA    .907
 41          LG    .143    .272   4.190    .456  31.540
 42          UC    .262    .122
 43          UA       0       5      16      30      65      77      84      90      94      97
 44          UA     100
             *

 45          KK   HC102
 46          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 102 WITH ROUTED FLOW FROM 100 & 101
 47          HC       3
             *

 48          KK   RM102
 49          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 102 TO 103
 50          KM              1) Reach Length = 720 ft.
 51          RD
 52          RC     .08     .08     .08     720   .0110
 53          RX       0      25      35      70     100     125     155     200
 54          RY      14      12      10       6       6      10      12      14
             *

 55          KK  SUB103
 56          KM   SUB-BASIN S103
 57          BA    .795
 58          LG    .150    .284   4.140    .431  21.010
 59          UC    .383    .298
 60          UA       0       5      16      30      65      77      84      90      94      97
 61          UA     100
             *

 62          KK   HC103
 63          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 103 WITH ROUTED FLOW FROM 102
 64          HC       2
             *

 65          KK   RM103
 66          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 103 TO 104
 67          KM              1) Reach Length = 1125 ft.
 68          RD
 69          RC     .08     .08     .08    1125   .0080
 70          RX       0      25      35      70     100     125     155     200
 71          RY      14      12      10       6       6      10      12      14
             *
1                                          HEC-1 INPUT                                          PAGE  3

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

 72          KK  SUB104
 73          KM   SUB-BASIN S104
 74          BA    .518
 75          LG    .110    .271   4.240    .454  19.350
 76          UC    .287    .178
 77          UA       0       5      16      30      65      77      84      90      94      97
 78          UA     100
             *

 79          KK   HC104
 80          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 104 WITH ROUTED FLOW FROM 103
 81          HC       2
             *

 82          KK   RM104
 83          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 104 THROUGH 105
 84          KM              1) Reach Length = 2631 ft.
 85          RD
 86          RC    .045    .045    .045    2631   .0068
 87          RX       0      50      60      75      90     115     150     200
 88          RY      20      18      14       9       9      14      14      15
             *

 89          KK  SUB105
 90          KM   SUB-BASIN S105
 91          BA    .402
 92          LG    .116    .283   4.240    .454  32.870
 93          UC    .254    .147
 94          UA       0       5      16      30      65      77      84      90      94      97
 95          UA     100
             *

 96          KK   HC105
 97          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 105 WITH ROUTED FLOW FROM 104
 98          HC       2
             *

 99          KK   RM105
100          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 105 THROUGH 107
101          KM              1) Reach Length = 5463 ft.
102          RD
103          RC    .045    .035    .045    5463   .0066
104          RX       0      55      80      95     110     145     190     250
105          RY      10       6       4       0       0       4       8      10
             *

106          KK  SUB106
107          KM   SUB-BASIN S106
108          BA    .443
109          LG    .132    .315   4.080    .419  21.450
110          UC    .387    .307
```

```
          111          UA       0       5      16      30      65      77      84      90      94      97
          112          UA     100
                       *
1                                                  HEC-1 INPUT                                                  PAGE  4

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

          113          KK   RM106
          114          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 106 THROUGH 107
          115          KM              1) Reach Length = 5946 ft.
          116          RD
          117          RC     .08     .08     .08    5946   .0145
          118          RX       0     100     150     170     185     205     215     325
          119          RY       8       6       4       0       0       4       6       8
                       *

          120          KK   SUB107
          121          KM    SUB-BASIN S107
          122          BA    .643
          123          LG    .106    .262   3.770    .349  20.900
          124          UC    .317    .160
          125          UA       0       5      16      30      65      77      84      90      94      97
          126          UA     100
                       *

          127          KK   HC107
          128          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 107 WITH ROUTED FLOW FROM 105 & 106
          129          HC       3
          130          ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

     8      SUB100
                V
                V
    23       RM100
                .
                .
    27          .      SUB101
                .           V
                .           V
    34          .       RM101
                .           .
                .           .
    38          .           .      SUB102
                .           .           .
                .           .           .
    45       HC102........................
                V
                V
    48       RM102
                .
                .
    55          .      SUB103
                .           .
                .           .
    62       HC103............
                V
                V
    65       RM103
                .
                .
    72          .      SUB104
                .           .
                .           .
    79       HC104............
                V
                V
    82       RM104
                .
                .
    89          .      SUB105
                .           .
                .           .
    96       HC105............
                V
                V
    99       RM105
                .
                .
   106          .      SUB106
                .           V
                .           V
   113          .       RM106
                .           .
                .           .
   120          .           .      SUB107
                .           .           .
                .           .           .
   127       HC107........................

