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DRAINAGE STUDY AND CONCEPTUAL DESIGN

VICINITY OF 107th AVENUE, RID CANAL
TO BETHANY HOME ROAD

FCD 84 - 32

VOLUME I - REPORT

(Indian School Drain)

DOOLEY - JONES & ASSOCIATES, INC.
ANCHOR CENTRE TWO
2207 E. CAMELBACK ROAD PHX., AZ. 85016
(602) 956 - 9850 SUITE 302

AUGUST 14, 1985

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AUGUST 14, 1985

Registered Professional Engineer (Civil)
CERTIFICATE NO. 8411
EDWIN D. BAILEY
Date Signed 8-14-85
ARIZONA, U.S.A.

ENGINEERING DIVISION

TABLE OF CONTENTS

PAGE NO.

VOLUME I (included)

EXECUTIVE SUMMARY 1

INTRODUCTION 3

METHODOLOGY & PROCEDURES 6

ANALYSIS AND RESULTS 13

CONCEPTUAL DESIGN 24

CONCLUSIONS AND RECOMMENDATIONS 41

REFERENCES 43

APPENDIX A - Precipitation Adjustment

APPENDIX B - HEC-I Summary Tables

APPENDIX C - Hydraulic Computer Output

VOLUME II (Bound Separately)

HEC-I COMPUTER PRINTOUT

EXECUTIVE SUMMARY

A hydrologic evaluation of a subbasin of the Agua Fria River watershed, Maricopa County, Arizona, was performed. This subbasin is bounded by the Agua Fria River to the west, Bethany Home Road to the north, 91st Avenue to the east and the Roosevelt Irrigation District (RID) Channel to the south. The evaluation was based on a series of computer simulations using the HEC-1 model, a deterministic rainfall-runoff software system developed by the United States Army Corps of Engineers. The physical and topographic basis included 1984 aerial photographs and U.S.G.S. Quandrangle Maps.

The total basin area (6.81 square miles) was divided into nine (9) subbasins. Computations were performed using a time interval of five (5) minutes. Topographic, soil, vegetation, hydraulic, hydrologic and rainfall data were assembled in the HEC-I format.

Precipitation intensities were developed based on the Soil Conservation Service (SCS) Type II rainfall distribution.

Existing conditions and future conditions were analyzed. Flows were developed at key points for both the existing and future conditions. Acceptable flows were then developed based on proposed interim and ultimate structural improvements.

Conceptual design was then performed which provides general definition of proposed interim Phase I and ultimate Phase II structural improvements. Order of magnitude cost estimates were prepared for the proposed improvements.

Conclusions were discussed and recommendations made. It was recommended that interim Phase I improvements be constructed in 1985/86 at a projected cost of $467,700. Ultimate Phase II improvement construction was assumed to be required by 1995/96 at a projected cost of $427,330 (1985 dollars). It was recommended that actual plans for ultimate Phase II improvement construction be reviewed for timing and perhaps for phasing as actual development occurs.

INTRODUCTION

(a) Statement of The Problem

Continuing development east of the Agua Fria River is increasing drainage runoff for which there are insufficient outlets into the river.

The subject of this study is an area generally bounded by the Agua Fria River, Bethany Home Road, 91st Avenue and the Roosevelt Irrigation District Canal south of Indian School Road.

A drainage outlet is being developed adjacent to the north line of the RID Canal, from 107th Avenue to the river. This outlet is to have a capacity of 150 cfs.

This study addresses the determination of 100 year 1 hour flood flows and design concepts for outfall facilities which will accommodate flows in excess of the 150 cfs outfall planned for the RID alignment.

(b) Scope of Study

The study data base includes 1 inch to 1,200 feet aerial photos, U.S.G.S. topographic maps and available data from the District, adjacent municipalities, the Maricopa County Highway Department, Arizona Department of Transportation, private developers and field observations.

(b) Scope of Study (continued)

Analysis includes delineation of drainage area boundaries, determination of 100 year flows and identification of apparent outfall alignments. Hydrology is based on HEC-I Analysis, using U.S.D.A. Soil Conservation Service (SCS) Type II rainfall distribution. Future conditions are defined based on estimates of developed density, assumed 10 year, 2 hour on-site retention and general southwesterly flow patterns.

Design concepts include recommended facility development for the present conditions and for future conditions after estimated ultimate development.

The design concepts include typical cross-section, capacity, slope, general alignment and cost estimates.

Conclusions and recommendations summarize and discuss study results and recommend construction of interim Phase I and ultimate Phase II facility improvements with respect to time and cost.

(c) Site Location

A site location map is presented in Figure 1.

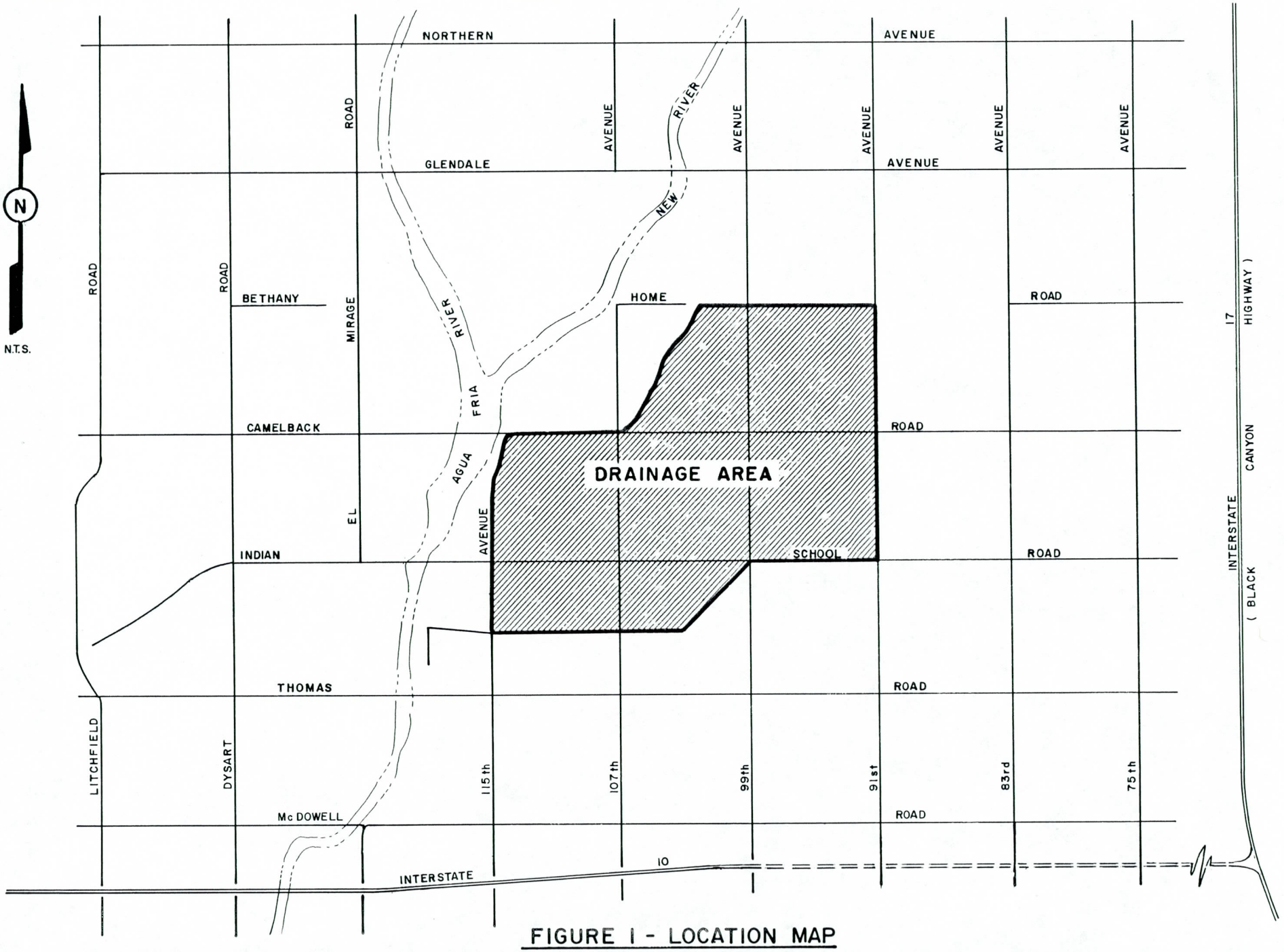


FIGURE 1 - LOCATION MAP

METHODOLOGY AND PROCEDURES

(a) Data Collection

Aerial photographs at a scale of 1 inch equals 1,200 feet, flown in December, 1984, were obtained.

Available United States Geological Survey Quadrangle Maps, at a scale of 1:24,000, with 5 foot contour intervals, were obtained.

Available data was obtained from the Flood Control District of Maricopa County, the Maricopa County Highway Department, the Arizona Department of Transportation, the City of Phoenix and the City of Glendale.

Contact was also made with the Salt River Project and the Roosevelt Irrigation District for available data.

Other data was obtained from engineering consultants involved with drainage studies and design of development projects in the area.

(b) Drainage Area Delineation

The drainage area was defined through analysis of existing data and conduction of a thorough field investigation.

Aerial photographs, U.S.G.S. Quadrangle Maps and other data were analyzed for initial definition of contributory area boundaries.

(b) Drainage Area Delineation (continued)

Field investigations were then performed for verification of assumptions based on available data: Physical locations were generally verified; General locations of irrigation ditches, culverts and permanent structures were recorded; Runoff coefficient factors were defined for each reach; Downstream conditions were examined for possible backwater effects which could influence the study area; Location of high water marks were recorded; Inquires were made about past flooding events; Visible existing conditions significant to the project were recorded.

Final drainage area boundaries were then established and have been indicated on Figures 2 through 5.

(c) Hydrology

Modeling Strategy:

The modeling strategy included performance of a series of simulations using a deterministic rainfall-runoff computational model. The U.S. Army Corps of Engineer's HEC-I model was used to simulate the surface runoff response of a watershed basin to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Each component models an aspect of the precipitation-runoff process within a portion of the basin, commonly referred to as a subbasin. A component may represent a surface runoff entity, a stream channel, or a detention/retention basin. Representation of a component

(c) Hydrology
Modeling Strategy: (continued)

requires a set of parameters which specify the particular characteristics of the component and mathematical relations which describe the physical processes. The result of the modeling process is the computation of streamflow hydrographs at desired locations in the watershed basin.

Regulatory Flow:
The regulatory flow as defined by The Flood Control District of Maricopa County is a flood generated by the 100 year 1 hour storm.

Precipitation Pattern:
SCS Type II distribution based on generalized rainfall depth-duration relationships obtained from Weather Bureau technical papers was used. Type II represents regions in which the high rates of runoff from small areas are usually generated from summer thunderstorms.

Type II distribution is arranged such that the greatest peak occurs near the middle of the rainfall duration. The second largest peak occurs in the next time interval and the third largest peak occurs in the preceeding interval.

Estimation of Direct Runoff from Storm Rainfall:
The SCS method of estimating direct runoff from storm rainfall was used. The SCS method was made to be usable for ungaged watersheds (not gaged for runoff) with rainfall and watershed data that are ordinarily available or easily obtainable for such watersheds. The CN Values and Impervious Percentages are summarized in Table I. Precipitation adjustment is included in Appendix A.

CN VALUE AND IMPERVIOUS PERCENTAGE

	CN		IMPERVIOUS	
AREA	PRESENT	FUTURE	PRESENT	FUTURE
1	81	86	35%	51%
2	72	88	4%	54%
3	85	85	48%	48%
4	72	88	4%	55%
5	71	89	2%	60%
6	80	85	29%	45%
7	71	89	2%	60%
8	71	89	2%	60%
9	71	89	2%	60%

TABLE I

(c) Hydrology (continued)

Kinematic Wave Method:

Rapid urbanization of river basins adjacent to metropolitan areas has forced land and water resources planners and hydrologists to develop a variety of methods for analyzing problems in urban hydrology. Problems involving both design and management decisions are often so complicated they require application of mathematical models. The mathematical models most commonly used rely on basic unit-graph techniques to model the application and distribution of precipitation, to compute rainfall losses and excesses, and determine subbasin outflow hydrographs. Although base models of a representative unit hydrograph are frequently applied and have been used successfully, it is difficult to associate physical properties of the basin to be modeled to the parameters necessary to develop a unit hydrograph.

It becomes even more difficult to define some of the parameters such as the Clark Tc and R or Snyder Ct and Cp for basins which have no recorded data. Because it is most important to develop the best representation of the actual urban runoff situation when analyzing storm water runoff problems, it would be desirable to relate runoff directly to measurable geographic features of the basin. It would also be desirable for the modeling technique to be able to reproduce nonlinear runoff characteristics rather than being limited to linear responses such as those developed by unit graph techniques.

The kinematic wave method of routing overland and river flows was chosen for several reasons. Although simple in form, kinematic wave theory alters the benefits of

(c) Hydrology

Kinematic Wave Method: (continued)

nonlinear response without needing an unduly complicated solution procedure. In addition, for the purpose of modeling unsteady overland flow, any model will require considerable parameter adjustment to account for the complexities of the basin and the specific flows which occur within the basin.

The kinematic waves occur when the dynamic terms in the momentum equations are negligible. This allows one to assume that the bed slope is approximately equal to the friction slope (So=Sf). Under these conditions and if there is no appreciable backwater effect, the discharge can be described as a function of depth of flow only, for all distance and time. The governing equation is: $Q = xy^m$; where, Q is discharge in cfs and x and m are kinematic wave routing parameters which are directly related to the shape of channel, the boundary roughness and the slope of the channel or overland flow surface.

There also have been several previous studies which have developed sets of appropriate values for these parameters for a large range of flow and boundary conditions. The kinematic wave approximation has been proven to be an accurate and efficient method of simulating stormwater runoff from small basins for both overland flow and stream channel routing.

Definition of Present and Future Conditions:

The present condition is defined as existing and specifically planned development.

(c) Hydrology

Definition of Present and Future Conditions: (continued)

The future condition is defined as total ultimate development in the area.

Retention Definition:

The retention volume defined for the future condition is the 10-year frequency 2 hour duration storm.

(d) Hydraulics

Channels were sized based on normal flow conditions. Culvert analysis was performed using conventional methodology for verification of flow types and identification of controlling flow. Rating curves were developed for affected structures when unequal flow split conditions applied. Computation was performed through use of the SESCAL hydraulic design program.

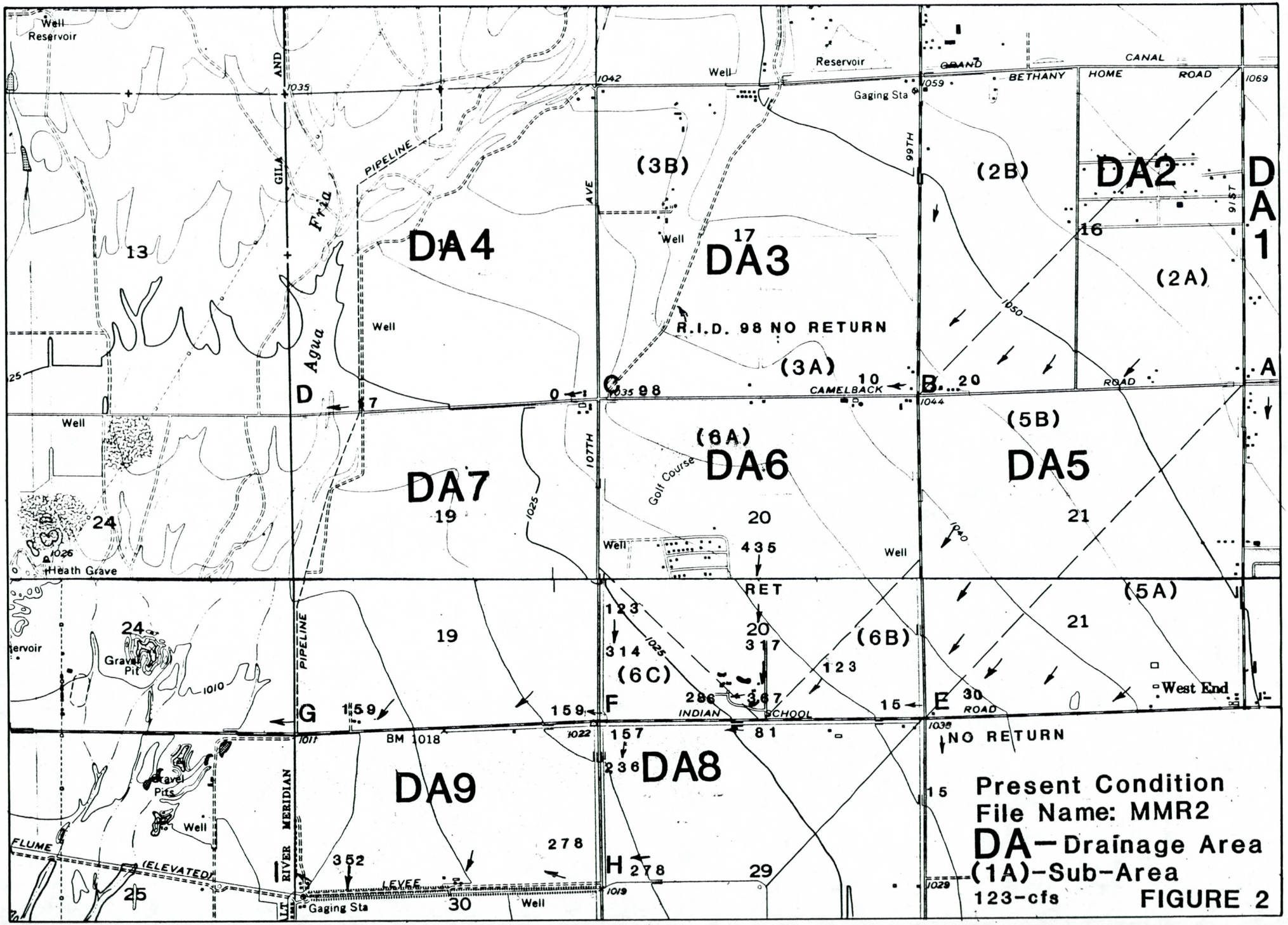
ANALYSIS AND RESULTS

The hydrologic analysis was performed based on the following assumptions: The northern hydrologic catchment limit is defined as the Grand Canal; Field investigation indicates that there will be little or no runoff from this study area flowing southerly to the I-10 Freeway Channel; Under the existing conditions, 91st Avenue will intercept flows from the east and divert them southerly toward Thomas Road.

(a) Present Condition (see Figure 2)

Under the existing condition, a 100 year 1 hour storm will generate 20 cfs from the 1.00 square mile Area 2 (bounded by Bethany Home Road, 91st Avenue, Camelback Road and 99th Avenue). This flow will concentrate at Point B (intersection of Camelback Road and 99th Avenue). Since Camelback Road and 99th Avenue are similar in width, slope and type of pavement, this flow will equally split to Camelback Road west and 99th Avenue south.

The 0.66 square mile Area 3 (bounded by Bethany Home Road, 99th Avenue, Camelback Road and the Roosevelt Irrigation District (RID) Channel), with 10 cfs carry over from Area 2, will generate 98 cfs at Point C (intersection of Camelback Road and 107th Avenue). Since the RID Channel has a capacity of 150 cfs for storm runoff, there will be no carry over to the West.


Present Condition
File Name: MMR2
DA—Drainage Area
(1A)-Sub-Area
123-cfs
FIGURE 2
DA1
DA2
DA3
DA4
DA5
DA6
DA7
DA8
DA9
(2A)
(2B)
(3A)
(3B)
(5A)
(5B)
(6A)
(6B)
(6C)
R.I.D. 98 NO RETURN
NO RETURN
RET
Gaging Sta
Reservoir
Well
Heath Grave
Gravel Pit
Gravel Pits
West End
Golf Course
BM 1018
GRAND CANAL
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
GILA AND RIVER MERIDIAN
Fria Agua
PIPELINE
FLUME (ELEVATED)
LEVEE
99TH AVE
107TH AVE
91ST

(a) Present Condition (continued)

The 1.06 square mile Area 4 (bounded by Bethany Home Road, the RID Channel, Camelback Road and the Agua Fria River) will generate 17 cfs at Point D (the intersection of Camelback Road and the RID Channel). This flow will continue westerly into the Agua Fria River.

The 1.00 square mile Area 5 with 10 cfs carryover from Area 2 will generate 30 cfs at Point E (intersection of 99th Avenue and Indian School Road). This flow will be equally split to Indian School Road West (toward concentration Point F) and 99th Avenue south (toward Thomas Road). This flow will not return to the study area.

The 0.88 square mile Area 6A and 6B, with 15 cfs carry over from Area 5, will generate 367 cfs at mid-point between points (E) and (F). Eighty-one (81) cfs will flow across Indian School Road and contribute to Area 8. The remaining 286 cfs will join flows from Area 6C (0.125 square miles) at Point F (intersection of 107th Avenue and Indian School) and produce a peak flow of 314 cfs. This flow will be equally split to Indian School Road west (toward the Agua Fria River) and 107th Avenue south (contributing to Area 8).

Of the total 0.95 square mile Area 7, only 0.58 square miles impacts on Indian School Road. The remaining area will drain into the Agua Fria River by sheet flow. The 0.58 square mile area, with 157 cfs

(a) Present Condition (continued)

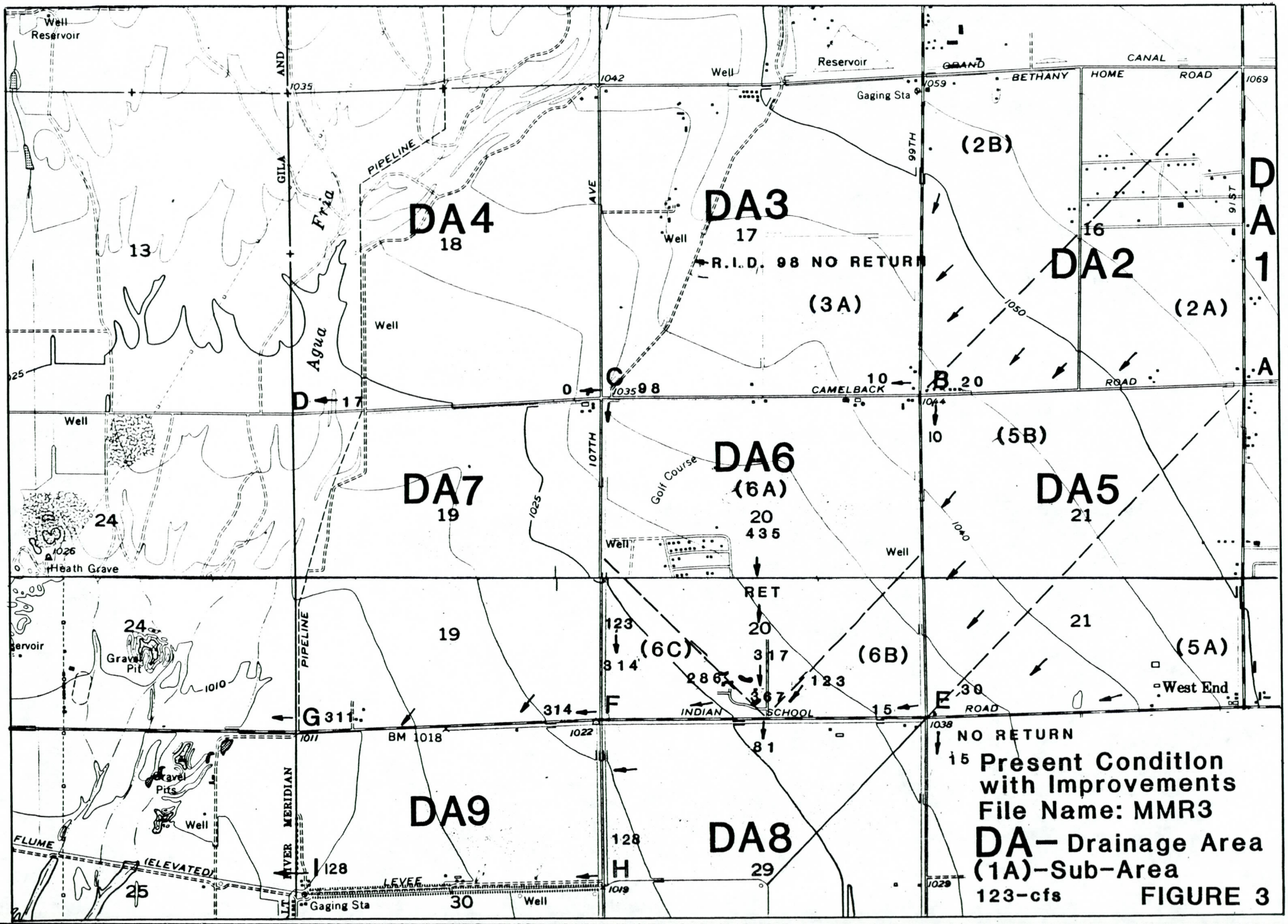
carry over from Area 6, will generate a flow of 159 cfs at Point F (107th Avenue and Indian School Road). This flow will discharge into the Agua Fria River at Point G.

The 0.30 square mile Area 8, with carryover from Area 6, will generate a flow of 236 cfs at Point H. This flow will carryover to Area 9.

Of the 0.62 square mile Area 9, only 0.30 square miles will impact on the south boundary. The remaining area will drain into the Agua Fria River by sheet flow. The 236 cfs carryover from Area 8 will join Area 9 to produce a peak flow of 352 cfs at Point I.

(b) Present Condition with Interim Improvements (see Figure 3)

Results from (a) Present Conditions show that no immediate action has to be taken at the intersection of 99th Avenue and Camelback Road, 107th Avenue and Camelback Road, or 99th Avenue and Indian School Road. Area 9 is under development with a planned channel north of the RID Channel to convey runoff from Area 8. This channel with a capacity of 150 cfs, is not included in the scope of this Study and Report. Improvements at the intersection of 107th Avenue and Indian School Road are needed to avoid excess flows onto the proposed development.


DA4
18
DA3
17
DA2
16
DA1
DA7
19
DA6
(6A)
20
DA5
21
DA9
DA8
29
30
13
24
25
(2B)
(2A)
(3A)
(5B)
(5A)
(6C)
(6B)
R.I.D. 98 NO RETURN
NO RETURN
Present Condition
with Improvements
File Name: MMR3
DA— Drainage Area
(1A)-Sub-Area
123-cfs
FIGURE 3
Well
Reservoir
Gaging Sta
Heath Grave
Gravel Pit
Gravel Pits
Golf Course
West End
BM 1018
GRAND CANAL
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
GILA AND RIVER MERIDIAN
Agua Fria PIPELINE
FLUME (ELEVATED)
LEVEE
99TH AVE
107TH AVE
91ST
1035
1042
1059
1069
1050
1044
1040
1038
1029
1025
1022
1019
1011
1010
1026
A
B
C
D
E
F
G
H
I
0
10
20
15
98
17
435
RET
123
314
286
367
317
81
311
128

(b) Present Condition with Interim Improvements (continued)

Model (b) is similar to Model (a) except that no flow split is allowed at the intersection of 107th Avenue and Indian School Road. Flows are presumed to proceed toward Indian School Road west to Point G, with a peak flow of 314 cfs discharging into the Agua Fria River. Under this situation only 81 cfs carryover from Area 6 will join Area 8 at Point H to produce a flow of 128 cfs. Since the flow from Area 9 will be retained on-site, the flow at Point I will remain at 128 cfs.

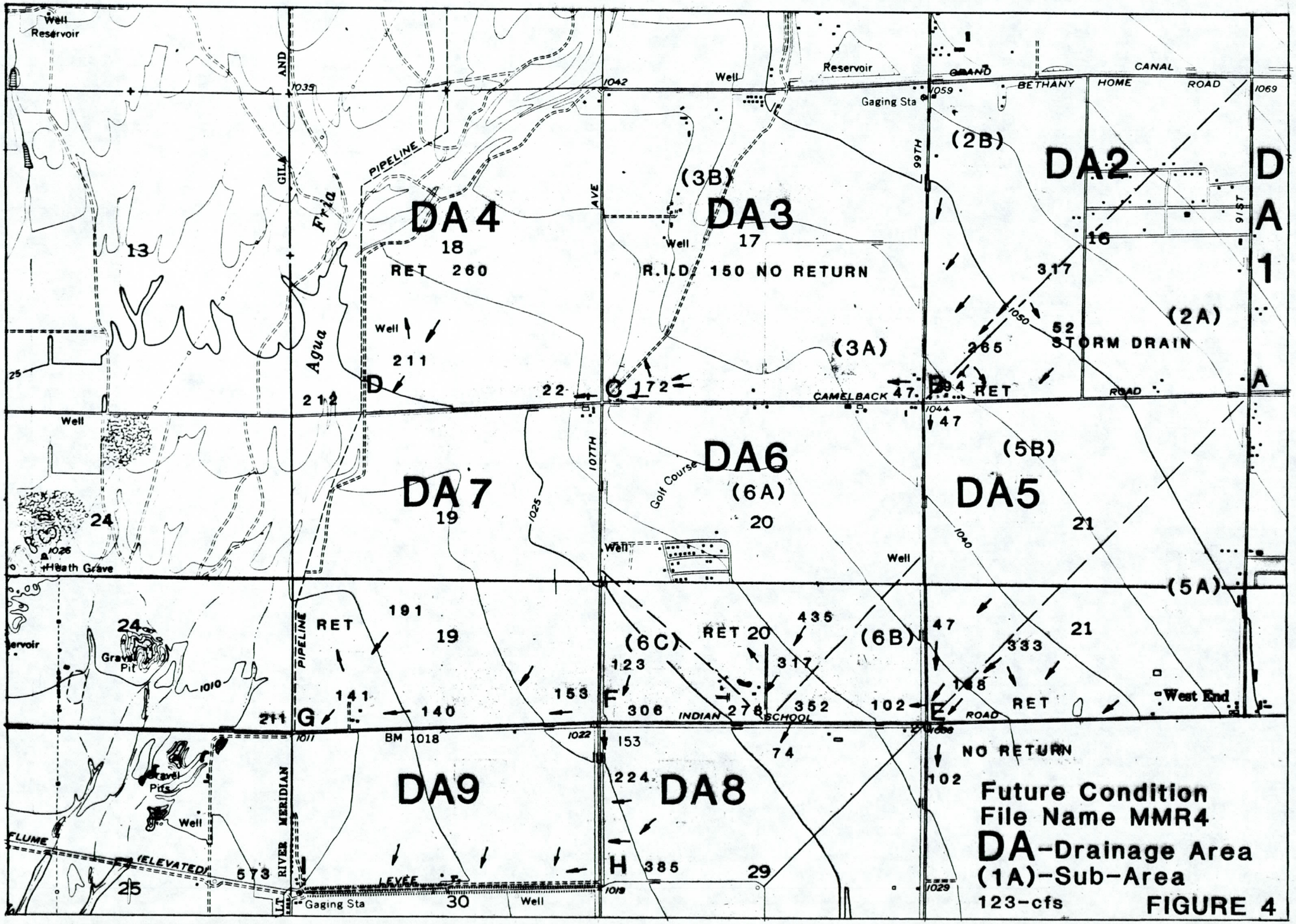
(c) Future Condition (see Figure 4)

Under the future condition, the 100 year 1 hour storm will generate 317 cfs from the 1.00 square mile Area 2 (bounded by Bethany Home Road, 91st Avenue, Camelback Road and 99th Avenue). With the proposed 52 cfs storm drain (by others) in Camelback Road, and retention requirement from Area 2, the peak flow of 317 cfs will be reduced to 94 cfs. This flow concentrates at Point B (intersection of Camelback Road and 99th Avenue). Since Camelback Road and 99th Avenue are similar in width, slope and type of pavement, this flow will equally split to Camelback Road west and 99th Avenue south.

The 0.66 square mile Area 3 (bounded by Bethany Home Road, 99th Avenue, Camelback Road and RID Channel), with 47 cfs carry over from Area 2, will generate 172 cfs at Point C (intersection of Camelback Road and 107th Avenue). Since the RID Channel has a capacity of 150 cfs for storm runoff, there will be a 22 cfs flow carry-over to the west in Camelback Road.

The 1.06 square mile Area 4 (bounded by Bethany Home Road, RID Channel, Camelback Road and the Agua Fria River), with 10 year, 2 hour retention, and with carry-over from Area 3, will produce 212 cfs and flow into the Agua Fria River.

The 1.00 square mile Area 5, with 47 cfs carry-over from Area 2 will generate 204 cfs at Point E (intersection of 99th Avenue and Indian School Road). This flow will be equally split to Indian School Road west (toward concentration Point F) and 99th Avenue south toward Thomas Road, with no return to the study area.


DA4
DA3
DA2
DA1
DA7
DA6
DA5
DA9
DA8
(1A)
(2A)
(2B)
(3A)
(3B)
(5A)
(5B)
(6A)
(6B)
(6C)
RET 260
R.I.D. 150 NO RETURN
STORM DRAIN
NO RETURN
Future Condition
File Name MMR4
DA-Drainage Area
(1A)-Sub-Area
123-cfs
FIGURE 4

(c) Future Condition (continued)

The 0.88 square mile Area 6A and 6B, with 102 cfs carry-over from Area 5, will generate 352 cfs at the mid-point between points (E) and (F). Seventy-four (74) cfs will flow south across Indian School Road contributing to Area 8. The remaining 278 cfs will join flows from Area 6C (0.125 square miles) at Point F (intersection of 107th Avenue and Indian School Road) to produce a peak flow of 306 cfs. This flow will be equally split to Indian School Road west (toward Agua Fria River) and 107th Avenue south, contributing to Area 8.

Of the 0.95 square mile Area 7 only 0.58 square miles impacts on Indian School Road. The remaining area will drain into the Agua Fria River by sheet flow. The 0.58 square mile area, with 10 year, 2 hour retention and with 211 cfs carry-over from Area 4 will produce a peak flow of 211 cfs and drain into the Agua Fria River at Point D.

The 0.30 square mile Area 8, with carry-over from Area 6, will produce a peak flow of 385 cfs at Point H. This flow will carry-over to Area 9.

Of the 0.62 square mile Area 9, only 0.30 square miles will impact on the south boundary. The remaining area will discharge into the Agua Fria River by sheet flow. The 385 cfs carry-over from Area 8 will join Area 9 to produce a peak flow of 573 cfs at Point I.

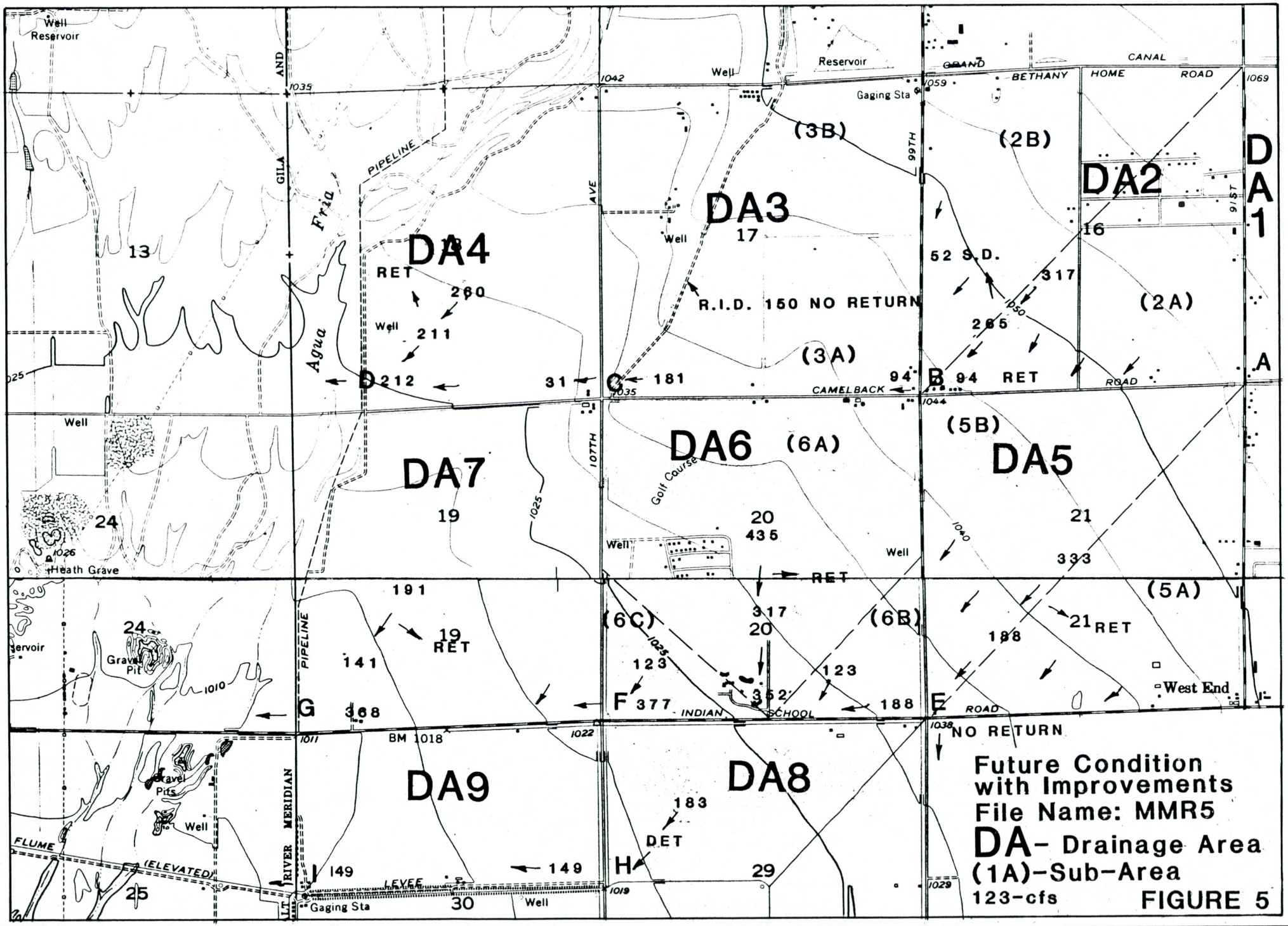
(d) Future Condition with Ultimate Improvements (see Figure 5)

Under the future condition, there would be substantial flooding at major intersections and roadways. A flow diverting scheme was developed based on: Proposed 99th Avenue Outer Loop Highway alignment by the Arizona Department of Transportation; Assumption of maximizing flow diversion to the Agua Fria River as quickly as possible, thereby minimizing the channel length; Assumption of minimizing structural inventory, including construction of culverts and channels.

Under these criteria, no flow splits at intersections are allowed and flows will be diverted through culverts discharging westerly toward the Agua Fria River.

A detention basin in Area 8 is assumed.

Under these assumed conditions, peak flows at concentration points are respectfully; 94 cfs at Point B, 31 cfs at Point C, 212 cfs at Point D, 188 cfs at Point E, 377 cfs at Point F, 368 cfs at Point G, and 149 cfs at Point H. Since all flow from Area 9 will be retained on-site, the peak flow at Point I will also be 149 cfs. This flow will discharge into the Agua Fria River.


DA1
DA2
DA3
DA4
DA5
DA6
DA7
DA8
DA9
(2A)
(2B)
(3A)
(3B)
(5A)
(5B)
(6A)
(6B)
(6C)
R.I.D. 150 NO RETURN
52 S.D.
317
265
94 RET
181
31
212
260
211
RET
19 RET
141
191
368
123
377
352
188
21 RET
333
435
20
317
183 DET
149
29
30
25
24
13
16
17
19
20
21
NO RETURN
Future Condition
with Improvements
File Name: MMR5
DA- Drainage Area
(1A)-Sub-Area
123-cfs
FIGURE 5
Well
Reservoir
Gaging Sta
Heath Grave
Gravel Pit
Gravel Pits
Golf Course
West End
BM 1018
GRAND CANAL
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
GILA AND RIVER MERIDIAN
Fria Agua PIPELINE
99TH AVE
107TH
FLUME (ELEVATED)
LEVEE

CONCEPTUAL DESIGN

Design concepts were developed for both the Present Condition with Interim Improvements, and for the Future Condition with Ultimate Improvements.

These concepts were developed for maximization of simplicity and for minimization of cost. The concepts relative to flows developed in the foregoing section.