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
****************************************
 *                                      *                                                  *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                  *    U.S. ARMY CORPS OF ENGINEERS
*
 *              MAY   1991              *                                                  *    HYDROLOGIC ENGINEERING CENTER
```

```
*
 *          VERSION 4.0.1E              *                                                  *        609 SECOND STREET
*
 *                                      *                                                  *      DAVIS, CALIFORNIA 95616
*
 *  RUN DATE  03/22/93  TIME  13:47:17  *                                                  *          (916) 551-1748
*
 *                                      *                                                  *
*
 ****************************************
****************************************
```

```
                         ACDC AREA DRAINAGE MASTER STUDY
                         FILENAME:   PHOENIX.DAT
                         CUDIA CITY WASH WATERSHED
                         100-YEAR 24-HOUR DURATION STORM
                         CITY OF PHOENIX DITRIBUTION AND POINT RAINFALL DEPTH OF 4.04 INCHES

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

     IT        HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        800  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      3   0  ENDING DATE
                   NDTIME       1835  ENDING TIME
                    ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL    0.08 HOURS
                     TOTAL TIME BASE   66.58 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
1
                                                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	SUB100	620.	12.50	110.	30.	11.	0.47		
+	ROUTED TO	RM100	614.	12.58	110.	30.	11.	0.47		
+	HYDROGRAPH AT	SUB101	761.	12.50	130.	35.	12.	0.64		
+	ROUTED TO	RM101	755.	12.58	130.	35.	12.	0.64		
+	HYDROGRAPH AT	SUB102	1214.	12.50	216.	59.	21.	0.91		
+	3 COMBINED AT	HC102	2572.	12.50	456.	124.	45.	2.01		
+	ROUTED TO	RM102	2559.	12.50	456.	124.	45.	2.01		
+	HYDROGRAPH AT	SUB103	948.	12.58	176.	47.	17.	0.80		
+	2 COMBINED AT	HC103	3506.	12.50	632.	170.	61.	2.81		
+	ROUTED TO	RM103	3473.	12.58	632.	170.	61.	2.81		
+	HYDROGRAPH AT	SUB104	652.	12.50	112.	30.	11.	0.52		
+	2 COMBINED AT	HC104	4113.	12.50	744.	200.	72.	3.33		
+	ROUTED TO	RM104	4105.	12.58	744.	200.	72.	3.33		
+	HYDROGRAPH AT	SUB105	538.	12.50	96.	26.	10.	0.40		
+	2 COMBINED AT	HC105	4600.	12.58	840.	227.	82.	3.73		
+	ROUTED TO	RM105	4574.	12.67	840.	227.	82.	3.73		

```
+        HYDROGRAPH AT
                          SUB106      525.   12.58        98.        26.         9.       0.44
+        ROUTED TO
                           RM106      519.   12.83        98.        26.         9.       0.44
+        HYDROGRAPH AT
                          SUB107      884.   12.50       154.        41.        15.       0.64
+        3 COMBINED AT
                           HC107     5800.   12.58      1092.       294.       106.       4.82
1
```

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
RM100	MANE	5.00	613.55	755.00	2.39	5.00	613.55	755.00	2.39

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5964E+02 EXCESS=0.0000E+00 OUTFLOW=0.5963E+02 BASIN STORAGE=0.8112E-02 PERCENT ERROR= 0.0

RM101	MANE	5.00	755.22	755.00	2.01	5.00	755.22	755.00	2.01

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6864E+02 EXCESS=0.0000E+00 OUTFLOW=0.6864E+02 BASIN STORAGE=0.3250E-02 PERCENT ERROR= 0.0

RM102	MANE	1.88	2561.85	751.63	2.28	5.00	2558.68	750.00	2.28

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2453E+03 EXCESS=0.0000E+00 OUTFLOW=0.2453E+03 BASIN STORAGE=0.2074E-03 PERCENT ERROR= 0.0

RM103	MANE	3.23	3485.99	752.59	2.26	5.00	3472.66	755.00	2.26

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3382E+03 EXCESS=0.0000E+00 OUTFLOW=0.3381E+03 BASIN STORAGE=0.3290E-03 PERCENT ERROR= 0.0

RM104	MANE	5.00	4105.27	755.00	2.24	5.00	4105.27	755.00	2.24

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3973E+03 EXCESS=0.0000E+00 OUTFLOW=0.3975E+03 BASIN STORAGE=0.6220E-03 PERCENT ERROR= 0.0