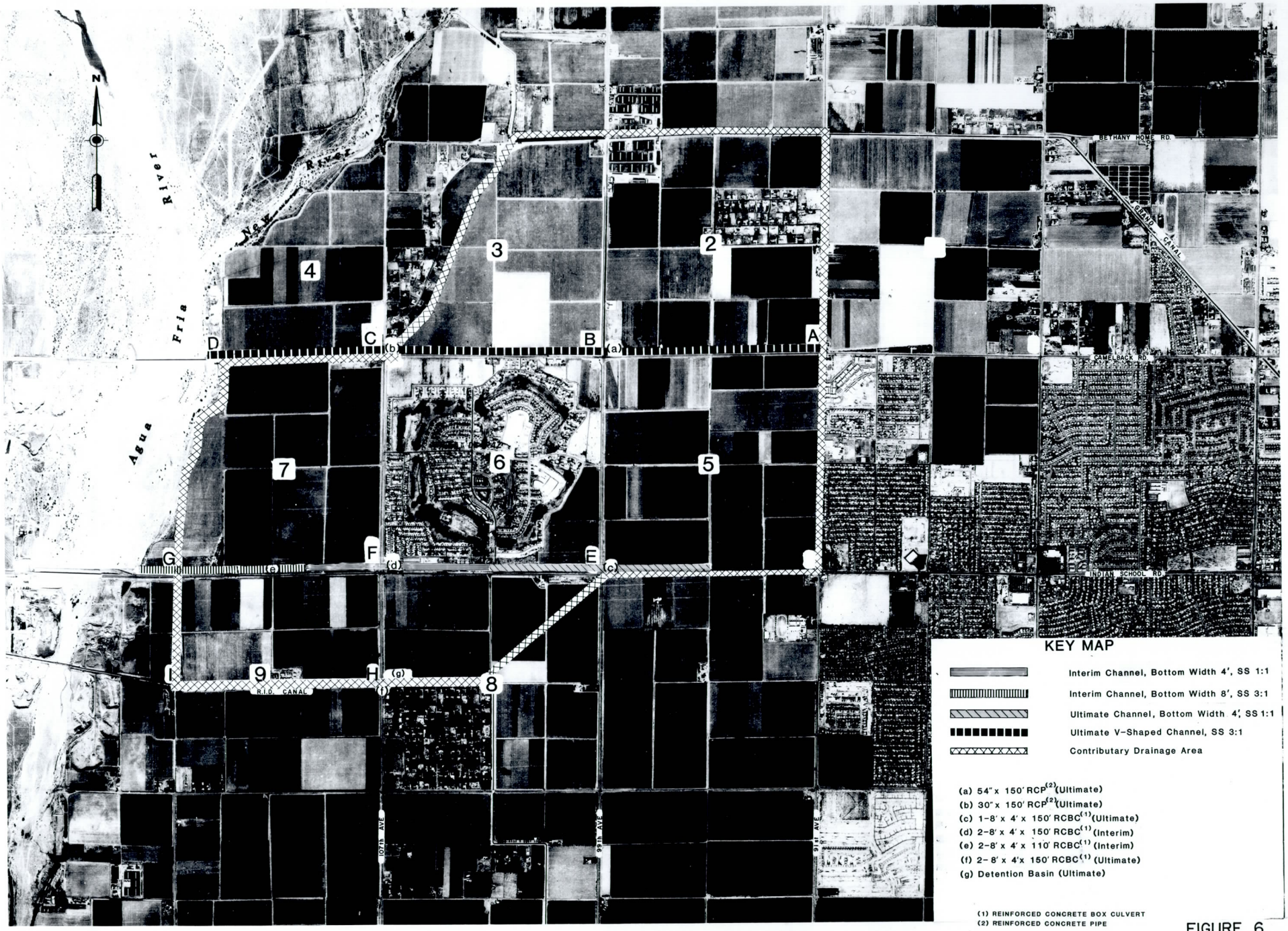
Interim Phase I design concept development was limited to the requirement for a maximum 150 cfs flow in the presently planned channel north of the RID channel, south of Indian School Road. These interim concept improvements will also alleviate problems in the existing Villa de Paz development and in areas south of Indian School Road.

Ultimate Phase II design concept development was based on providing flood protection for a future totally urbanized drainage area.

The design concepts include reinforced concrete box culverts, reinforced concrete pipe culverts and open drainage channels.

Figure 6 indicates the location and extent of both the interim and ultimate facility improvements.

Details of each of the design concepts are presented in the following paragraphs.


N
Agua Fria River
New River
BETHANY HOME RD.
BEELINE CANAL
CAMELBACK RD.
INDIAN SCHOOL RD.
R.I.D. CANAL
107th AVE.
99th AVE.
91st AVE.
A
B
C
D
E
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G
H
I
(a)
(b)
(c)
(d)
(e)
(f)
(g)
2
3
4
5
6
7
8
9
KEY MAP
Interim Channel, Bottom Width 4', SS 1:1
Interim Channel, Bottom Width 8', SS 3:1
Ultimate Channel, Bottom Width 4', SS 1:1
Ultimate V-Shaped Channel, SS 3:1
Contributary Drainage Area
(a) 54" x 150' RCP(2) (Ultimate)
(b) 30" x 150' RCP(2) (Ultimate)
(c) 1-8' x 4' x 150' RCBC(1) (Ultimate)
(d) 2-8' x 4' x 150' RCBC(1) (Interim)
(e) 2-8' x 4' x 110' RCBC(1) (Interim)
(f) 2-8' x 4' x 150' RCBC(1) (Ultimate)
(g) Detention Basin (Ultimate)
(1) REINFORCED CONCRETE BOX CULVERT
(2) REINFORCED CONCRETE PIPE

FIGURE 6

Conceptual Design (continued)

I. Interim Design Concepts (Phase I)

Phase I improvements include open channel construction along the north side of Indian School Road, from 103rd Avenue to the Aqua Fria River. Also included are reinforced concrete box culverts under 107th Avenue, 111th Avenue and under driveway crossings. The work will also include a drop structure connection to the existing 24 inch underground pipe at 115th Avenue.

(a) 103rd Avenue to a point 1800 feet west of 107th Avenue

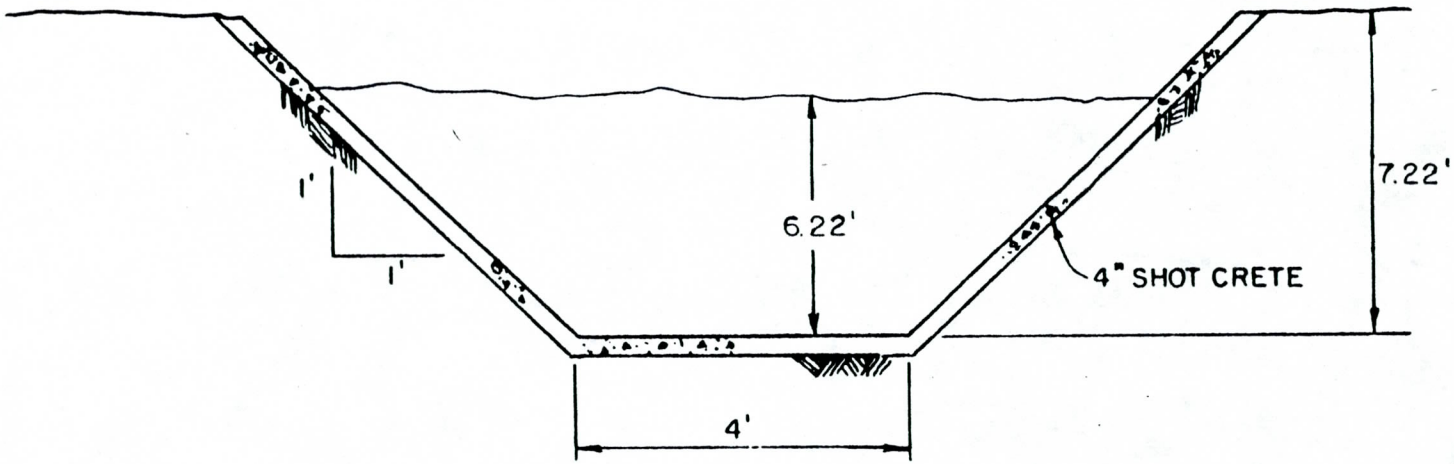
A shotcrete lined channel of 6.86 feet depth, 4 feet bottom width and 1:1 side slopes was selected for construction along this reach. This channel, with 0.0015 ft/ft slope will have a capacity of 377 cfs at a velocity of 5.93 fps and a water depth of 5.86 feet. Details of this concept are shown in Figure 7.

(b) Aqua Fria River to a point 1,800 feet west of 107th Avenue

An unlined channel of 5.25 feet depth, 8 feet bottom width and 3:1 side slopes was selected for this reach which includes a drainage easement in addition to the Indian School Road right of way. This channel, with 0.0015 ft/ft slope will have a capacity of 377 cfs at a velocity of 4.28 fps and a water depth of 4.25 feet. The channel will terminate at the Aqua Fria River with a shotcrete lined section and a drop structure into the existing 24 inch underground pipe. Figure 8 includes details of this concept.

TYPICAL TRAPEZOIDAL CHANNEL

INDIAN SCHOOL ROAD



Q_{100} = 377 cfs

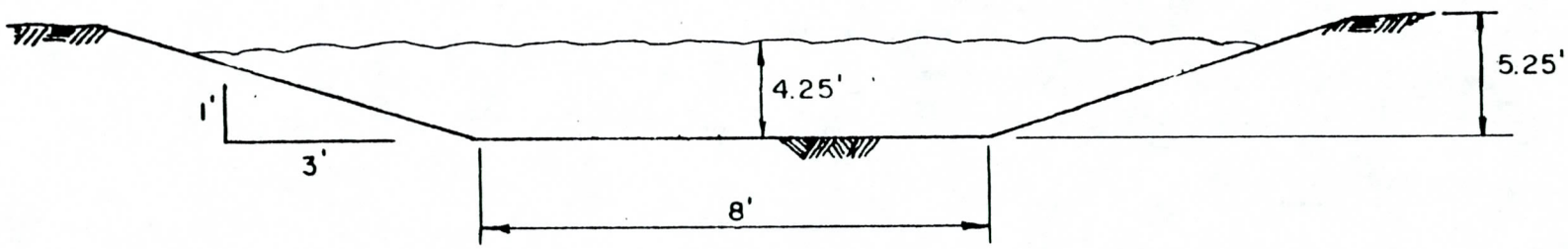
V = 5.93 fps

INTERIM PHASE I FACILITY - 103rd AVE TO A POINT 1,800 FEET WEST OF 107th AVE.

ULTIMATE PHASE II FACILITY - 95th AVE TO 103rd AVE.

FIGURE 7

TYPICAL TRAPEZOIDAL CHANNEL
INDIAN SCHOOL ROAD



Q_{100} = 377 cfs
V = 4.28 fps

INTERIM PHASE I FACILITY – AGUA FRIA RIVER TO A POINT 1,800 FEET WEST OF 107th AVE.

FIGURE 8

Dooley-Jones & Associates, Inc.
CONSULTING ENGINEERS | PLANNERS

CULVERT COMPUTATION RECORD

SHT. ___ OF ___

PROJECT: FCDMC
JOB NO: 2-84-172-10
STATION: INTERSECTION OF 107th AVE. AND INDIAN SCHOOL ROAD

DESIGNER: S.E.S.
CK. BY: ___
DATE: 8-8-85

HYDROLOGIC AND CHANNEL INFORMATION

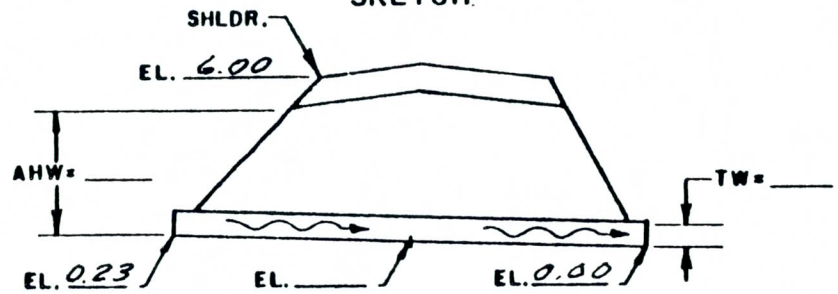
DRAINAGE AREA ___

Q_1 = 377 C.F.S. Q
Q_2 = 189 C.F.S. Q/3

TW_1 = ___
TW_2 = ___

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = 0.15% L = ___ L/100 S_0 = 0.23
MEAN STREAM VELOCITY = ___

CULVERT DESCRIPTION		Q	CAP. CHART HW	HEADWATER COMPUTATION										CONTROL HW	OUTLET VELOCITY	DEPTH IN CULVERT	DHW ELEV.	COMMENTS
				INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$												
SIZE	ENTR. TYPE			HW/D	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_0	LS_0	HW					
8'x4'	R.C.B.C.	189		1.1	4.4	0.50	0.9	2.58	3.29	—	3.29	0.23	3.96	4.4	6.73	3.50	4.63	

SUMMARY & RECOMMENDATIONS
2 BARREL - 8'x4' R.C.B.C.
INTERIM PHASE I FACILITY

FIGURE 9

(c) 107th Avenue and Indian School Road

Due to the complexity of existing underground utilities, two alternatives for conveyance of flow under 107th Avenue were investigated.

(i) Traditional Culverts

Traditional culverts are proposed under the assumption that underground utilities from zero to six feet deep can be either relocated or siphoned. Under these conditions, a straight culvert can be constructed under 107th Avenue and above the existing R.I.D. culvert which is approximately 6 to 12 feet below ground.

A 2 barrel, 8'x4'x150' reinforced concrete box culvert (RCBC) was selected for this case. The culvert with 0.0015 ft/ft slope, will have a capacity of 377 cfs at design head of 4.56 feet above the inlet invert. Open channel flow will predominate with a water depth of 3.5 feet and a velocity of 6.73 fps. Since the channels will be lined, no special outlet protection is required. However, appropriate wingwalls and headwalls should be provided in order to achieve a smooth transition to the channel. Details of this concept are shown in Figure 9.

A 3 barrel, 8'x3'x150' RCBC was selected as a substitution for the proposed 2 barrel, 8'x4'x150' RCBC, if the vertical clearance has to be reduced. Under these conditions, the head water will be increased to 4.63 feet above the inlet invert. The culvert will be under pressure flow with an outlet velocity of 5.24 fps.

(ii) Inverted Siphon

If relocation of the existing utilities becomes too costly or time consuming, an inverted siphon may be the solution.

Conceptual Design (continued)

The term, inverted siphon, is applied to a pressure conduit carrying a flow across a vertical depression. A two barrel, 6'x6'x180' reinforced concrete depressed culvert (RCDC) was selected for this alternative. The depressed culvert will have a design head of 6.1 feet above the inlet invert. The outlet velocity will be 6.65 fps.

(d) 111th Avenue and Indian School Road

A 2 barrel, 8'x4'x110' RCBC was selected for construction at this location. The culvert, with 0.0015 ft/ft slope will have the same hydraulic performance as the proposed 2 barrel, 8'x4'x150' RCBC at 107th and Indian School Road. (See Figure 9)

II. Ultimate Design Concepts (Phase II)

Phase II improvements include open channel construction along the north side of Camelback Road from 95th Avenue to the Agua Fria River, and along the north side of Indian School Road from 95th Avenue to 103rd Avenue. Also included are reinforced concrete pipe culverts in Camelback Road under 95th, 99th, 103rd, 107th and 111th Avenues. Reinforced concrete box culverts are included in Indian School Road under 95th, 99th and 103rd Avenues. RCBC construction is also included under 107th Avenue along a prolongation of Osborn Road with discharge into the proposed channel north of the RID canal. Also included is a detention basin within Area 8, northeast of 107th Avenue and the Osborn Road prolongation.

(a) Camelback Road, 95th Avenue to the Agua Fria River

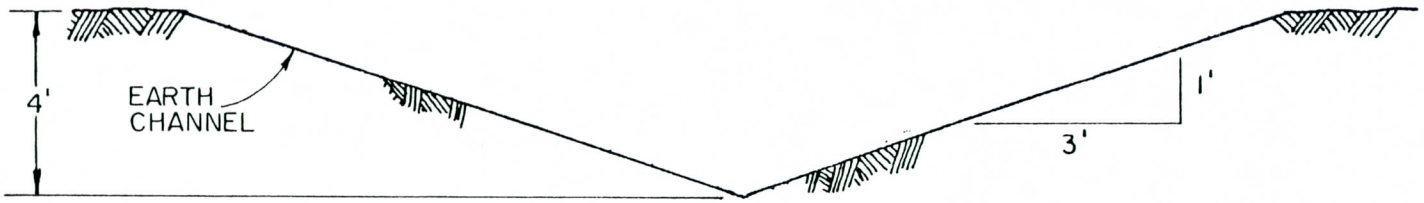
A V-shaped earth channel of 4.00 feet depth and 3:1 side slopes was selected for construction along the north side of this reach. The maximum velocity in the earth channel will be 2.95 fps with a slope of 0.0015 ft/ft and a capacity of 142 cfs. See Figure 10 for concept details. Small reaches of this channel east of the river and east of 107th Avenue will be lined to accomodate up to 212 cfs at 4.41 fps.

(b) Camelback Road Culverts

A 54" x 150' reinforced concrete pipe (RCP) was selected for construction north of Camelback Road under 99th Avenue. Similar culverts should also be constructed at 95th Avenue and at 103rd Avenue. The culvert, with 0.0015 ft/ft slope, will have a design capacity of 94 cfs at design head of 4.68 feet above the inlet invert. The outlet velocity will be 5.91 fps. No outlet protection will be required. However, appropriate ADOT standard wingwalls and apron should be provided. See Figure 11 for details of this concept.

TYPICAL V CHANNEL

CAMELBACK ROAD



LINED	EARTH
Q_{100} = 212 cfs	Q_{100} = 141cfs
V = 4.41 fps	V = 2.94 fps

ULTIMATE PHASE II FACILITY – 95th AVE TO AGUA FRIA RIVER.

(SMALL REACHES TO BE LINED EAST OF RIVER AND EAST OF 107th AVE)

FIGURE 10

Dooley-Jones & Associates, Inc.
CONSULTING ENGINEERS | PLANNERS

CULVERT COMPUTATION RECORD

SHT. ___ OF ___

PROJECT: FCDMC
JOB NO: 2-84-172-10
STATION: INTERSECTION OF 99th AVE. AND CAMELBACK ROAD

DESIGNER: S.E.S.
CK. BY: ___
DATE: 8-8-85

HYDROLOGIC AND CHANNEL INFORMATION

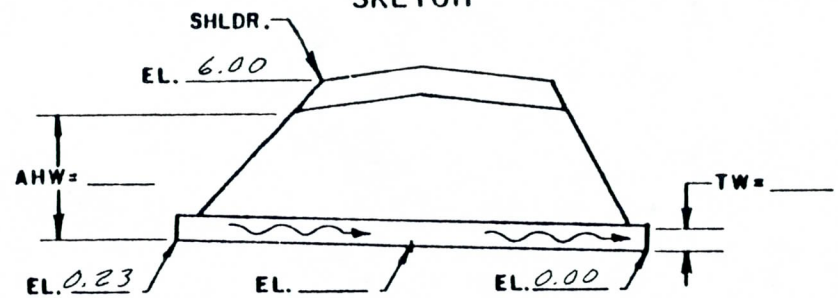
DRAINAGE AREA ___

Q_1 = 94 C.F.S.
Q_2 = ___

TW_1 = ___
TW_2 = ___

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = 0.15% L = 150 FT. L/100 S_0 = 0.23
MEAN STREAM VELOCITY = ___

CULVERT DESCRIPTION		Q	CAP. CHART HW	HEADWATER COMPUTATION										CONTROL HW	OUTLET VELOCITY	DEPTH IN CULVERT	DHW ELEV.	COMMENTS
				INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$												
SIZE	ENTR. TYPE			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_0	LS_0	HW					
54"	R.C.P.	94		1.0	4.5	0.5	1.1	2.85	3.68	–	3.68	0.23	4.55	4.55	5.91	4.5'	4.78	

SUMMARY & RECOMMENDATIONS
1 - 54" R.C.P.

ULTIMATE PHASE II FACILITY

FIGURE 11

Dooley-Jones & Associates, Inc.
CONSULTING ENGINEERS | PLANNERS

CULVERT COMPUTATION RECORD

SHT. ___ OF ___

PROJECT: FCDMC
JOB NO: 2-84-172-10
STATION: INTERSECTION OF 107th AVE. AND CAMELBACK ROAD

DESIGNER: S.E.S.
CK. BY:
DATE: 8-8-85

HYDROLOGIC AND CHANNEL INFORMATION

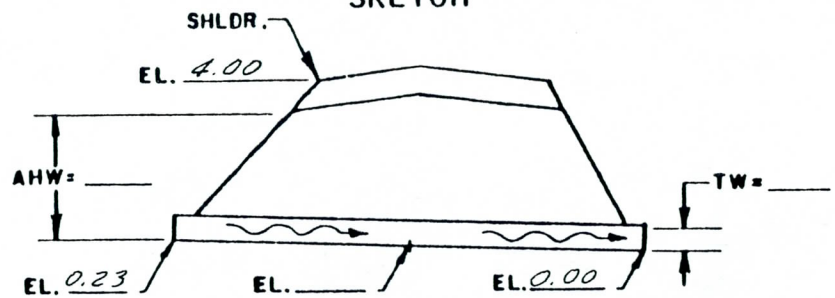
DRAINAGE AREA _____

Q_1 = 31 C.F.S.
Q_2 = _____

TW_1 = _____
TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = 0.15% L = _____ L/100 S_0 = 0.23
MEAN STREAM VELOCITY = _____

CULVERT DESCRIPTION		Q	CAP. CHART HW	HEADWATER COMPUTATION										CONTROL HW	OUTLET VELOCITY	DEPTH IN CULVERT	DHW ELEV.	COMMENTS
				INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$												
SIZE	ENTR. TYPE			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_0	LS_0	HW					
30"	R.C.P.	31		1.3	3.25	0.5	1.7	1.90	2.20	–	2.20	0.23	3.67	3.67	6.32	2.50'	3.90	

SUMMARY & RECOMMENDATIONS
1- 30" R.C.P.
ULTIMATE PHASE II FACILITY

FIGURE 12

Dooley-Jones & Associates, Inc.
CONSULTING ENGINEERS | PLANNERS

CULVERT COMPUTATION RECORD

SHT.___ OF___

PROJECT: F.C.D.M.C.
JOB NO: 2-84-172-10
STATION: INTERSECTION 99th AVE. AND INDIAN SCHOOL ROAD

DESIGNER: S.E.S.
CK. BY: ___
DATE: 8-8-85

HYDROLOGIC AND CHANNEL INFORMATION

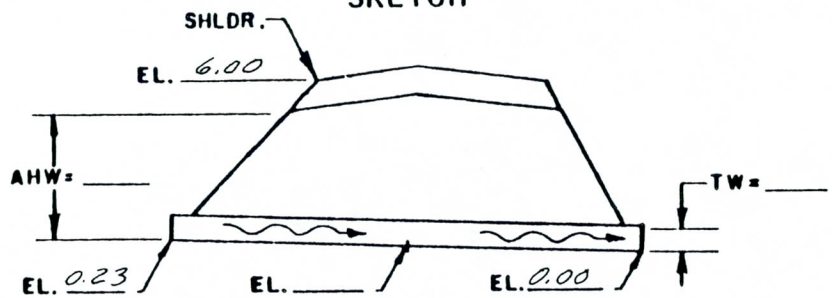
DRAINAGE AREA ___

Q_1 = 188 C.F.S. Q
Q_2 = ___

TW_1 = ___
TW_2 = ___

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = 0.15% L = 150 L/100 S_0 = 0.23

MEAN STREAM VELOCITY = ___

HEADWATER COMPUTATION

CULVERT DESCRIPTION		Q	CAP. CHART HW	INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$								CONTROL HW	OUTLET VELOCITY	DEPTH IN CULVERT	DHW ELEV.	COMMENTS
SIZE	ENTR. TYPE			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_0	LS_0	HW					
8'x4'	R.C.B.C.	188		1.1	4.4	0.50	0.9	2.58	3.29	–	3.29	0.23	3.96	4.4	6.73	3.50	4.63	

SUMMARY & RECOMMENDATIONS

1 - 8'x4' R.C.B.C.

ULTIMATE PHASE II FACILITY

FIGURE 13

Ultimate Design Concepts (Phase II) (continued)

A 30" x 150' RCP was selected for construction north of Camelback Road, under 107th Avenue. A similar culvert will also be required at 111th Avenue. The culvert, with 0.0015 ft/ft slope, will have a design capacity of 31 cfs at a design head of 3.76 feet above the inlet invert. The outlet velocity is 6.32 fps. See Figure 12 for details of this concept. ADOT or MAG standard wingwalls and apron should be provided.

(c) Indian School Road, 95th Avenue to 103rd Avenue

A shotcrete lined channel similar to Interim Concept I (a) was selected for construction north of Indian School Road. This 4 feet bottom width, 1:1 side slope, 6.86 feet deep channel will have a capacity of 377 cfs with a velocity of 5.93 fps.

(d) An 8' x 4' x 150' RCBC was selected for construction north of Indian School Road, under 99th Avenue. Similar culverts should also be provided at 95th Avenue and at 103rd Avenue. The culvert, with 0.0015 ft/ft slope will have a design capacity of 188 cfs at a design head of 4.08 feet above the inlet invert. The outlet velocity is 6.73 fps. Figure 13 indicates details of this concept. Outlet protection will not be required. However, ADOT standard wingwalls and apron should be provided.

(e) Culvert Under 107th Avenue at Osborn Road Prolongation

An 8' x 4' x 150' RCBC was selected for construction at this location. The culvert will have a capacity of 149 cfs at a velocity of 8.43 fps with a design head of 3.90 feet above the inlet invert. Details of this concept are included in Figure 14.

Dooley-Jones & Associates, Inc.
CONSULTING ENGINEERS / PLANNERS

CULVERT COMPUTATION RECORD

SHT. ___ OF ___

PROJECT: FCDMC
JOB NO: 2-84-172-10
STATION: 107th AVE AT RID CANAL

DESIGNER: E.D.B.
CK. BY: ___
DATE: 8-8-85

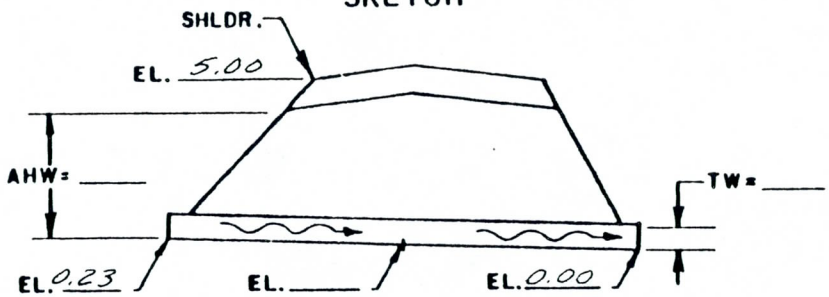
HYDROLOGIC AND CHANNEL INFORMATION

DRAINAGE AREA ___

Q_1 = ___ TW_1 = ___
Q_2 = 149 TW_2 = ___

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50})

SKETCH



S_0 = 0.15 % L = 150 L/100 S_0 = 0.23
MEAN STREAM VELOCITY = ___

HEADWATER COMPUTATION

CULVERT DESCRIPTION		Q	CAP. CHART HW	INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$								CONTROL HW	OUTLET VELOCITY	DEPTH IN CULVERT	DHW ELEV.	COMMENTS
SIZE	ENTR. TYPE			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c + D}{2}$	TW	h_0	LS_0	HW					
8x4'	R.C.B.C.	149		0.98	3.90	0.50	0.95	2.21	3.11	–	3.11	0.23	3.83	3.90	6.32	2.95	4.13	

SUMMARY & RECOMMENDATIONS
1 BARREL 8'x4' R.C.B.C.
ULTIMATE PHASE II FACILITY

FIGURE 14

Ultimate Design Concepts (Phase II) (continued)

(f) A detention basin was selected for construction in Area 8. This facility with 3 feet depth and a 8 acre-feet storage will regulate outflow peak into Area 9. The flow will be limited to 150 cfs. This facility is proposed for construction by the developer of Area 8.

(g) Spillways are proposed at confluences of drainage channels with Agua Fria River because soil cement bank protection is provided along bridge embankments. Since discharge from the drainage channels is small compared to the Agua Fria River flows, energy dissipation structures are not required.

III. Order of Magnitude Cost Estimates (1985 dollars)

DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
INTERIM PHASE I FACILITIES				
Utility Relocation/Siphon (107th)		L.S.		$ 67,500
2 bbl. 8'x4' RCBC(107th)	150	L.F.	$400.00	60,000
2 bbl. 8'x4' RCBC(111th)	110	L.F.	400.00	44,000
2 bbl. 8'x4' RCBC (drives)	108	L.F.	400.00	43,200
Channel Excavation	31,000	C.Y.	2.00	62,000
Lining	11,000	S.Y.	16.00	176,000
Drop Structure(115th)		L.S.		15,000
SUB-TOTAL				$467,700
ULTIMATE PHASE II FACILITIES				
54" RCP (99th/Camelback)	150	L.F.	$ 75.00	$ 11,250
54" RCP (95th/Camelback)	110	L.F.	75.00	8,250
54" RCP (103rd/Camelback)	110	L.F.	75.00	8,250
54" RCP (drives/Camelback)	108	L.F.	75.00	8,100
30" RCP (107th/Camelback)	150	L.F.	45.00	6,750
30" RCP (111th/Camelback)	110	L.F.	45.00	4,950
30" RCP (drives/Camelback)	36	L.F.	45.00	1,620
8'x4' RCBC (99th/Ind.School)	150	L.F.	230.00	34,500
8'x4' RCBC (95th/Ind.School)	110	L.F.	230.00	25,300
8'x4' RCBC (103rd/Ind.School)	110	L.F.	230.00	25,300
8'x4' RCBC (drives/Ind.School)	72	L.F.	230.00	16,560
8'x4' RCBC(107th/RID)	150	L.F.	230.00	34,500
Channel Excavation	25,000	C.Y.	2.00	50,000
Lining	12,000	S.Y.	16.00	192,000
SUB-TOTAL				$427,330
TOTAL				$895,030

CONCLUSIONS AND RECOMMENDATIONS

In order to allow presently planned developments in the area to proceed, it is necessary that certain improvements be implemented.

One of these improvements involves construction of a channel north of the RID Channel from 107th Avenue westerly to the Agua Fria River. Implementation of this facility is being arranged separately by the FCDMC. It is not included in the scope of this study.

The other necessary improvements have been defined as Interim Phase I Design Concepts in this study. These facilities involve box culverts and a channel north of Indian School Road from 103rd Avenue to the Agua Fria River. The 1985 cost of these Interim Improvements is estimated at $467,700.

It is recommended that implementation proceed immediately on these Interim Phase I Improvements.

Continued additional development in the area will require implementation of additional improvements.

Ultimate Phase II Design Concepts have been defined in this study based on assumed ultimate urbanization of the area. These facilities involve box culverts and a channel north of Indian School Road from 95th Avenue to 103rd Avenue. Also involved are pipe culverts, box culverts and a channel north of Camelback Road from 95th Avenue to the Agua Fria River. Other facilities include a detention basin northeast of 107th avenue and the prolongation of Osborn Road, and also a box culvert at this intersection.

Estimated cost, in 1985 dollars, for these facilities is $427,330.

Conclusions and Recommendations (continued)

Implementation timing requirements for these Ultimate Phase II Improvements will depend upon the location, extent and timing of future development in the area. It is possible that improvements under 99th Avenue may be implemented with the Outer Loop Highway construction, unless they are required sooner. It is probable that parts of the Ultimate Phase II Improvements will be required within three(3) years and that most will be required within ten (10) years.

It is recommended that implementation planning proceed for a phased Ultimate Phase II Improvement Program with respect to timing as determined from planned development.

REFERENCES

1. HEC-I, Flood Hydrograph Package, Users Manual, January, 1985, U.S. Army Corps of Engineers.

2. Introduction and Application of Kinematic Wave Routing Techniques Using HEC-I, Training Document No. 10, May, 1979, U.S. Army Corps of Engineers.

3. SESCAL, Computational Hydraulic Design, Users Manual, May, 1985, by Shi-En Shiau.

4. Hydrology, An Advanced Introduction to Hydrological Processes and Modeling, January, 1978 by A.J. Raudkivi.

5. U.S.G.S. Quadrangle, Glendale, AZ 1974.

6. U.S.G.S. Quadrangle, Fowler, AZ 1982.

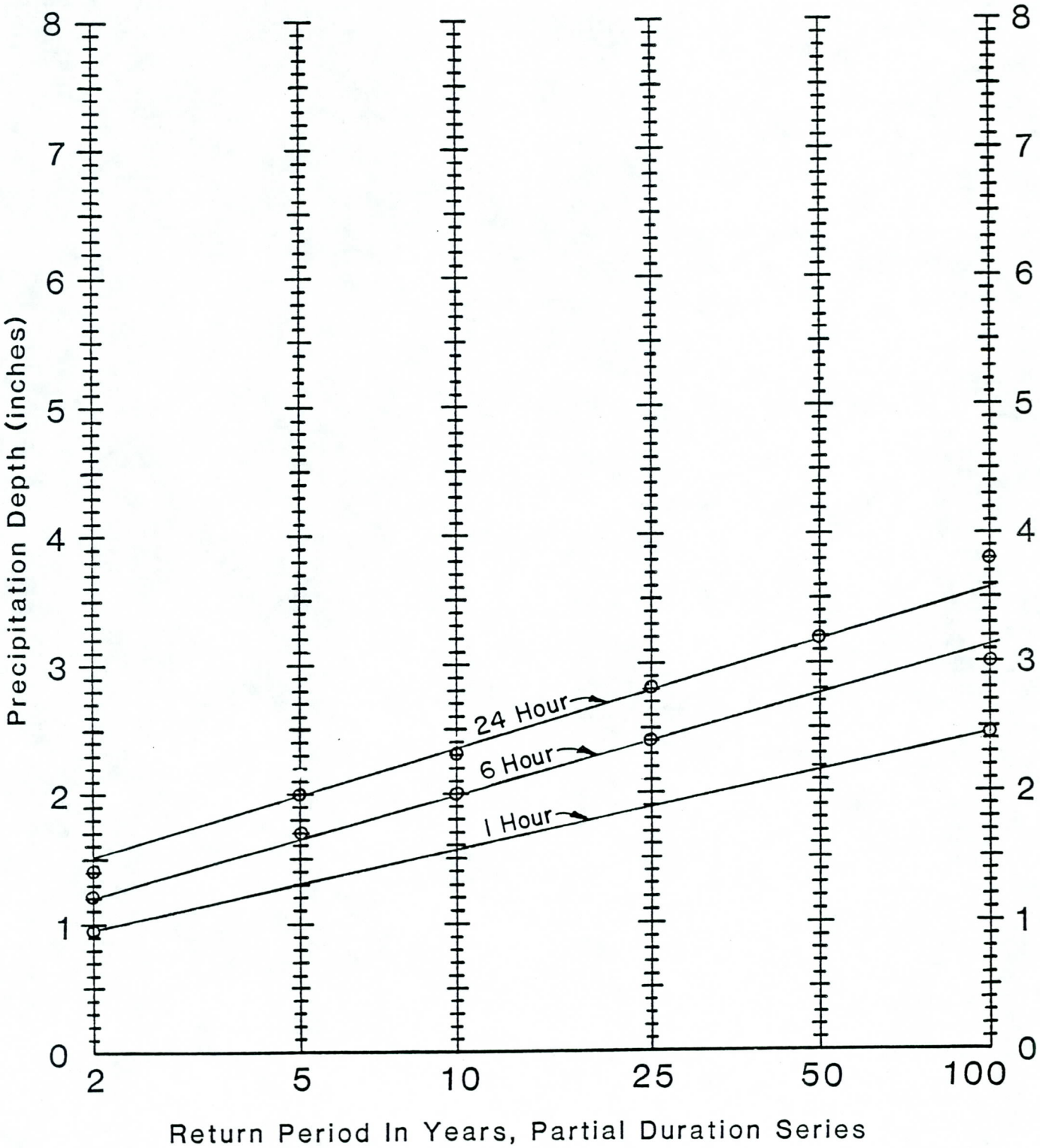
7. U.S.G.S. Quadrangle, El Mirage, AZ 1974.

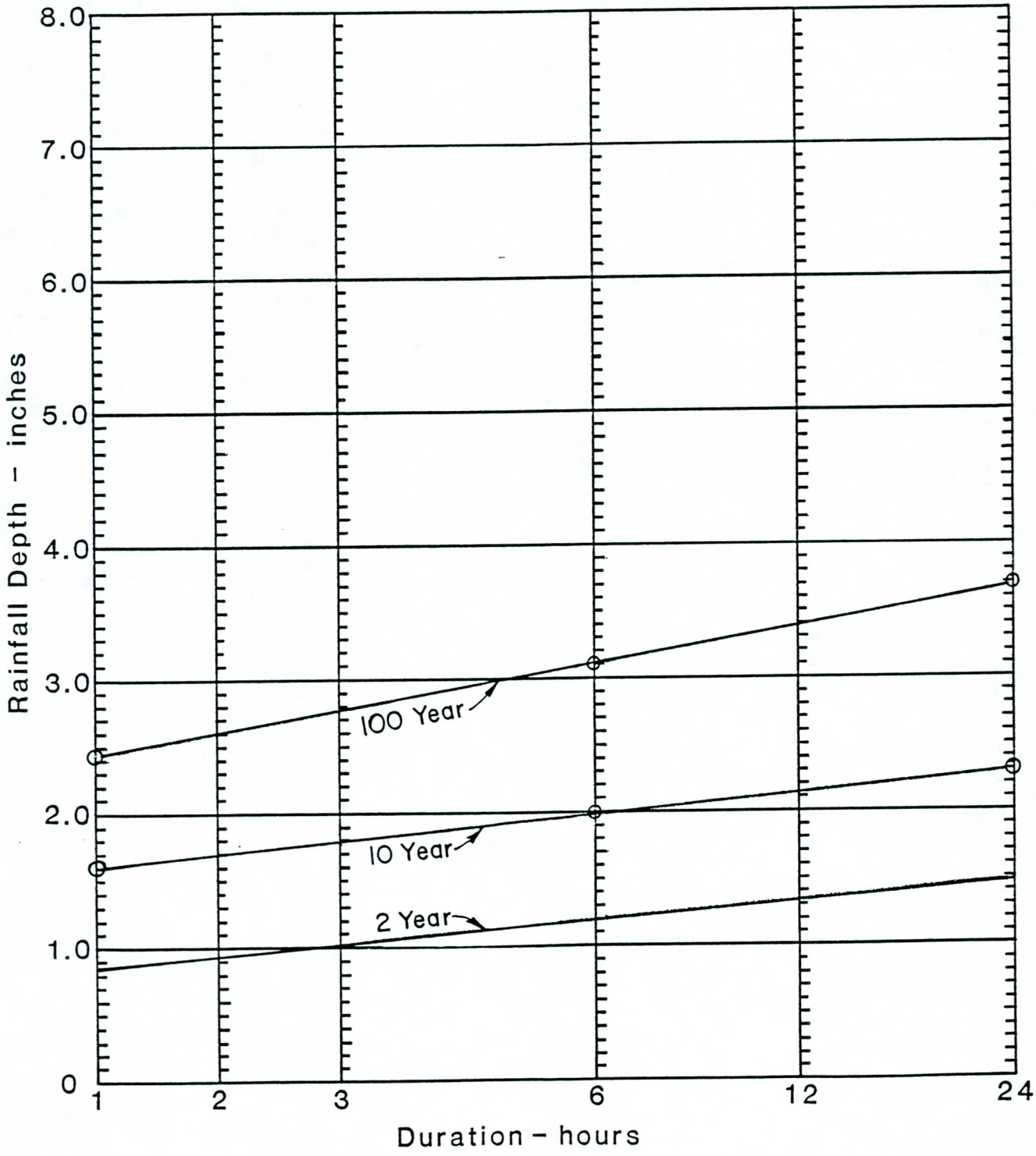
8. U.S.G.S. Quadrangle, Tolleson, AZ 1971.

APPENDIX A

Precipitation Adjustment

Return Period (Years)	Precipitation Values (Inches)					
	6 Hour Duration		24 Hour Duration		1 Hr.	2 Hr.
	Map Value	Corrected Value	Map Value	Corrected Value	Calcs & Chart	Calcs & Chart
2	1.2	1.22	1.4	1.4	0.96	1.0
5	1.7	1.70	2.0	1.95		
10	2.0	2.00	2.3	2.31	1.56	1.7
25	2.4	2.40	2.8	2.80		
50	2.8	2.75	3.2	3.25		
100	3.0	3.10	3.8	3.70	2.45	2.6


Precipitation Depth (inches)
0
1
2
3
4
5
6
7
8
24 Hour
6 Hour
1 Hour
2
5
10
25
50
100
Return Period In Years, Partial Duration Series


8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
Rainfall Depth - inches
100 Year
10 Year
2 Year
1
2
3
6
12
24
Duration - hours

APPENDIX B

HEC-1 Summary Tables

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981              *
*          REVISED 30 OCT 81            *
*                                       *
*  RUN DATE      11-J    TIME      11:0 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*  (916) 440-3285 OR (FTS) 449-3285     *
*                                       *
*****************************************
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```
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 -ANSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. SEE SEPTEMBER 1981 INPUT DESCRIPTION FOR NEW DEFINITIONS.