RM105	MANE	5.00	4573.82	760.00	2.26	5.00	4573.82	760.00	2.26

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4499E+03 EXCESS=0.0000E+00 OUTFLOW=0.4500E+03 BASIN STORAGE=0.9005E-03 PERCENT ERROR= 0.0

RM106	MANE	5.00	519.10	770.00	2.20	5.00	519.10	770.00	2.20

```
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5188E+02 EXCESS=0.0000E+00 OUTFLOW=0.5203E+02 BASIN STORAGE=0.1757E-02 PERCENT ERROR=  -0.3


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

Appendix F

```
1*****************************************
*****************************************
 *                                      *                                                  *
 *                                      *                                                  *   U.S. ARMY CORPS OF ENGINEERS
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                  *   HYDROLOGIC ENGINEERING CENTER
 *                                      *                                                  *
 *              MAY   1991              *                                                  *        609 SECOND STREET
 *                                      *                                                  *
 *           VERSION 4.0.1E             *                                                  *      DAVIS, CALIFORNIA 95616
 *                                      *                                                  *
 *                                      *                                                  *          (916) 551-1748
 *  RUN DATE  03/12/93  TIME  10:39:37  *                                                  *
 *                                      *                                                  *
 *                                      *
 *****************************************
*****************************************
```

```
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. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                                HEC-1 INPUT                                                PAGE  1

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

            1           ID       ACDC AREA DRAINAGE MASTER STUDY
            2           ID       FILENAME:  CCITY24.DAT
            3           ID       CUDIA CITY WASH WATERSHED
            4           ID       100-YEAR 24-HOUR DURATION STORM
            5           ID       SCS TYPE-II DISTRIBUTION WAS USED AND POINT RAINFALL DEPTH OF 3.69 INCHES

                        *                                                                  *
                        *    PRELIMINARY HEC-1 RUN FOR CUDIA CITY WASH WATERSHED           *
                        *              JORGE R. GARRE - FCDMC  02/25/93                    *
                        *DIAGRAM
            6           IT       4                    800
            7           IO       5
                        *    *    *    *    *    *    *    *
                        *                                  *
                        *        CUDIA CITY WASH           *
                        *      SUB-BASINS 100 - 107        *
                        *                                  *
                        *    *    *    *    *    *    *    *

            8           KK    S100
            9           KM   SUB-BASIN sub100
           10           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
           11           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
           12           BA    .468
           13           IN      30
           14           KM   RAINFALL DEPTH OF 3.80 WAS SPACIALLY REDUCED AS SHOWN BY THE PB RECORD
           15           PB   3.686
           16           KM   THE FOLLOWING PC RECORD USED A 24-HR SCS TYPE II STORM
           17           PC    .000    .005    .011    .016    .022    .028    .035    .041    .048    .056
           18           PC    .063    .071    .080    .089    .098    .109    .120    .133    .147    .163
           19           PC    .181    .204    .235    .283    .663    .735    .772    .799    .820    .838
           20           PC    .854    .868    .880    .891    .902    .912    .921    .929    .937    .945
           21           PC    .952    .959    .965    .972    .978    .984    .989    .995   1.000
           22           LG    .122    .283   4.190    .458  30.770
           23           UC    .313    .177
           24           UA       0       5      16      30      65      77      84      90      94      97
           25           UA     100
                        *

           26           KK   RM100
           27           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 100 THROUGH 102
           28           KM             1) Reach Length = 3025 ft.
           29           RD    3025   .0073    .085            TRAP      15       2
                        *

           30           KK    S101
           31           KM   SUB-BASIN sub101
           32           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
           33           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
           34           BA    .639
           35           LG    .159    .269   4.240    .510  17.830
           36           UC    .383    .255
           37           UA       0       5      16      30      65      77      84      90      94      97
           38           UA     100
                        *
1                                                HEC-1 INPUT                                                PAGE  2
```

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

 39           KK   RM101
 40           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 101 THROUGH 102
 41           KM             1) Reach Length = 1692 ft.
 42           RD    1692   .0089    .085            TRAP       5       2
              *

 43           KK    S102
 44           KM   SUB-BASIN sub102
 45           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 46           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
 47           BA    .907
 48           LG    .143    .272   4.190    .456  31.540
 49           UC    .333    .159
 50           UA      0       5      16      30      65      77      84      90      94      97
 51           UA     100
              *

 52           KK   HC102
 53           KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 102 WITH ROUTED FLOW FROM 100 & 101
 54           HC       3
              *

 55           KK   RM102
 56           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 102 TO 103
 57           KM             1) Reach Length = 720 ft.
 58           RD
 59           RC     .08     .08     .08     720    .008
 60           RX       0      25      35      70     100     125     155     200
 61           RY      14      12      10       6       6      10      12      14
              *

 62           KK    S103
 63           KM   SUB-BASIN sub103
 64           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 65           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
 66           BA    .795
 67           LG    .150    .284   4.140    .431  21.010
 68           UC    .483    .385
 69           UA      0       5      16      30      65      77      84      90      94      97
 70           UA     100
              *

 71           KK   HC103
 72           KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 103 WITH ROUTED FLOW FROM 102
 73           HC       2
              *

 74           KK   RM103
 75           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 103 TO 104
 76           KM             1) Reach Length = 1125 ft.
 77           RD
 78           RC     .08     .08     .08    1125   .0080
 79           RX       0      25      35      70     100     125     155     200
 80           RY      14      12      10       6       6      10      12      14
              *
```