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

  1           ID  MARICOPA COUNTY FLOOD CONTROL DISTRICT
  2           ID  HYDROLOGY(AQUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
  3           ID   1 HOUR 100 YEAR DISCHARGE EXISTING CONDITION
  4           ID   TYPE 2 RAINFALL DISTRIBUTION
  5           ID   KINEMATIC WAVE METHOD
  6           ID   VAX-MMR2-DAT
  7           IT       5             120
  8           IO       5       0

  9           KK   SUB2A
 10           KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 11           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
 12           PB    2.45
 13           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 14           PI    0.06    0.05
 15           BA    0.50
 16           LS       0      72       4              72       4
 17           UK    1850   .0033     0.2      25
 18           UK    5600   .0033     0.2      75
 19           RK    2640   0.005   0.025            TRAP

 20           KK   SUB2B
 21           KM  NORTH-WEST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 22           KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99-TH ST ROAD
 23           PB    2.45
 24           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 25           PI    0.06    0.05
 26           BA    0.50
 27           LS       0      72       4              72       4
 28           UK    1850   .0033     0.2      25
 29           UK    5600   .0033     0.2      75
 30           RK    2640   0.005   0.025            TRAP

 31           KK    SUB2
 32           KM        COMBINE RUNOFF FROM SUB2A AND SUB2B AT C.P.(B)
 33           HC       2

 34           KK    SUB2
 35           KM         DIVERT TO SUB5B
 36           DT   DIV25
 37           DI       2     100    1000
 38           DQ       1      50     500

 39           KK   SUB3A
 40           KM   AREA BOUNDED BY BETHANY HOME ROAD- 99TH ST- CAMELBACK ROAD- RID CHANNEL
 41           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
 42           KM   HYDROGRAPH AT C.P. (C)
 43           PB    2.45
 44           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 45           PI    0.06    0.05
 46           BA    0.66
 47           LS       0      85      48
 48           UK    4500    .005     0.2     100
 49           RK    5280    .003   0.025            TRAP                    YES
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```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  50          KK   SUB3A
  51          KM        DIVERT TO R.I.D. CHANNEL
  52          DT     RID
  53          DI       1     150     151     300    1000
  54          DQ       1     150     150     150     150

  55          KK    SUB4
  56          KM   AREA BOUNDED BY BETHANY HOME ROAD- AGUA FRIA-CAMELBACK ROAD- RID CHANNEL
  57          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
  58          KM   HYDROGRAPH AT C.P. (D) INTO AGUA FRIA WASH
  59          PB    2.45
  60          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  61          PI    0.06    0.05
  62          BA    1.06
  63          LS       0      72       4
  64          UK    5800    .005     0.2     100
  65          RK    4000    .003   0.025            TRAP                    YES

  66          KK   DIV25
  67          KM        RETRIEVE DIVERSION FROM CONCENTRATION B OF AREA 2
  68          DR   DIV25

  69          KK   SUB5B
  70          KM  NORTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
  71          KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99TH STREET
  72          PB    2.45
  73          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  74          PI    0.06    0.05
  75          BA    0.50
  76          LS       0      72       4              72       4
  77          UK    1850   .0033     0.2      25
  78          UK    5600   .0033     0.2      75
  79          RK    2640   0.005   0.025            TRAP                    YES

  80          KK   SUB5A
  81          KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
  82          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
  83          PB    2.45
  84          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  85          PI    0.06    0.05
  86          BA    0.50
  87          LS       0      72       4              72       4
  88          UK    1850   .0033     0.2      25
  89          UK    5600   .0033     0.2      75
  90          RK    2640   0.005   0.025            TRAP

  91          KK    SUB5
  92          KM        COMBINE RUNOFF FROM SUB5A AND SUB5B AND DIVERT 25 AT C.P.(E)
  93          HC       2
```

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

  94          KK   SUB5
  95          KM        DIVERT TO THOMAS ROAD
  96          DT  THOMAS
  97          DI      2     100    1000
  98          DQ      1      50     500

  99          KK   SUB6
 100          KM        ROUTED TO SUB6 (AT MID-POINT OF (E) AND (F))
 101          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 102          RK   2640   0.005   0.025            TRAP       5     0.5

 103          KK   SUB6A
 104          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 105          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 106          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 107          KM         MAIN CHANNEL 5000' RUNING NORTH-SOUTH
 108          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
 109          KM   MODELED AS 75% OF THE AREA ROUTED THROUGH THE LAKE
 110          BA    .75
 111          LS            80      29
 112          UK    100   .0033     0.2     100
 113          RK   2000    .005    0.16     .10    TRAP
 114          RK   5000    .005    0.16            TRAP

 115          KK   SUB6A
 116          KM        SUB6A LAKE ROUTING
 117          RL      0       0
 118          RS      1    STOR       0
 119          SV      0     5.5    11.0    16.5    17.9    19.3    20.7    23.5
 120          SQ      0       0       0       0      67     190     350     750
 121          SE      0       1       2       3     3.2     3.4     3.6     4.0

 122          KK   SUB6B
 123          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 124          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 125          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 126          KM         MAIN CHANNEL 1000' RUNING NORTH-SOUTH
 127          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
 128          KM   MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
 129          BA    .125
 130          LS      0      80      29
 131          UK    100   .0033     0.2     100
 132          RK   2000    .005    0.16     .10    TRAP
 133          RK   1000    .005    0.16            TRAP

 134          KK   SUB6
 135          KM        COMBINED SUB6B, ROUTED SUB6A AND ROUTED 5 AT C.P. (F)
 136          HC      3
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```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 137          KK    SUB6
 138          KM         DIVERT TO SUB8 AT MID-POINT OF (E) AND (F)
 139          OT  DIV681
 140          DI       1     111     146     199     266     350     450     570     711
 141          DQ       0       1       5      17      39      73     121     186     267

 142          KK    SUB6
 143          KM         ROUTED TO SUB6 (CONTRATION POINT F)
 144          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 145          RK    2640   0.005   0.025            TRAP       5     0.5

 146          KK   SUB6C
 147          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 148          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 149          KM          COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 150          KM          MAIN CHANNEL 1000' RUNING NORTH-SOUTH
 151          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT (F)
 152          KM   MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
 153          BA    .125
 154          LS       0      80      29
 155          UK     100   .0033     0.2     100
 156          RK    2000    .005    0.16     .10    TRAP
 157          RK    1000    .005    0.16            TRAP

 158          KK    SUB6
 159          KM         COMBINED SUB6C, ROUTED (SUB6A,SUB6B  AND ROUTED 5) AT C.P. (F)
 160          HC       2

 161          KK    SUB6
 162          KM         DIVERT TO SUB8
 163          DT  DIV682
 164          DI       2     150    1000
 165          DQ       1      75     500

 166          KK    SUB7
 167          KM   AREA BOUNDED BY 107TH ST- CAMELBACK ROAD- INDIAN SCHOOL-AUGU FRIA
 168          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 169          KM   HYDROGRAPH AT C.P. (G) INTO AGUA FRIA WASH
 170          PB    2.45
 171          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 172          PI    0.06    0.05
 173          BA    0.58
 174          LS       0      71       2
 175          UK    4500    .005     0.2     100
 176          RK    5800    .003   0.025            TRAP                    YES

 177          KK  DIV681
 178          KM         RETRIEVED DIVERSION FROM SUB6
 179          DR  DIV681
```

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

 180          KK   SUB6
 181          KM        ROUTED TO SUB6 (CONTRATION POINT F)
 182          KM   ASSUME COLLECTOR CHANNEL ALONG SOUTH SIDE EASEMENT INDIAN SCHOOL ROAD
 183          RK   2640   0.005   0.025           TRAP       5     0.5

 184          KK  DIV682
 185          KM        RETRIEVED DIVERSION FROM SUB6
 186          DR  DIV682

 187          KK   SUB68
 188          KM        COMBINE DIVERT FLOW 681 AND 682
 189          HC      2

 190          KK   SUB8
 191          KM   SOUTH-EAST CORNER OF INDIAN SCHOOL RD AND 107 TH ST
 192          KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 107TH ST
 193          KM   HYDROGRAPH AT C.P. (H)
 194          PB   2.45
 195          PI   0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 196          PI   0.06    0.05
 197          BA   0.36
 198          LS      0      89       2
 199          UK   3000    .005     0.2     100
 200          RK   2640    .003   0.025           TRAP                    YES

 201          KK   SUB9
 202          KM   AREA BOUNDED BY INDIAN SCHOOL RD-107 ST-LEVEE-AGUA FRIA
 203          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT OF LEVEE
 204          KM   HYDROGRAPH AT C.P. (I) INTO AGUA FRIA WASH
 205          PB   2.45
 206          PI   0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 207          PI   0.06    0.05
 208          BA   0.30
 209          LS      0      89       2
 210          UK   1500    .005     0.2     100
 211          RK   6400    .003   0.025           TRAP                    YES
 212          ZZ
```

```
****************************************
*                                      *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981             *
*          REVISED 30 OCT 81           *
*                                      *
* RUN DATE      11-J    TIME      11:0 *
*                                      *
****************************************
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****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
* THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
* (916) 440-3285 OR (FTS) 448-3285     *
*                                      *
****************************************
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                    MARICOPA COUNTY FLOOD CONTROL DISTRICT
                    HYDROLOGY(AQUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
                     1 HOUR 100 YEAR DISCHARGE EXISTING CONDITION
                     TYPE 2 RAINFALL DISTRIBUTION
                     KINEMATIC WAVE METHOD
                     VAX-MMR2-DAT

  8 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       0120  STARTING TIME
                      NQ        101  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE     1    0  ENDING DATE
                  NDTIME       0940  ENDING TIME

              COMPUTATION INTERVAL    0.08 HOURS
                   TOTAL TIME BASE    8.33 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
```

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	SUB2A	10.	1.42	10.	8.	8.	0.50		
HYDROGRAPH AT	SUB2B	10.	1.42	10.	8.	8.	0.50		
2 COMBINED AT	SUB2	20.	1.42	19.	17.	17.	1.00		
DIVERSION TO	DIV25	10.	1.42	10.	8.	8.	1.00		
HYDROGRAPH AT	SUB2	10.	1.42	10.	8.	8.	1.00		
HYDROGRAPH AT	SUB3A	98.	2.00	88.	73.	73.	1.66		
DIVERSION TO	RID	98.	0.08	88.	73.	73.	1.66		
HYDROGRAPH AT	SUB3A	0.	0.08	0.	0.	0.	1.66		
HYDROGRAPH AT	SUB4	17.	2.33	17.	15.	15.	2.72		
HYDROGRAPH AT	DIV25	10.	1.42	10.	8.	8.	0.00		
HYDROGRAPH AT	SUB5B	20.	1.58	20.	17.	17.	0.50		
HYDROGRAPH AT	SUB5A	10.	1.42	10.	8.	8.	0.50		
2 COMBINED AT	SUB5	30.	1.58	29.	25.	25.	1.00		
DIVERSION TO	THOMAS	15.	1.50	15.	13.	13.	1.00		
HYDROGRAPH AT	SUB5	15.	1.50	15.	13.	13.	1.00		
ROUTED TO	SUB6	15.	1.83	15.	12.	12.	1.00		
HYDROGRAPH AT	SUB6A	435.	1.25	95.	69.	69.	0.75		
ROUTED TO	SUB6A	317.	1.67	62.	45.	45.	0.75	3.55	1.67
HYDROGRAPH AT	SUB6B	123.	0.92	16.	12.	12.	0.13		
3 COMBINED AT	SUB6	367.	1.58	92.	69.	69.	1.88		
DIVERSION TO	DIV681	81.	1.58	8.	6.	6.	1.88		
HYDROGRAPH AT	SUB6	286.	1.58	84.	64.	64.	1.88		
ROUTED TO	SUB6	284.	1.67	84.	63.	63.	1.88		
HYDROGRAPH AT	SUB6C	123.	0.92	16.	12.	12.	0.13		
2 COMBINED AT	SUB6	314.	1.67	100.	75.	75.	2.00		
DIVERSION TO	DIV682	157.	1.67	50.	38.	38.	2.00		
HYDROGRAPH AT	SUB6	157.	1.67	50.	38.	38.	2.00		
HYDROGRAPH AT	SUB7	159.	1.83	59.	46.	46.	2.58		

HYDROGRAPH AT	DIV681	81.	1.58	8.	6.	6.	0.00
ROUTED TO	SUB6	79.	1.67	8.	6.	6.	0.00
HYDROGRAPH AT	DIV682	157.	1.67	50.	38.	38.	0.00
2 COMBINED AT	SUB68	236.	1.67	58.	43.	43.	0.00
HYDROGRAPH AT	SUB8	278.	1.75	98.	75.	75.	0.36
HYDROGRAPH AT	SUB9	352.	1.92	137.	104.	104.	0.66

```
*** NORMAL END OF HEC-1 ***
101
$ EXIT
  SHIAU        Job terminated at 11-JUN-1985 11:08:23.32

  Accounting information:
  Buffered I/O count:          66      Peak working set size:   701
  Direct I/O count:           184      Peak page file size:     791
  Page faults:                532      Mounted volumes:           0
  Elapsed CPU time:     0 00:00:33.52  Elapsed time:     0 00:01:43.66
```

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*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981              *
*          REVISED 30 OCT 81            *
*                                       *
*  RUN DATE      11-J    TIME      11:0 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*  (916) 440-3285 OR (FTS) 448-3285     *
*                                       *
*****************************************
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```
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. SEE SEPTEMBER 1981 INPUT DESCRIPTION FOR NEW DEFINITIONS.

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

  1           ID  MARICOPA COUNTY FLOOD CONTROL DISTRICT
  2           ID  HYDROLOGY(AQUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
  3           ID   1 HOUR 100 YEAR DISCHARGE EXISTING CONDITION
  4           ID   W/ IMPROVEMENT AT INTERSECTION OF INDIAN SCHOOL AND 107TH ST
  5           ID   NO SPLIT FLOW TO THE SOUTH OF C.P. (F)
  6           ID   TYPE 2 RAINFALL DISTRIBUTION
  7           ID   KINEMATIC WAVE METHOD
  8           ID   VAX-MMR3.DAT
  9           IT       5            120
 10           IO       5       0

 11           KK   SUB2A
 12           KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 13           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
 14           PB    2.45
 15           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 16           PI    0.06    0.05
 17           BA    0.50
 18           LS       0      72       4              72       4
 19           UK    1850   .0033     0.2      25
 20           UK    5600   .0033     0.2      75
 21           RK    2640   0.005   0.025            TRAP

 22           KK   SUB2B
 23           KM  NORTH-WEST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 24           KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99-TH ST ROAD
 25           PB    2.45
 26           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 27           PI    0.06    0.05
 28           BA    0.50
 29           LS       0      72       4              72       4
 30           UK    1850   .0033     0.2      25
 31           UK    5600   .0033     0.2      75
 32           RK    2640   0.005   0.025            TRAP

 33           KK    SUB2
 34           KM        COMBINE RUNOFF FROM SUB2A AND SUB2B AT C.P.(B)
 35           HC       2

 36           KK    SUB2
 37           KM         DIVERT TO SUB5B
 38           DT   DIV25
 39           DI       2     100    1000
 40           DQ       1      50     500

 41           KK   SUB3A
 42           KM   AREA BOUNDED BY BETHANY HOME ROAD- 99TH ST- CAMELBACK ROAD- RID CHANNEL
 43           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
 44           KM   HYDROGRAPH AT C.P. (C)
 45           PB    2.45
 46           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 47           PI    0.06    0.05
 48           BA    0.66
 49           LS       0      85      40
 50           UK    4500    .005     0.2     100
```

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

 51           RK    5280    .003   0.025            TRAP                     YES

 52           KK   SUB3A
 53           KM         DIVERT TO R.I.D. CHANNEL
 54           DT     RID
 55           DI       1     150     151     300    1000
 56           DQ       1     150     150     150     150

 57           KK    SUB4
 58           KM   AREA BOUNDED BY BETHANY HOME ROAD- AGUA FRIA-CAMELBACK ROAD- RID CHANNEL
 59           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
 60           KM   HYDROGRAPH AT C.P. (D) INTO AGUA FRIA WASH
 61           PB    2.45
 62           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 63           PI    0.06    0.05
 64           BA    1.06
 65           LS       0      72       4
 66           UK    5800    .005     0.2     100
 67           RK    4000    .003   0.025            TRAP                     YES

 68           KK   DIV25
 69           KM         RETRIEVE DIVERSION FROM CONCENTRATION B OF AREA 2
 70           OR   DIV25

 71           KK   SUB5B
 72           KM  NORTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
 73           KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99TH STREET
 74           PB    2.45
 75           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 76           PI    0.06    0.05
 77           BA    0.50
 78           LS       0      72       4              72       4
 79           UK    1850   .0033     0.2      25
 80           UK    5600   .0033     0.2      75
 81           RK    2640   0.005   0.025            TRAP                     YES

 82           KK   SUB5A
 83           KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
 84           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 85           PB    2.45
 86           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 87           PI    0.06    0.05
 88           BA    0.50
 89           LS       0      72       4              72       4
 90           UK    1850   .0033     0.2      25
 91           UK    5600   .0033     0.2      75
 92           RK    2640   0.005   0.025            TRAP

 93           KK    SUB5
 94           KM         COMBINE RUNOFF FROM SUB5A AND SUB5B AND DIVERT 25 AT C.P.(E)
 95           HC       2
```

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

 96           KK   SUB5
 97           KM        DIVERT TO THOMAS ROAD
 98           DT  THOMAS
 99           DI      2     100    1000
100           DQ      1      50     500

101           KK   SUB6
102           KM        ROUTED TO SUB6 (AT MID-POINT OF (E) AND (F))
103           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
104           RK   2640   0.005   0.025            TRAP       5     0.5

105           KK   SUB6A
106           KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
107           KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
108           KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
109           KM         MAIN CHANNEL 5000' RUNING NORTH-SOUTH
110           KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
111           KM   MODELED AS 75% OF THE AREA ROUTED THROUGH THE LAKE
112           BA    .75
113           LS            80      29
114           UK    100   .0033     0.2     100
115           RK   2000    .005    0.16     .10    TRAP
116           RK   5000    .005    0.16            TRAP

117           KK   SUB6A
118           KM        SUB6A LAKE ROUTING
119           RL      0       0
120           RS      1    STOR       0
121           SV      0     5.5    11.0    16.5    17.9    19.3    20.7    23.5
122           SQ      0       0       0       0      67     190     350     750
123           SE      0       1       2       3     3.2     3.4     3.6     4.0

124           KK   SUB6B
125           KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
126           KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
127           KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
128           KM         MAIN CHANNEL 1000' RUNING NORTH-SOUTH
129           KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
130           KM   MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
131           BA   .125
132           LS      0      80      29
133           UK    100   .0033     0.2     100
134           RK   2000    .005    0.16     .10    TRAP
135           RK   1000    .005    0.16            TRAP

136           KK   SUB6
137           KM        COMBINED SUB6B, ROUTED SUB6A AND ROUTED 5 AT C.P. (F)
138           HC      3
```

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

 139          KK   SUB6
 140          KM        DIVERT TO SUB8 AT MID-POINT OF (E) AND (F)
 141          DT  DIV681
 142          DI      1     111     146     199     266     350     450     570     711
 143          DQ      0       1       5      17      39      73     121     186     267

 144          KK   SUB6
 145          KM        ROUTED TO SUB6 (CONTRATION POINT F)
 146          KM  ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 147          RK   2640   0.005   0.025            TRAP      5     0.5

 148          KK  SUB6C
 149          KM  AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 150          KM  ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 151          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 152          KM         MAIN CHANNEL 1000' RUNING NORTH-SOUTH
 153          KM  CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT (F)
 154          KM  MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
 155          BA   .125
 156          LS      0      80      29
 157          UK    100   .0033     0.2     100
 158          RK   2000    .005    0.16     .10    TRAP
 159          RK   1000    .005    0.16            TRAP

 160          KK   SUB6
 161          KM        COMBINED SUB6C, ROUTED (SUB6A,SUB6B  AND ROUTED 5) AT C.P. (F)
 162          HC      2

 163          KK   SUB7
 164          KM  AREA BOUNDED BY 107TH ST- CAMELBACK ROAD- INDIAN SCHOOL-AUGU FRIA
 165          KM  ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 166          KM  HYDROGRAPH AT C.P. (G) INTO AGUA FRIA WASH
 167          PB   2.45
 168          PI   0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 169          PI   0.06    0.05
 170          BA   0.58
 171          LS      0      71       2
 172          UK   4500    .005     0.2     100
 173          RK   5800    .003   0.025            TRAP      5       3     YES