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

 81           KK    S104
 82           KM   SUB-BASIN sub104
 83           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 84           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
 85           BA    .518
 86           LG    .110    .271   4.240    .454  19.350
 87           UC    .363    .230
 88           UA      0       5      16      30      65      77      84      90      94      97
 89           UA     100
              *

 90           KK   HC104
 91           KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 104 WITH ROUTED FLOW FROM 103
 92           HC       2
              *

 93           KK   RM104
 94           KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 104 THROUGH 105
 95           KM             1) Reach Length = 2631 ft.
 96           RD
 97           RC     .045    .045    .045   2631   .0068
 98           RX       0      50      60      75      90     115     150     200
 99           RY      20      18      14       9       9      14      14      15
              *

100           KK    S105
101           KM   SUB-BASIN sub105
102           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
103           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
104           BA    .402
105           LG    .116    .283   4.240    .454  32.870
106           UC    .321    .190
107           UA      0       5      16      30      65      77      84      90      94      97
108           UA     100
              *

109           KK   HC105
110           KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 105 WITH ROUTED FLOW FROM 104
111           HC       2
              *
```

```
 112          KK   RM105
 113          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 105 THROUGH 107
 114          KM              1) Reach Length = 5463 ft.
 115          RD
 116          RC    .045    .035    .045    5463   .0066
 117          RX       0      55      80      95     110     145     190     250
 118          RY      10       6       4       0       0       4       8      10
              *
1                                          HEC-1 INPUT                                                    PAGE  4

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

 119          KK    S106
 120          KM   SUB-BASIN sub106
 121          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 122          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
 123          BA    .443
 124          LG    .132    .315   4.080    .419  21.450
 125          UC    .488    .396
 126          UA       0       5      16      30      65      77      84      90      94      97
 127          UA     100
              *

 128          KK   RM106
 129          KM    MUSKINGUM-CUNGE ROUTE IN CHANNEL FROM SUB-BASIN 106 THROUGH 107
 130          KM              1) Reach Length = 5946 ft.
 131          RD
 132          RC     .08     .08     .08    5946   .0145
 133          RX       0     100     150     170     185     205     215     325
 134          RY       8       6       4       0       0       4       6       8
              *

 135          KK    S107
 136          KM   SUB-BASIN sub107
 137          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 138          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .970
 139          BA    .643
 140          LG    .106    .262   3.770    .349  20.900
 141          UC    .392    .202
 142          UA       0       5      16      30      65      77      84      90      94      97
 143          UA     100
              *

 144          KK   HC107
 145          KM    COMBINE HYDROGRAPHS FROM SUB-BASIN 107 WITH ROUTED FLOW FROM 105 & 106
 146          HC       3
 147          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

     8       S100
                V
                V
    26      RM100
                .
                .
    30          .        S101
                .           V
                .           V
    39          .       RM101
                .           .
                .           .
    43          .           .        S102
                .           .           .
                .           .           .
    52      HC102.......................
                V
                V
    55      RM102
                .
                .
    62          .        S103
                .           .
                .           .
    71      HC103............
                V
                V
    74      RM103
                .
                .
    81          .        S104
                .           .
                .           .
    90      HC104............
                V
                V
    93      RM104
                .
                .
   100          .        S105
                .           .
                .           .
   109      HC105............
                V
                V
   112      RM105
                .
                .
   119          .        S106
```