 174          KK  DIV681
 175          KM        RETRIEVED DIVERSION FROM SUB6
 176          DR  DIV681

 177          KK   SUB6
 178          KM        ROUTED TO SUB6 (CONTRATION POINT F)
 179          KM  ASSUME COLLECTOR CHANNEL ALONG SOUTH SIDE EASEMENT INDIAN SCHOOL ROAD
 180          RK   2640   0.005   0.025            TRAP      5     0.5
```

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

 181          KK   SUB8
 182          KM   SOUTH-EAST CORNER OF INDIAN SCHOOL RD AND 107 TH ST
 183          KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 107TH ST
 184          KM   HYDROGRAPH AT C.P. (H)
 185          PB    2.45
 186          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 187          PI    0.06    0.05
 188          BA    0.36
 189          LS       0      89       2
 190          UK    3000    .005     0.2     100
 191          RK    2640    .003   0.025            TRAP                    YES

 192          KK   SUB9
 193          KM   AREA BOUNDED BY INDIAN SCHOOL RD-107 ST-LEVEE-AGUA FRIA
 194          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT OF LEVEE
 195          KM   HYDROGRAPH AT C.P. (I) INTO AGUA FRIA WASH
 196          PB    2.45
 197          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 198          PI    0.06    0.05
 199          BA    0.30
 200          LS       0      89       2
 201          UK    1500    .005     0.2     100
 202          RK    6400    .003   0.025            TRAP                    YES
 203          ZZ
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981              *
*          REVISED 30 OCT 81            *
*                                       *
*  RUN DATE      11-J    TIME      11:0 *
*                                       *
*****************************************
```

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

MARICOPA COUNTY FLOOD CONTROL DISTRICT
HYDROLOGY(AGUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
1 HOUR 100 YEAR DISCHARGE EXISTING CONDITION
W/ IMPROVEMENT AT INTERSECTION OF INDIAN SCHOOL AND 107TH ST
NO SPLIT FLOW TO THE SOUTH OF C.P. (F)
TYPE 2 RAINFALL DISTRIBUTION
KINEMATIC WAVE METHOD
VAX-MMR3.DAT

```
10 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       0120  STARTING TIME
                       NQ        101  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1    0  ENDING DATE
                   NDTIME       0940  ENDING TIME

                COMPUTATION INTERVAL    0.08 HOURS
                     TOTAL TIME BASE    8.33 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
```

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	SUB2A	10.	1.42	10.	8.	8.	0.50		
HYDROGRAPH AT	SUB2B	10.	1.42	10.	8.	8.	0.50		
2 COMBINED AT	SUB2	20.	1.42	19.	17.	17.	1.00		
DIVERSION TO	DIV25	10.	1.42	10.	8.	8.	1.00		
HYDROGRAPH AT	SUB2	10.	1.42	10.	8.	8.	1.00		
HYDROGRAPH AT	SUB3A	98.	2.00	88.	73.	73.	1.66		
DIVERSION TO	RID	98.	0.08	88.	73.	73.	1.66		
HYDROGRAPH AT	SUB3A	0.	0.08	0.	0.	0.	1.66		
HYDROGRAPH AT	SUB4	17.	2.33	17.	15.	15.	2.72		
HYDROGRAPH AT	DIV25	10.	1.42	10.	8.	8.	0.00		
HYDROGRAPH AT	SUB5B	20.	1.58	20.	17.	17.	0.50		
HYDROGRAPH AT	SUB5A	10.	1.42	10.	8.	8.	0.50		
2 COMBINED AT	SUB5	30.	1.58	29.	25.	25.	1.00		
DIVERSION TO	THOMAS	15.	1.50	15.	13.	13.	1.00		
HYDROGRAPH AT	SUB5	15.	1.50	15.	13.	13.	1.00		
ROUTED TO	SUB6	15.	1.83	15.	12.	12.	1.00		
HYDROGRAPH AT	SUB6A	435.	1.25	95.	69.	69.	0.75		
ROUTED TO	SUB6A	317.	1.67	62.	45.	45.	0.75	3.56	1.67
HYDROGRAPH AT	SUB6B	123.	0.92	16.	12.	12.	0.13		
3 COMBINED AT	SUB6	367.	1.58	92.	69.	69.	1.88		
DIVERSION TO	DIV681	81.	1.58	8.	6.	6.	1.88		
HYDROGRAPH AT	SUB6	286.	1.58	84.	64.	64.	1.88		
ROUTED TO	SUB6	284.	1.67	84.	63.	63.	1.88		
HYDROGRAPH AT	SUB6C	123.	0.92	16.	12.	12.	0.13		
2 COMBINED AT	SUB6	314.	1.67	100.	75.	75.	2.00		
HYDROGRAPH AT	SUB7	311.	1.83	108.	83.	83.	2.58		
HYDROGRAPH AT	DIV681	81.	1.58	8.	6.	6.	0.00		
ROUTED TO	SUB6	79.	1.67	8.	6.	6.	0.00		

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HYDROGRAPH AT      SUB8      128.    1.83        48.        38.        38.      0.36

HYDROGRAPH AT      SUB9      197.    2.00        87.        67.        67.      0.66


*** NORMAL END OF HEC-1 ***
101
$ EXIT
  SHIAU       Job terminated at 11-JUN-1985 11:08:42.25

  Accounting information:
  Buffered I/O count:          68      Peak working set size:   704
  Direct I/O count:           153      Peak page file size:     791
  Page faults:                534      Mounted volumes:           0
  Elapsed CPU time:     0 00:00:32.16  Elapsed time:     0 00:01:42.64
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981              *
*          REVISED 30 OCT 81            *
*                                       *
*  RUN DATE      11-J    TIME      1110 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*  (916) 440-3283 OR (FTS) 448-3283     *
*                                       *
*****************************************
```


```
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. SEE SEPTEMBER 1981 INPUT DESCRIPTION FOR NEW DEFINITIONS.

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

  1           ID  MARICOPA COUNTY FLOOD CONTROL DISTRICT
  2           ID  HYDROLOGY(AQUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
  3           ID   1 HOUR 100 YEAR DISCHARGE FUTURE CONDITION
  4           ID   NO IMPROVEMENT AT ANY INTERSECTION
  5           ID   TYPE 2 RAINFALL DISTRIBUTION
  6           ID   KINEMATIC WAVE METHOD
  7           ID   VAX-MMR4.DAT
  8           IT       5            120
  9           IO       5       0

 10           KK   SUB2A
 11           KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 12           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
 13           PB    2.45
 14           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 15           PI    0.06    0.05
 16           BA    0.50
 17           LS       0      89      54              89      54
 18           UK    1850   .0033     0.1      25
 19           UK    5600   .0033     0.1      75
 20           RK    2640   0.005   0.025            TRAP

 21           KK   SUB2B
 22           KM  NORTH-WEST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 23           KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99-TH ST ROAD
 24           PB    2.45
 25           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 26           PI    0.06    0.05
 27           BA    0.50
 28           LS       0      89      54              89      54
 29           UK    1850   .0033     0.1      25
 30           UK    5600   .0033     0.1      75
 31           RK    2640   0.005   0.025            TRAP

 32           KK    SUB2
 33           KM        COMBINE RUNOFF FROM SUB2A AND SUB2B AT C.P.(B)
 34           HC       2

 35           KK    SUB2
 36           KM         DIVERSION FOR THE STORM DRAIN
 37           DT     SD2
 38           DI       1      52    1000
 39           DQ       1      52      52

 40           KK    RET2
 41           KM         RETENTION REQUIREMENT
 42           RL       0       0
 43           RS       1    STOR       0
 44           SV       0    14.3    28.7    43.0    45.9    48.8    51.7    57.3
 45           SQ       0       0       0       0     107     304     558    1200
 46           SE       0       1       2       3     3.2     3.4     3.6     4.0
```

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

  47          KK   SUB2
  48          KM        DIVERT TO SUB5B
  49          DT   DIV25
  50          DI      2     100    1000
  51          DQ      1      50     500

  52          KK   SUB3A
  53          KM   AREA BOUNDED BY BETHANY HOME ROAD- 99TH ST- CAMELBACK ROAD- RID CHANNEL
  54          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
  55          KM   HYDROGRAPH AT C.P. (C)
  56          PB   2.45
  57          PI   0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  58          PI   0.06    0.05
  59          BA   0.66
  60          LS      0      85      48
  61          UK   4500    .003     0.1     100
  62          RK   5280    .003   0.025           TRAP                    YES

  63          KK   SUB3A
  64          KM        DIVERT TO R.I.D. CHANNEL
  65          DT    RID
  66          DI      1     150     151     300    1000
  67          DQ      1     150     150     150     150

  68          KK   SUB4
  69          KM        SUBAREA 3 ROUTED TO SUBAREA 4
  70          RK   4000    .003   0.025           TRAP       5     0.5

  71          KK   SUB4
  72          KM   AREA BOUNDED BY BETHANY HOME ROAD- AGUA FRIA-CAMELBACK ROAD- RID CHANNEL
  73          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
  74          KM   HYDROGRAPH AT C.P. (D) INTO AGUA FRIA WASH
  75          PB   2.45
  76          PI   0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  77          PI   0.06    0.05
  78          BA   1.06
  79          LS      0      83      55
  80          UK   5800    .005     0.1     100
  81          RK   4000    .003   0.025           TRAP

  82          KK   RET4
  83          KM        RETENTION REQUIREMENT FOR SUB AREA 4
  84          RL      0       0
  85          RS      1    STOR       0
  86          SV      0      15      30      45      48      51      54      60
  87          SQ      0       0       0       0     107     304     558    1200
  88          SE      0       1       2       3     3.2     3.4     3.6     4.0

  89          KK   SUB4
  90          KM        COMBINED ROUTED SUB3 AND ROUTED SUB4
  91          HC      2
```

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

 92           KK   DIV25
 93           KM        RETRIEVE DIVERSION FROM CONCENTRATION B OF AREA 2
 94           DR   DIV25

 95           KK    SUB5
 96           KM        DIVERSION FLOW FROM SUB2 ROUTED TO SUB5
 97           RK    5280   0.005   0.025            TRAP      5     0.5

 98           KK   SUB5B
 99           KM  NORTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
100           KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99TH STREET
101           PB    2.45
102           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
103           PI    0.06    0.05
104           BA    0.50
105           LS       0      89      60              89      60
106           UK    1850   .0033     0.1      25
107           UK    5600   .0033     0.1      75
108           RK    2640   0.005   0.025            TRAP

109           KK   SUB5A
110           KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
111           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
112           PB    2.45
113           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
114           PI    0.06    0.05
115           BA    0.50
116           LS       0      89      60              89      60
117           UK    1850   .0033     0.1      25
118           UK    5600   .0033     0.1      75
119           RK    2640   0.005   0.025            TRAP

120           KK    SUB5
121           KM        COMBINE RUNOFF FROM SUB5A AND SUB5B
122           HC       2

123           KK    RET5
124           KM        RETENTION REQUIREMENT FOR SUBAREA 5
125           RS       1    STOR       0
126           SV       0      15      30      45      48      51      54      60
127           SQ       0       0       0       0     107     304     558    1200
128           SE       0       1       2       3     3.2     3.4     3.6     4.0

129           KK    SUB5
130           KM        COMBINE ROUTED SUB5A-B AND DIVERTED SUB2
131           HC       2

132           KK    SUB5
133           KM        DIVERT TO THOMAS ROAD
134           DT  THOMAS
135           DI       2     100    1000
136           DQ       1      50     500
```

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

 137          KK   SUB6
 138          KM        ROUTED TO SUB6 (AT MID-POINT (E) AND (F))
 139          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 140          RK    2640   0.005   0.025            TRAP       5     0.5

 141          KK   SUB6A
 142          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 143          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 144          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 145          KM         MAIN CHANNEL 5000' RUNING NORTH-SOUTH
 146          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
 147          KM   MODELED AS 75% OF THE AREA ROUTED THROUGH THE LAKE
 148          BA     .75
 149          LS              80      29
 150          UK    100   .0033     0.2     100
 151          RK   2000    .005    0.16     .10    TRAP
 152          RK   5000    .005    0.16            TRAP

 153          KK   SUB6A
 154          KM        SUB6A LAKE ROUTING
 155          RL      0       0
 156          RS      1    STOR       0
 157          SV      0     5.5    11.0    16.5    17.9    19.3    20.7    23.5
 158          SQ      0       0       0       0      67     190     350     750
 159          SE      0       1       2       3     3.2     3.4     3.6     4.0

 160          KK   SUB6B
 161          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 162          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 163          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 164          KM         MAIN CHANNEL 1000' RUNING NORTH-SOUTH
 165          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
 166          KM   MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
 167          BA    .125
 168          LS      0      80      29
 169          UK    100   .0033     0.2     100
 170          RK   2000    .005    0.16     .10    TRAP
 171          RK   1000    .005    0.16            TRAP

 172          KK   SUB6
 173          KM        COMBINED SUB6B, ROUTED SUB6A AND ROUTED 5 AT C.P. (F)
 174          HC      3

 175          KK   SUB6
 176          KM        DIVERT TO SUB8
 177          DT  DIV681
 178          DI      1     111     146     199     266     350     450     570     711
 179          DQ      0       1       5      17      39      73     121     186     267
```

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

 180          KK   SUB6
 181          KM        ROUTED TO SUB6 (CONTRATION POINT F)
 182          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 183          RK    2640   0.005   0.025            TRAP       5     0.5

 184          KK   SUB6C
 185          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 186          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 187          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 188          KM         MAIN CHANNEL 1000' RUNING NORTH-SOUTH
 189          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
 190          KM   MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
 191          BA    .125
 192          LS       0      80      29
 193          UK     100   .0033     0.2     100
 194          RK    2000    .005    0.16     .10    TRAP
 195          RK    1000    .005    0.16            TRAP

 196          KK   SUB6
 197          KM        COMBINED SUB6C, ROUTED(SUB6A, SUB6B AND ROUTED 5) AT C.P. (F)
 198          HC       2

 199          KK   SUB6
 200          KM        DIVERT TO SUB8
 201          DT  DIV682
 202          DI       2     150    1000
 203          DQ       1      75     500

 204          KK   SUB7
 205          KM        SUB6 ROUTED TO SUB7
 206          RK    5800    .003   0.025            TRAP       5     0.5

 207          KK   SUB7
 208          KM   AREA BOUNDED BY 107TH ST- CAMELBACK ROAD- INDIAN SCHOOL-AUGU FRIA
 209          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 210          KM   HYDROGRAPH AT C.P. (G) INTO AGUA FRIA WASH
 211          PB    2.45
 212          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 213          PI    0.06    0.05
 214          BA    0.58
 215          LS       0      89      60
 216          UK    4500    .005     0.1     100
 217          RK    5800    .003   0.025            TRAP

 218          KK   RET7
 219          KM        RETENTION REQUIREMENT FOR SUBAREA 7
 220          RS       1    STOR       0
 221          SV       0       9      18      27      29      31      32      36
 222          SQ       0       0       0       0     107     304     558    1200
 223          SE       0       1       2       3     3.2     3.4     3.6     4.0
```

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

224           KK    SUB7
225           KM          COMBINED ROUTED SUB6 AND ROUTED SUB7
226           HC       2

227           KK  DIV681
228           KM          RETRIEVED DIVERSION FROM SUB6
229           DR  DIV681

230           KK    SUB6
231           KM          ROUTED TO SUB6 (CONTRATION POINT F)
232           KM   ASSUME COLLECTOR CHANNEL ALONG SOUTH SIDE EASEMENT INDIAN SCHOOL ROAD
233           RK    2640   0.005   0.025            TRAP       5     0.5

234           KK  DIV682
235           KM          RETRIEVED DIVERSION FROM SUB6
236           DR  DIV682

237           KK   SUB68
238           KM          COMBINED RETRIVED DIV681 AND DIV682
239           HC       2

240           KK    SUB8
241           KM   SOUTH-EAST CORNER OF INDIAN SCHOOL RD AND 107 TH ST
242           KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 107TH ST
243           KM   HYDROGRAPH AT C.P. (H)
244           PB    2.45
245           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
246           PI    0.06    0.05
247           BA    0.36
248           LS       0      89      60
249           UK    3000    .005     0.1     100
250           RK    2640    .003   0.025            TRAP                    YES

251           KK    SUB9
252           KM   AREA BOUNDED BY INDIAN SCHOOL RD-107 ST-LEVEE-AGUA FRIA
253           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT OF LEVEE
254           KM   HYDROGRAPH AT C.P. (I) INTO AGUA FRIA WASH
255           PB    2.45
256           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
257           PI    0.06    0.05
258           BA    0.30
259           LS       0      89      60
260           UK    1500    .005     0.1     100
261           RK    6400    .003   0.025            TRAP                    YES
262           ZZ
```

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*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981              *
*          REVISED 30 OCT 81            *
*                                       *
*  RUN DATE      11-J    TIME      1110 *
*                                       *
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*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*  THE HYDROLOGIC ENGINEERING CENTER *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*  (916) 440-3285 OR (FTS) 448-3285 *
*                                   *
*************************************
```

MARICOPA COUNTY FLOOD CONTROL DISTRICT
HYDROLOGY(AQUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
1 HOUR 100 YEAR DISCHARGE FUTURE CONDITION
NO IMPROVEMENT AT ANY INTERSECTION
TYPE 2 RAINFALL DISTRIBUTION
KINEMATIC WAVE METHOD
VAX-HMR4.DAT

```
9 ID          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       0120  STARTING TIME
                      NQ        101  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1    0  ENDING DATE
                  NDTIME       0940  ENDING TIME

              COMPUTATION INTERVAL    0.08 HOURS
                   TOTAL TIME BASE    8.33 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
```

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	SUB2A	158.	1.17	85.	66.	66.	0.50		
HYDROGRAPH AT	SUB2B	158.	1.17	85.	66.	66.	0.50		
2 COMBINED AT	SUB2	317.	1.17	169.	131.	131.	1.00		
DIVERSION TO	SD2	52.	1.17	52.	47.	47.	1.00		
HYDROGRAPH AT	SUB2	265.	1.17	117.	85.	85.	1.00		
ROUTED TO	RET2	94.	3.92	31.	22.	22.	1.00	3.18	3.92
DIVERSION TO	DIV25	47.	3.92	15.	11.	11.	1.00		
HYDROGRAPH AT	SUB2	47.	3.92	15.	11.	11.	1.00		
HYDROGRAPH AT	SUB3A	172.	1.67	117.	89.	89.	1.66		
DIVERSION TO	RID	150.	1.67	112.	85.	85.	1.66		
HYDROGRAPH AT	SUB3A	22.	1.67	5.	4.	4.	1.66		
ROUTED TO	SUB4	22.	1.92	5.	4.	4.	1.66		
HYDROGRAPH AT	SUB4	260.	1.17	175.	135.	135.	1.06		
ROUTED TO	RET4	211.	3.50	95.	69.	69.	1.06	3.31	3.50
2 COMBINED AT	SUB4	212.	3.50	97.	72.	72.	2.72		
HYDROGRAPH AT	DIV25	47.	3.92	15.	11.	11.	0.00		
ROUTED TO	SUB5	47.	4.08	15.	11.	11.	0.00		
HYDROGRAPH AT	SUB5B	167.	1.17	88.	68.	68.	0.50		
HYDROGRAPH AT	SUB5A	167.	1.17	88.	68.	68.	0.50		
2 COMBINED AT	SUB5	333.	1.17	175.	136.	136.	1.00		
ROUTED TO	RET5	188.	3.17	96.	69.	69.	1.00	3.28	3.17
2 COMBINED AT	SUB5	204.	3.83	111.	80.	80.	1.00		
DIVERSION TO	THOMAS	102.	3.83	55.	40.	40.	1.00		
HYDROGRAPH AT	SUB5	102.	3.83	55.	40.	40.	1.00		
ROUTED TO	SUB6	102.	3.92	55.	40.	40.	1.00		
HYDROGRAPH AT	SUB6A	435.	1.25	95.	69.	69.	0.75		
ROUTED TO	SUB6A	317.	1.67	62.	45.	45.	0.75	3.36	1.67
HYDROGRAPH AT	SUB6B	123.	0.92	16.	12.	12.	0.13		

3 COMBINED AT	SUB6	352.	1.58	126.	97.	97.	1.88		
DIVERSION TO	DIV681	74.	1.58	8.	6.	6.	1.88		
HYDROGRAPH AT	SUB6	278.	1.58	118.	91.	91.	1.88		
ROUTED TO	SUB6	276.	1.67	117.	90.	90.	1.88		
HYDROGRAPH AT	SUB6C	123.	0.92	16.	12.	12.	0.13		
2 COMBINED AT	SUB6	306.	1.67	133.	102.	102.	2.00		
DIVERSION TO	DIV682	153.	1.67	67.	51.	51.	2.00		
HYDROGRAPH AT	SUB6	153.	1.67	67.	51.	51.	2.00		
ROUTED TO	SUB7	140.	1.92	66.	50.	50.	2.00		
HYDROGRAPH AT	SUB7	191.	1.67	104.	79.	79.	0.58		
ROUTED TO	RET7	141.	3.00	55.	40.	40.	0.58	3.23	3.00
2 COMBINED AT	SUB7	211.	3.08	116.	90.	90.	2.58		
HYDROGRAPH AT	DIV681	74.	1.58	8.	6.	6.	0.00		
ROUTED TO	SUB6	71.	1.67	8.	6.	6.	0.00		
HYDROGRAPH AT	DIV682	153.	1.67	67.	51.	51.	0.00		
2 COMBINED AT	SUB68	224.	1.67	75.	57.	57.	0.00		
HYDROGRAPH AT	SUB8	385.	1.75	145.	109.	109.	0.36		
HYDROGRAPH AT	SUB9	573.	1.17	205.	154.	154.	0.66		

```
*.

*** NORMAL END OF HEC-1 ***
101
$ EXIT
  SHIAN      Job terminated at 11-JUN-1985 11:08:48.52

  Accounting information:
  Buffered I/O count:          79      Peak working set size:   696
  Direct I/O count:           731      Peak page file size:     791
  Page faults:                530      Mounted volumes:           0
  Elapsed CPU time:     0 00:00:33.23  Elapsed time:     0 00:01:37.94
```

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****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            FEBRUARY 1981             *
*          REVISED 30 OCT 81           *
*                                      *
* RUN DATE      11-J    TIME      11:0 *
*                                      *
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*    U.S. ARMY CORPS OF ENGINEERS      *
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*                                      *
****************************************
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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. SEE SEPTEMBER 1981 INPUT DESCRIPTION FOR NEW DEFINITIONS.

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

  1           ID  MARICOPA COUNTY FLOOD CONTROL DISTRICT
  2           ID  HYDROLOGY(AQUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
  3           ID   1 HOUR 100 YEAR DISCHARGE FUTURE CONDITION
  4           ID   IMPROVEMENT AT INTERSECTION THAT NO SPLIT FLOW TOWARD SOUTH
  5           ID   TYPE 2 RAINFALL DISTRIBUTION
  6           ID   KINEMATIC WAVE METHOD
  7           ID   VAX-MMR5.DAT
  8           IT       5            120
  9           IO       5       0

 10           KK   SUB2A
 11           KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 12           KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
 13           PB    2.45
 14           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 15           PI    0.06    0.05
 16           BA    0.50
 17           LS       0      89      54              89      54
 18           UK    1850   .0033     0.1      25
 19           UK    5600   .0033     0.1      75
 20           RK    2640   0.005   0.025            TRAP

 21           KK   SUB2B
 22           KM  NORTH-WEST HALF OF 91ST-CAMELBACK-99TH-BETHANY HOME ROAD
 23           KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99-TH ST ROAD
 24           PB    2.45
 25           PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 26           PI    0.06    0.05
 27           BA    0.50
 28           LS       0      89      54              89      54
 29           UK    1850   .0033     0.1      25
 30           UK    5600   .0033     0.1      75
 31           RK    2640   0.005   0.025            TRAP

 32           KK    SUB2
 33           KM        COMBINE RUNOFF FROM SUB2A AND SUB2B AT C.P.(B)
 34           HC       2

 35           KK    SUB2
 36           KM         DIVERSION FOR THE STORM DRAIN
 37           DT     SD2
 38           DI       1      52    1000
 39           DQ       1      52      52

 40           KK    RET2
 41           KM         RETENTION REQUIREMENT
 42           RL       0       0
 43           RS       1    STOR       0
 44           SV       0    14.3    28.7    43.0    45.9    48.8    51.7    57.3
 45           SQ       0       0       0       0     107     304     558    1200
 46           SE       0       1       2       3     3.2     3.4     3.6     4.0
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  47          KK   SUB3A
  48          KM   AREA BOUNDED BY BETHANY HOME ROAD- 99TH ST- CAMELBACK ROAD- RID CHANNEL
  49          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
  50          KM   PROPOSED CHANNEL : V SHAPE, SIDE SLOPE = 3:1
  51          KM   HYDROGRAPH AT C.P. (C)
  52          PB    2.45
  53          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  54          PI    0.06    0.05
  55          BA    0.66
  56          LS       0      85      48
  57          UK    4500    .005     0.1     100
  58          RK    5280    .003   0.025            TRAP       0       3     YES

  59          KK   SUB3A
  60          KM         DIVERT TO R.I.D. CHANNEL
  61          DT     RID
  62          DI       1     150     151     300    1000
  63          DQ       1     150     150     150     150

  64          KK    SUB4
  65          KM         SUBAREA 3 ROUTED TO SUBAREA 4
  66          KM         PROPOSED CHANNEL : V SHAPE, SIDE SLOPE= 3:1
  67          RK    4000    .003   0.025            TRAP       0       3

  68          KK    SUB4
  69          KM   AREA BOUNDED BY BETHANY HOME ROAD- AGUA FRIA-CAMELBACK ROAD- RID CHANNEL
  70          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT CAMELBACK ROAD
  71          KM   HYDROGRAPH AT C.P. (D) INTO AGUA FRIA WASH
  72          PB    2.45
  73          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  74          PI    0.06    0.05
  75          BA    1.06
  76          LS       0      88      55
  77          UK    5800    .005     0.1     100
  78          RK    4000    .003   0.025            TRAP

  79          KK    RET4
  80          KM         RETENTION REQUIREMENT FOR SUB AREA 4
  81          RL       0       0
  82          RS       1    STOR       0
  83          SV       0      15      30      45      48      51      54      60
  84          SQ       0       0       0       0     107     304     558    1200
  85          SE       0       1       2       3     3.2     3.4     3.6     4.0

  86          KK    SUB4
  87          KM         COMBINED ROUTED SUB3 AND ROUTED SUB4
  88          HC       2

  89          KK   SUB5B
  90          KM  NORTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
  91          KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 99TH STREET
  92          PB    2.45
  93          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
  94          PI    0.06    0.05
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  95          BA    0.50
  96          LS       0      89      60              89      60
  97          UK    1850   .0033     0.1      25
  98          UK    5600   .0033     0.1      75
  99          RK    2640   0.005   0.025            TRAP

 100          KK    SUB5A
 101          KM  SOUTH-EAST HALF OF 91ST-CAMELBACK-99TH-INDIAN SCHOOL ROAD
 102          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 103          PB    2.45
 104          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 105          PI    0.06    0.05
 106          BA    0.50
 107          LS       0      89      60              89      60
 108          UK    1850   .0033     0.1      25
 109          UK    5600   .0033     0.1      75
 110          RK    2640   0.005   0.025            TRAP

 111          KK    SUB5
 112          KM        COMBINE RUNOFF FROM SUB5A AND SUB5B
 113          HC       2

 114          KK    RET5
 115          KM         RETENTION REQUIREMENT FOR SUBAREA 5
 116          RS       1    STOR       0
 117          SV       0      15      30      45      48      51      54      60
 118          SQ       0       0       0       0     107     304     558    1200
 119          SE       0       1       2       3     3.2     3.4     3.6     4.0

 120          KK    SUB6
 121          KM         ROUTED TO SUB6
 122          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 123          KM         PROPOSED CHANNEL : BW = 8', SIDE SLOPE = 3:1
 124          RK    2640   0.005   0.025            TRAP       8       3

 125          KK    SUB6A
 126          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 127          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 128          KM          COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 129          KM          MAIN CHANNEL 5000' RUNING NORTH-SOUTH
 130          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (E) AND (F)
 131          KM   MODELED AS 75% OF THE AREA ROUTED THROUGH THE LAKE
 132          BA     .75
 133          LS              80      29
 134          UK     100   .0033     0.2     100
 135          RK    2000    .005    0.16     .10    TRAP
 136          RK    5000    .005    0.16            TRAP

 137          KK    SUB6A
 138          KM         SUB6A LAKE ROUTING
 139          RL       0       0
 140          RS       1    STOR       0
 141          SV       0     5.5    11.0    16.5    17.9    19.3    20.7    23.5
 142          SQ       0       0       0       0      67     190     350     750
 143          SE       0       1       2       3     3.2     3.4     3.6     4.0
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9.......10

 144          KK   SUB6B
 145          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 146          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 147          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 148          KM         MAIN CHANNEL 1000' RUNING NORTH-SOUTH
 149          KM   CONCENTRATION POINT ON INDIAN SCHOOL ROAD AT MID-POINT OF (F) AND (F)
 150          KM   MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
 151          BA    .125
 152          LS      0      80      29
 153          UK    100   .0033     0.2     100
 154          RK   2000    .005    0.16     .10    TRAP
 155          RK   1000    .005    0.16            TRAP

 156          KK   SUB6
 157          KM        COMBINED SUB6B, ROUTED SUB6A AND ROUTED 5 AT C.P. (F)
 158          HC      3

 159          KK   SUB6
 160          KM        ROUTED TO SUB6 (CONTRATION POINT F)
 161          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 162          KM        PROPOSED CHANNEL : BW = 8', SIDE SLOPE = 3:1
 163          RK   2640   0.005   0.025            TRAP      8      3

 164          KK   SUB6C
 165          KM   AREA BOUNDED BY CAMELBACK-99TH-INDIAN SCHOOL-107TH
 166          KM   ASSUME OVERLAND LENGTH 100' AS LOT SIZE
 167          KM         COLLECTOR CHANNEL 2000' RUNNING EAST-WEST
 168          KM         MAIN CHANNEL 1000' RUNING NORTH-SOUTH
 169          KM   CONCENTRATION POINT AT (F)
 170          KM   MODELED AS 12.5% OF THE AREA NOT EFFECT BY THE LAKE
 171          BA    .125
 172          LS      0      80      29
 173          UK    100   .0033     0.2     100
 174          RK   2000    .005    0.16     .10    TRAP
 175          RK   1000    .005    0.16            TRAP

 176          KK   SUB6
 177          KM        COMBINED ROUTED SUB6 AND SUB6C
 178          HC      2

 179          KK   SUB7
 180          KM        ROUTED TO SUB7 AT C.P. (G)
 181          KM        ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 182          RK   5800   .0033    .025            TRAP      8      3

 183          KK   SUB7
 184          KM   AREA BOUNDED BY 107TH ST- CAMELBACK ROAD- INDIAN SCHOOL-AUGU FRIA
 185          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT INDIAN SCHOOL ROAD
 186          KM   PROPOSED CHANNEL : BW = 8', SIDE SLOPE = 3:1
 187          KM   HYDROGRAPH AT C.P. (G) INTO AGUA FRIA WASH
 188          PB    2.45
 189          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 190          PI    0.06    0.05
 191          BA    0.58
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 192          LS       0      89      60
 193          UK    4500    .005     0.1     100
 194          RK    5800    .003   0.025             TRAP

 195          KK    RET7
 196          KM         RETENTION REQUIREMENT FOR SUBAREA 7
 197          RS       1    STOR       0
 198          SV       0       9      18      27      29      31      32      36
 199          SQ       0       0       0       0     107     304     558    1200
 200          SE       0       1       2       3     3.2     3.4     3.6     4.0

 201          KK    SUB7
 202          KM         COMBINED ROUTED SUB6 AND ROUTED SUB7
 203          HC       2

 204          KK    SUB8
 205          KM   SOUTH-EAST CORNER OF INDIAN SCHOOL RD AND 107 TH ST
 206          KM   ASSUME COLLECTOR CHANNEL ALONG EAST SIDE EASEMENT 107TH ST
 207          KM   HYDROGRAPH AT C.P. (H)
 208          PB    2.45
 209          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 210          PI    0.06    0.05
 211          BA    0.36
 212          LS       0      89      60
 213          UK    3000    .005     0.1     100
 214          RK    2640    .003   0.025             TRAP

 215          KK    DET8
 216          KM         DETENTION REQUIREMENT FOR SUBAREA 8 TO REGULATE OUTFLOW PEAK TO 150 CFS
 217          RL       0       0
 218          RS       1    STOR       0
 219          SV       0       1       4       6      13      51      54      60
 220          SQ       0      65     130     150     210     304     558    1200
 221          SE       0       1       2     2.3     3.2     3.4     3.6     4.0

 222          KK    SUB9
 223          KM   AREA BOUNDED BY INDIAN SCHOOL RD-107 ST-LEVEE-AGUA FRIA
 224          KM   ASSUME COLLECTOR CHANNEL ALONG NORTH SIDE EASEMENT OF LEVEE
 225          KM   HYDROGRAPH AT C.P. (I) INTO AGUA FRIA WASH
 226          PB    2.45
 227          PI    0.05    0.07    0.07    0.10    0.16    1.16    0.39    0.14    0.11    0.09
 228          PI    0.06    0.05
 229          BA    0.30
 230          LS       0      89      60
 231          UK    1500    .005     0.1     100
 232          RK    6400    .003   0.025             TRAP                    YES
 233          ZZ
```

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****************************************
*                                      *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            FEBRUARY 1981             *
*          REVISED 30 OCT 81           *
*                                      *
* RUN DATE      11-J    TIME      11:0 *
*                                      *
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****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
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*          609 SECOND STREET           *
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*                                      *
****************************************
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```
                    MARICOPA COUNTY FLOOD CONTROL DISTRICT
                    HYDROLOGY(AQUA FRIA RIVER-BETHANY HOME-91TH ST-THOMAS RD)
                     1 HOUR 100 YEAR DISCHARGE FUTURE CONDITION
                     IMPROVEMENT AT INTERSECTION THAT NO SPLIT FLOW TOWARD SOUTH
                     TYPE 2 RAINFALL DISTRIBUTION
                     KINEMATIC WAVE METHOD
                     VAX-MMRS.DAT

 9 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       0120  STARTING TIME
                       NQ        101  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1   0  ENDING DATE
                   NDTIME       0940  ENDING TIME