```
                .          V
                .          V
   128          .       RM106
                .          .
                .          .
   135          .          .        S107
                .          .          .
                .          .          .
   144       HC107.......................
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1****************************************
****************************************
 *                                      *                                        *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                        *   U.S. ARMY CORPS OF ENGINEERS
*
 *              MAY   1991              *                                        *   HYDROLOGIC ENGINEERING CENTER
*
 *           VERSION 4.0.1E             *                                        *         609 SECOND STREET
*
 *                                      *                                        *       DAVIS, CALIFORNIA 95616
*
 *  RUN DATE  03/12/93  TIME  10:39:37  *                                        *           (916) 551-1748
*
 *                                      *                                        *
*
 ****************************************
****************************************
```

ACDC AREA DRAINAGE MASTER STUDY
FILENAME: CCITY24.DAT
CUDIA CITY WASH WATERSHED
100-YEAR 24-HOUR DURATION STORM
SCS TYPE-II DISTRIBUTION WAS USED

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

    IT          HYDROGRAPH TIME DATA
                       NMIN          4  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1   0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        800  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      3   0  ENDING DATE
                     NDTIME       0516  ENDING TIME
                      ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL    0.07 HOURS
                      TOTAL TIME BASE   53.27 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
1
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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	S100	582.	12.07	72.	22.	10.	0.47		
+	ROUTED TO	RM100	564.	12.20	72.	22.	10.	0.47		
+	HYDROGRAPH AT	S101	631.	12.07	80.	23.	11.	0.64		
+	ROUTED TO	RM101	620.	12.20	80.	23.	11.	0.64		
+	HYDROGRAPH AT	S102	1160.	12.07	141.	44.	20.	0.91		
+	3 COMBINED AT	HC102	2226.	12.07	293.	89.	40.	2.01		
+	ROUTED TO	RM102	2207.	12.13	293.	89.	40.	2.01		
+	HYDROGRAPH AT	S103	694.	12.13	110.	32.	15.	0.80		
+	2 COMBINED AT	HC103	2901.	12.13	403.	121.	55.	2.81		
+	ROUTED TO	RM103	2854.	12.20	403.	121.	55.	2.81		

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+        HYDROGRAPH AT
                          S104      566.   12.07        70.        20.         9.       0.52
+        2 COMBINED AT
                          HC104     3325.   12.20       473.       141.        64.       3.33
+        ROUTED TO
                          RM104     3319.   12.27       473.       141.        64.       3.33
+        HYDROGRAPH AT
                          S105      497.   12.07        63.        20.         9.       0.40
+        2 COMBINED AT
                          HC105     3617.   12.20       536.       161.        73.       3.73
+        ROUTED TO
                          RM105     3593.   12.40       536.       161.        73.       3.73
+        HYDROGRAPH AT
                          S106      381.   12.13        61.        18.         8.       0.44
+        ROUTED TO
                          RM106      376.   12.53        61.        18.         8.       0.44
+        HYDROGRAPH AT
                          S107      796.   12.07        95.        28.        12.       0.64
+        3 COMBINED AT
                          HC107     4297.   12.33       692.       207.        93.       4.82
1
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SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
RM100	MANE	4.00	563.78	732.00	1.76	4.00	563.78	732.00	1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4392E+02 EXCESS=0.0000E+00 OUTFLOW=0.4389E+02 BASIN STORAGE=0.8251E-02 PERCENT ERROR= 0.0

RM101	MANE	4.00	620.48	732.00	1.36	4.00	620.48	732.00	1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4646E+02 EXCESS=0.0000E+00 OUTFLOW=0.4645E+02 BASIN STORAGE=0.3004E-02 PERCENT ERROR= 0.0

RM102	MANE	2.21	2210.61	727.68	1.65	4.00	2207.04	728.00	1.65

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1768E+03 EXCESS=0.0000E+00 OUTFLOW=0.1768E+03 BASIN STORAGE=0.2398E-03 PERCENT ERROR= 0.0

RM103	MANE	3.33	2858.30	731.86	1.61	4.00	2854.01	732.00	1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2408E+03 EXCESS=0.0000E+00 OUTFLOW=0.2407E+03 BASIN STORAGE=0.3956E-03 PERCENT ERROR= 0.0

RM104	MANE	4.00	3318.56	736.00	1.58	4.00	3318.56	736.00	1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2810E+03 EXCESS=0.0000E+00 OUTFLOW=0.2810E+03 BASIN STORAGE=0.4450E-03 PERCENT ERROR= 0.0

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RM105  MANE        4.00   3593.05    744.00      1.61      4.00   3593.05    744.00        1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3201E+03 EXCESS=0.0000E+00 OUTFLOW=0.3201E+03 BASIN STORAGE=0.6403E-03 PERCENT ERROR=   0.0

RM106  MANE        4.00    376.30    752.00      1.52      4.00    376.30    752.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3587E+02 EXCESS=0.0000E+00 OUTFLOW=0.3597E+02 BASIN STORAGE=0.1495E-02 PERCENT ERROR=  -0.3


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