                 COMPUTATION INTERVAL    0.08 HOURS
                      TOTAL TIME BASE    8.33 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
```

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	SUB2A	158.	1.17	85.	66.	66.	0.50		
HYDROGRAPH AT	SUB2B	158.	1.17	85.	66.	66.	0.50		
2 COMBINED AT	SUB2	317.	1.17	169.	131.	131.	1.00		
DIVERSION TO	SD2	52.	1.17	52.	47.	47.	1.00		
HYDROGRAPH AT	SUB2	265.	1.17	117.	85.	85.	1.00		
ROUTED TO	RET2	94.	3.92	31.	22.	22.	1.00	3.18	3.92
HYDROGRAPH AT	SUB3A	181.	3.92	132.	100.	100.	1.66		
DIVERSION TO	RID	150.	3.92	123.	94.	94.	1.66		
HYDROGRAPH AT	SUB3A	31.	3.92	9.	6.	6.	1.66		
ROUTED TO	SUB4	28.	4.17	9.	6.	6.	1.66		
HYDROGRAPH AT	SUB4	260.	1.17	175.	135.	135.	1.06		
ROUTED TO	RET4	211.	3.50	95.	69.	69.	1.06	3.31	3.50
2 COMBINED AT	SUB4	212.	3.50	101.	75.	75.	2.72		
HYDROGRAPH AT	SUB5B	167.	1.17	88.	68.	68.	0.50		
HYDROGRAPH AT	SUB5A	167.	1.17	88.	68.	68.	0.50		
2 COMBINED AT	SUB5	333.	1.17	175.	136.	136.	1.00		
ROUTED TO	RET5	188.	3.17	96.	69.	69.	1.00	3.28	3.17
ROUTED TO	SUB6	188.	3.25	95.	68.	68.	1.00		
HYDROGRAPH AT	SUB6A	435.	1.25	95.	69.	69.	0.75		
ROUTED TO	SUB6A	317.	1.67	62.	45.	45.	0.75	3.56	1.67
HYDROGRAPH AT	SUB6B	123.	0.92	16.	12.	12.	0.13		
3 COMBINED AT	SUB6	352.	1.58	160.	125.	125.	1.88		
ROUTED TO	SUB6	347.	1.67	159.	124.	124.	1.88		
HYDROGRAPH AT	SUB6C	123.	0.92	16.	12.	12.	0.13		
2 COMBINED AT	SUB6	377.	1.67	174.	136.	136.	2.00		
ROUTED TO	SUB7	339.	1.92	172.	133.	133.	2.00		
HYDROGRAPH AT	SUB7	191.	1.67	104.	79.	79.	0.58		
ROUTED TO	RET7	141.	3.00	55.	40.	40.	0.58		

								3.23	3.00
2 COMBINED AT	SUB7	369.	3.33	223.	173.	173.	2.58		
HYDROGRAPH AT	SUB8	183.	1.17	71.	53.	53.	0.36		
ROUTED TO	DET8	149.	2.00	71.	53.	53.	0.36	2.28	2.00
HYDROGRAPH AT	SUB9	387.	1.17	132.	98.	98.	0.66		

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

101

$ EXIT

SHIAU Job terminated at 11-JUN-1985 11:09:19.49

Accounting information:

Buffered I/O count:	83	Peak working set size:	661
Direct I/O count:	137	Peak page file size:	791
Page faults:	501	Mounted volumes:	0
Elapsed CPU time:	0 00:00:28.53	Elapsed time:	0 00:00:54.36

APPENDIX C

Hydraulic Computer Output

11:24:52 2-AUG-85

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : SHI-EN SHIAU

****
MCFCD
INDIAN SCHOOL ROAD
BW=4', SLOPE = 0.0015, SIDE SLOPE = 1:1, LINED (n=0.02)
DESIGN DISCHARGE AT 377 CFS
****

SECTION # 1 STATION 1.00

NORMAL FLOW COMPUTATION

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	6.22	16.44	63.61	1.0:1	1.0:1	21.60

FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.53	5.93	0.00150	377.00	0.02000	4.53	9.76

11:24:52 2-AUG-85

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : SHI-EN SHIAU

****
MCECD
INDIAN SCHOOL ROAD CHANNEL
BW = 4', SLOPE = 0.0015, SIDE SLOPE = 1:1, LINED (n=0.02)
MAXIMUN DEPTH AT 10', MAXIMUN TOP WIDTH = 24'
****

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	0.50	5.00	2.25	1.0:1	1.0:1	5.41
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.42	1.61	0.00150	3.62	0.02000	0.29	2.94

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	1.00	6.00	5.00	1.0:1	1.0:1	6.83
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.45	2.34	0.00150	11.72	0.02000	0.61	4.17

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	1.50	7.00	8.25	1.0:1	1.0:1	8.24
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.47	2.89	0.00150	23.82	0.02000	0.95	5.07

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	2.00	8.00	12.00	1.0:1	1.0:1	9.66
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.48	3.34	0.00150	40.02	0.02000	1.30	5.80

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	2.50	9.00	16.25	1.0:1	1.0:1	11.07
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC

0.49	3.73	0.00150	60.56	0.02000	1.66	6.43

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	3.00	10.00	21.00	1.0:1	1.0:1	12.49
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.50	4.08	0.00150	85.70	0.02000	2.03	6.99

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	3.50	11.00	26.25	1.0:1	1.0:1	13.90
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.50	4.41	0.00150	115.72	0.02000	2.41	7.51

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	4.00	12.00	32.00	1.0:1	1.0:1	15.31
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.51	4.72	0.00150	150.91	0.02000	2.79	7.98

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	4.50	13.00	38.25	1.0:1	1.0:1	16.73
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.51	5.01	0.00150	191.55	0.02000	3.17	8.42

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	5.00	14.00	45.00	1.0:1	1.0:1	18.14
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.52	5.29	0.00150	237.92	0.02000	3.56	8.83

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	5.50	15.00	52.25	1.0:1	1.0:1	19.56
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.52	5.56	0.00150	290.28	0.02000	3.96	9.22

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	6.00	16.00	60.00	1.0:1	1.0:1	20.97
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.53	5.82	0.00150	348.91	0.02000	4.35	9.60

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	6.50	17.00	68.25	1.0:1	1.0:1	22.38
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.53	6.07	0.00150	414.07	0.02000	4.75	9.96

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	7.00	18.00	77.00	1.0:1	1.0:1	23.80
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.54	6.31	0.00150	486.01	0.02000	5.15	10.30

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	7.50	19.00	86.25	1.0:1	1.0:1	25.21
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.54	6.55	0.00150	565.00	0.02000	5.56	10.64

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	8.00	20.00	96.00	1.0:1	1.0:1	26.63
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.55	6.78	0.00150	651.28	0.02000	5.97	10.95

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	8.50	21.00	106.25	1.0:1	1.0:1	28.04
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.55	7.01	0.00150	745.10	0.02000	6.37	11.27

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER

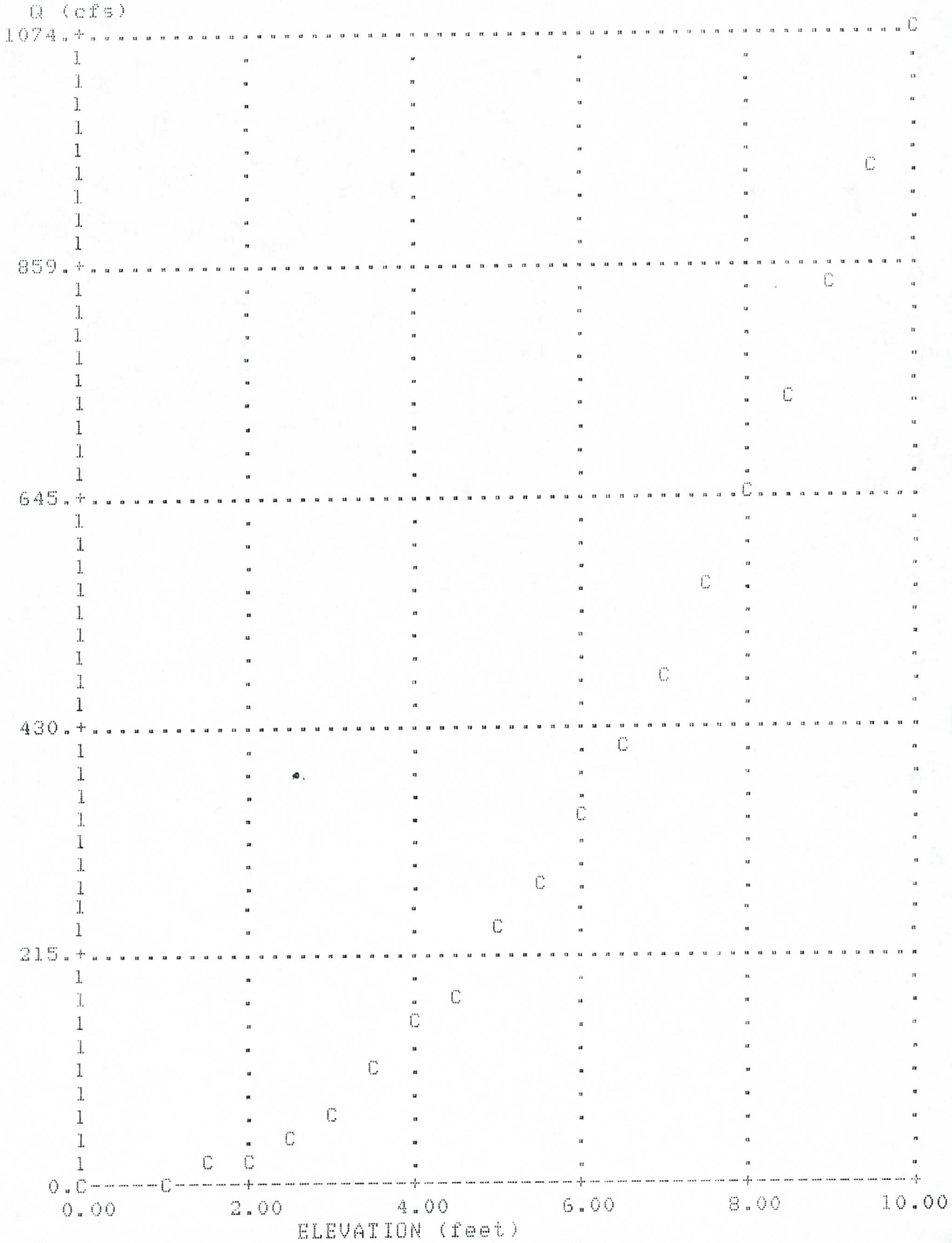
4.00	9.00	22.00	117.00	1.0:1	1.0:1	29.46
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.55	7.24	0.00150	846.70	0.02000	6.78	11.57

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	9.50	23.00	128.25	1.0:1	1.0:1	30.87
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.56	7.46	0.00150	956.33	0.02000	7.20	11.87

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
4.00	10.00	24.00	140.00	1.0:1	1.0:1	32.28
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.56	7.67	0.00150	1074.21	0.02000	7.61	12.16

ELEVATION - DISCHARGE CURVE

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	0.00	11.72	1.00
23.82	1.50	40.02	2.00
60.56	2.50	85.70	3.00
115.72	3.50	150.91	4.00
191.55	4.50	237.92	5.00
290.28	5.50	348.91	6.00
414.07	6.50	486.01	7.00
565.00	7.50	651.28	8.00
745.10	8.50	846.70	9.00
956.33	9.50	1074.21	10.00



C : CULVERT/CHANNEL Q

11:14:33 12-AUG-85

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : DR. LONG-CHENG HUANG

****
WEST OF 107TH UNLINED CHANNLE
BW=8',S=0.0015,Q=377 CFS,N=0.025,S.S.=3:1

****

SECTION # 1 STATION 0.00

NORMAL FLOW COMPUTATION

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
8.00	4.25	33.48	88.06	3.0:1	3.0:1	34.86

FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.47	4.28	0.00150	377.00	0.02500	2.89	7.82

15:20:17 30-JUL-85

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USER : SHI-EN SHIAU

****

MCFCD
107TH STREET AND INDIAN SCHOOL ROAD
111TH STREET AND INDIAN SCHOOL ROAD
PHASE 1
2-8'x4'x150' RCBC

****

** CULVERT COMPUTATION **

BOX CULVERT

DOWNSTREAM CONTROL -
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 4.78
NORMAL DEPTH = 3.50
VELOCITY = 6.73 FROUDE NUMBER = 0.63
U.S. FREE BOARD IS 1.22 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
4.781	4.746	3.722	4.781	4.670

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
2.583	9.121	3.501	6.730	0.634
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
0.000	3.740	0.225	4.781	6.000
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
377.000	64.000	150.000	0.150	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
0.000	4.000	8.000	2.000	1.726

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.500

15:20:17 30-JUL-85

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USER : SHI-EN SHIAU

****

MCFCD

INVERTED SIPHON AT 107TH AND INDIAN SCHOOL ROAD

PHASE 1 - ALTERNATIVE

2- 6'x6'x180' RCBC

****

** CULVERT COMPUTATION **

BOX CULVERT

CULVERT IS NOT RUNNING FULL, PRESSURE FLOW IS NOT ADEQUATE

DOWNSTREAM CONTROL -

TOTAL ENERGY (MAXIMUN PONDING ELEVATION) IS 5.96

NORMAL DEPTH = 4.72

VELOCITY = 6.65 FROUDE NUMBER = 0.54

U.S. FREE BOARD IS 0.04 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
5.955	5.590	4.453	5.955	6.022

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
3.130	10.037	4.724	6.651	0.539
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
0.000	4.960	0.270	5.955	6.000
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
377.000	72.000	180.000	0.150	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
0.000	6.000	6.000	2.000	2.496

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.792	0.400	0.000	0.600	0.400

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10:47:34     6-AUG-85

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                                                    USER : SHI-EN SHIAU
*****************************************************************************
MCFCD
107TH STREET AND RID CHANNL
1-8'x4'x150' RCBC
*****************************************************************************

** CULVERT COMPUTATION **

BOX CULVERT

OUTLET WSEL IS        3.10 NOT       0.00 ( IF PRESSURE FLOW CONTROL )
DOWNSTREAM CONTROL -
TOTAL ENERGY (MAXIMUN PONDING ELEVATION ) IS        4.10
NORMAL DEPTH =        2.95
VELOCITY =        6.32 FROUDE NUMBER =        0.65
U.S. FREE BOARD IS  0.90 FEET

                    SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY  INLET CRITICAL   ORIFICE FLOW   NORMAL FLOW   PRESSURE FLOW
```

4.103	4.090	3.160	4.103	3.779

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
2.209	8.432	2.949	6.316	0.648
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
0.000	3.104	0.225	4.103	5.000
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
149.000	32.000	150.000	0.150	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
0.000	4.000	8.000	1.000	2.003

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.500

10:47:34 6-AUG-85

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USER : SHI-EN SHIAU

15:20:17 30-JUL-85

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USER : SHI-EN SHIAU

****

MCFCD
EXISTING 24"x275' RCP
PHEONIX SAND AND ROCK AT INDIAN SCHOOL ROAD

****

** CULVERT COMPUTATION **

OUTLET WSEL IS 987.45 NOT 0.00 (IF PRESSURE FLOW CONTROL)
DOWNSTREAM CONTROL -
TOTAL ENERGY (MAXIMUN PONDING ELEVATION) IS 988.05
NORMAL DEPTH = 0.50
VELOCITY = 3.22 FROUDE NUMBER = 0.95
U.S. FREE BOARD IS 10.85 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
988.045	988.051	988.317	988.045	987.476

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
0.491	3.345	0.504	3.216	0.947
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	987.445	987.300	988.045	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
2.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.55 NOT 0.00 (IF PRESSURE FLOW CONTROL)
INLET CONTROL- CRITICAL FLOW AT INLET OF THE CULVERT
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 988.39
OUTLET WSEL IS 986.92 NOT 987.55
U.S. FREE BOARD IS 10.51 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
988.387	988.387	988.370	988.379	987.674

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
0.701	4.071	0.722	3.912	0.945
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	986.922	987.300	988.387	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
4.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.63 NOT 0.00 (IF PRESSURE FLOW CONTROL)
INLET CONTROL- CRITICAL FLOW AT INLET OF THE CULVERT
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 988.66
OUTLET WSEL IS 987.10 NOT 987.63
U.S. FREE BOARD IS 10.24 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
988.659	988.659	988.457	988.645	987.911

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
0.866	4.602	0.902	4.364	0.925
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	987.102	987.300	988.659	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
6.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.70 NOT 0.00 (IF PRESSURE FLOW CONTROL)
INLET CONTROL- CRITICAL FLOW AT INLET OF THE CULVERT
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 988.90
OUTLET WSEL IS 987.27 NOT 987.70
U.S. FREE BOARD IS 10.00 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
988.901	988.901	988.580	988.880	988.198

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.007	5.049	1.067	4.691	0.894
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	987.267	987.300	988.901	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
8.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.77 NOT 0.00 (IF PRESSURE FLOW CONTROL)
INLET CONTROL- CRITICAL FLOW AT INLET OF THE CULVERT
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 989.12
OUTLET WSEL IS 987.43 NOT 987.77
U.S. FREE BOARD IS 9.78 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
989.125	989.125	988.737	989.097	988.539

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.131	5.456	1.229	4.937	0.853
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	987.429	987.300	989.125	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
10.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.82 NOT 0.00 (IF PRESSURE FLOW CONTROL)
INLET CONTROL- CRITICAL FLOW AT INLET OF THE CULVERT
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 989.34
OUTLET WSEL IS 987.60 NOT 987.82
U.S. FREE BOARD IS 9.56 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
989.339	989.339	988.929	989.308	988.936

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.244	5.841	1.399	5.111	0.796
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	987.599	987.300	989.339	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
12.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.87 NOT 0.00 (IF PRESSURE FLOW CONTROL)
INLET CONTROL- CRITICAL FLOW AT INLET OF THE CULVERT
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 989.55
OUTLET WSEL IS 987.80 NOT 987.87
U.S. FREE BOARD IS 9.35 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
989.548	989.548	989.157	989.528	989.389

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.348	6.216	1.597	5.205	0.708
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	987.797	987.300	989.548	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
14.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	0.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.92 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 989.90
U.S. FREE BOARD IS 9.00 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
989.900	989.756	989.419	0.000	989.900

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.442	6.597	0.000	5.093	0.000
D.S. ELEV	D.S. WSEL	U.S. ELEV	U.S. WSEL	SHOULDER ELEV.
986.200	987.921	987.300	989.900	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
16.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 987.96 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 990.47
U.S. FREE BOARD IS 8.43 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
990.469	989.966	989.716	0.000	990.469

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.528	6.988	0.000	5.730	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	987.964	987.300	990.469	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
18.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.00 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 991.10
U.S. FREE BOARD IS 7.80 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
991.096	990.180	990.048	0.000	991.096

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.606	7.397	0.000	6.366	0.000
D.S. FLEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.003	987.300	991.096	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
20.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.04 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 991.78
U.S. FREE BOARD IS 7.12 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
991.779	990.403	990.415	0.000	991.779

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.675	7.831	0.000	7.003	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.037	987.300	991.779	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
22.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.07 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 992.52
U.S. FREE BOARD IS 6.38 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
992.521	990.636	990.817	0.000	992.521

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.735	8.291	0.000	7.639	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.068	987.300	992.521	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
24.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.09 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 993.32
U.S. FREE BOARD IS 5.58 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
993.319	990.882	991.254	0.000	993.319

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.786	8.781	0.000	8.276	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.093	987.300	993.319	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
26.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 989.11 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 994.18
U.S. FREE BOARD IS 4.72 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
994.176	991.143	991.726	0.000	994.176

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.828	9.300	0.000	8.913	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.114	987.300	994.176	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
28.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.13 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 995.09
U.S. FREE BOARD IS 3.81 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
995.090	991.420	992.233	0.000	995.090

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.862	9.844	0.000	9.549	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.131	987.300	995.090	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
30.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.14 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 996.06
U.S. FREE BOARD IS 2.84 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
996.062	991.714	992.775	0.000	996.062

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.890	10.411	0.000	10.186	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.145	987.300	996.062	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
32.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.16 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 997.09
U.S. FREE BOARD IS 1.81 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
997.093	992.027	993.352	0.000	997.093

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.911	10.995	0.000 -	10.823	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.156	987.300	997.093	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
34.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

OUTLET WSEL IS 988.20 NOT 0.00
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 998.22
U.S. FREE BOARD IS 0.68 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
998.220	0.000	993.964	0.000	998.220

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
0.000	0.000	0.000	11.459	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
986.200	988.200	987.300	998.220	998.900
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
36.000	3.142	275.000	0.400	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.000	0.000	0.000	1.000	4.914

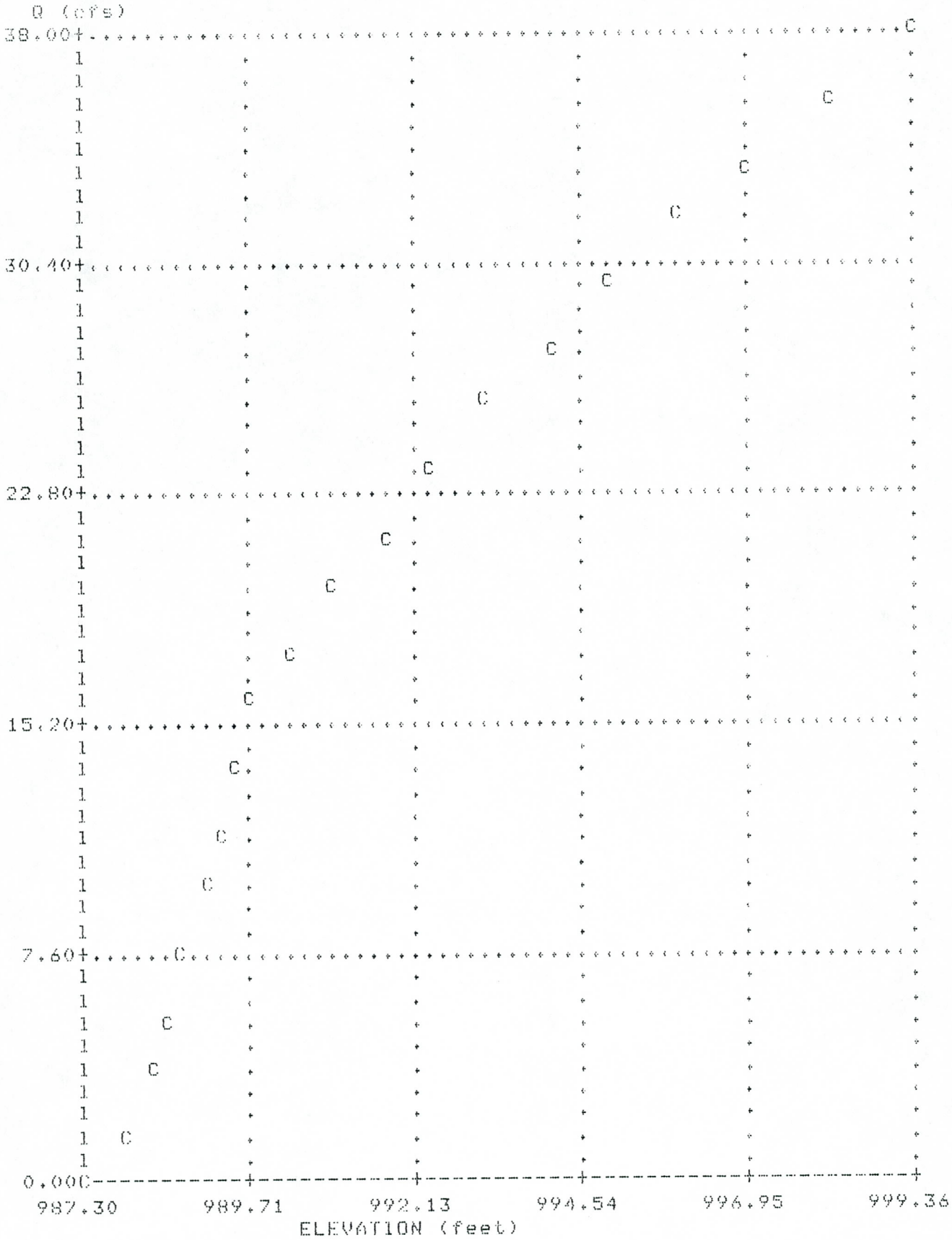
SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

CULVERT RATING SUMMARY TABLE

ELEVATION - DISCHARGE CURVE

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	987.30	2.00	988.05
4.00	988.39	6.00	988.66
8.00	988.90	10.00	989.12
12.00	989.34	14.00	989.55
16.00	989.90	18.00	990.47
20.00	991.10	22.00	991.78
24.00	992.52	26.00	993.32
28.00	994.18	30.00	995.09
32.00	996.06	34.00	997.09
36.00	998.22	38.00	999.36



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USER : SHI-EN SHIAU

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MCFCD

CAMELBACK ROAD CHANNEL

V-SHAPE, SLOPE = 0.0015, SIDE SLOPE = 3:1, UNLINED (n = 0.03)

MAXIMUN DEPTH = 4', MAXIMUN TOP WIDTH = 24'

****

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.20	1.20	0.12	3.0:1	3.0:1	1.26
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.22	0.40	0.00150	0.05	0.03000	0.11	1.33

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.40	2.40	0.48	3.0:1	3.0:1	2.53
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.25	0.64	0.00150	0.30	0.03000	0.23	1.92

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.60	3.60	1.08	3.0:1	3.0:1	3.79
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.27	0.83	0.00150	0.90	0.03000	0.35	2.39

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.80	4.80	1.92	3.0:1	3.0:1	5.06
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.28	1.01	0.00150	1.94	0.03000	0.48	2.78

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.00	6.00	3.00	3.0:1	3.0:1	6.32
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC

0.29	1.17	0.00150	3.51	0.03000	0.61	3.14

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.20	7.20	4.32	3.0:1	3.0:1	7.59
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.30	1.32	0.00150	5.71	0.03000	0.74	3.46

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.40	8.40	5.88	3.0:1	3.0:1	8.85
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.31	1.46	0.00150	8.61	0.03000	0.87	3.75

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.60	9.60	7.68	3.0:1	3.0:1	10.12
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.32	1.60	0.00150	12.29	0.03000	1.01	4.03

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.80	10.80	9.72	3.0:1	3.0:1	11.38
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.32	1.73	0.00150	16.83	0.03000	1.14	4.29

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.00	12.00	12.00	3.0:1	3.0:1	12.65
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.33	1.86	0.00150	22.29	0.03000	1.28	4.54

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.20	13.20	14.52	3.0:1	3.0:1	13.91
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.33	1.98	0.00150	28.74	0.03000	1.42	4.78

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.40	14.40	17.28	3.0:1	3.0:1	15.18
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.34	2.10	0.00150	36.24	0.03000	1.55	5.00

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.60	15.60	20.28	3.0:1	3.0:1	16.44
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.34	2.21	0.00150	44.86	0.03000	1.69	5.22

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.80	16.80	23.52	3.0:1	3.0:1	17.71
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.35	2.32	0.00150	54.67	0.03000	1.83	5.43

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	3.00	18.00	27.00	3.0:1	3.0:1	18.97
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.35	2.43	0.00150	65.71	0.03000	1.97	5.63

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	3.20	19.20	30.72	3.0:1	3.0:1	20.24
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.35	2.54	0.00150	78.05	0.03000	2.11	5.83

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	3.40	20.40	34.68	3.0:1	3.0:1	21.50
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.36	2.65	0.00150	91.74	0.03000	2.25	6.02

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER

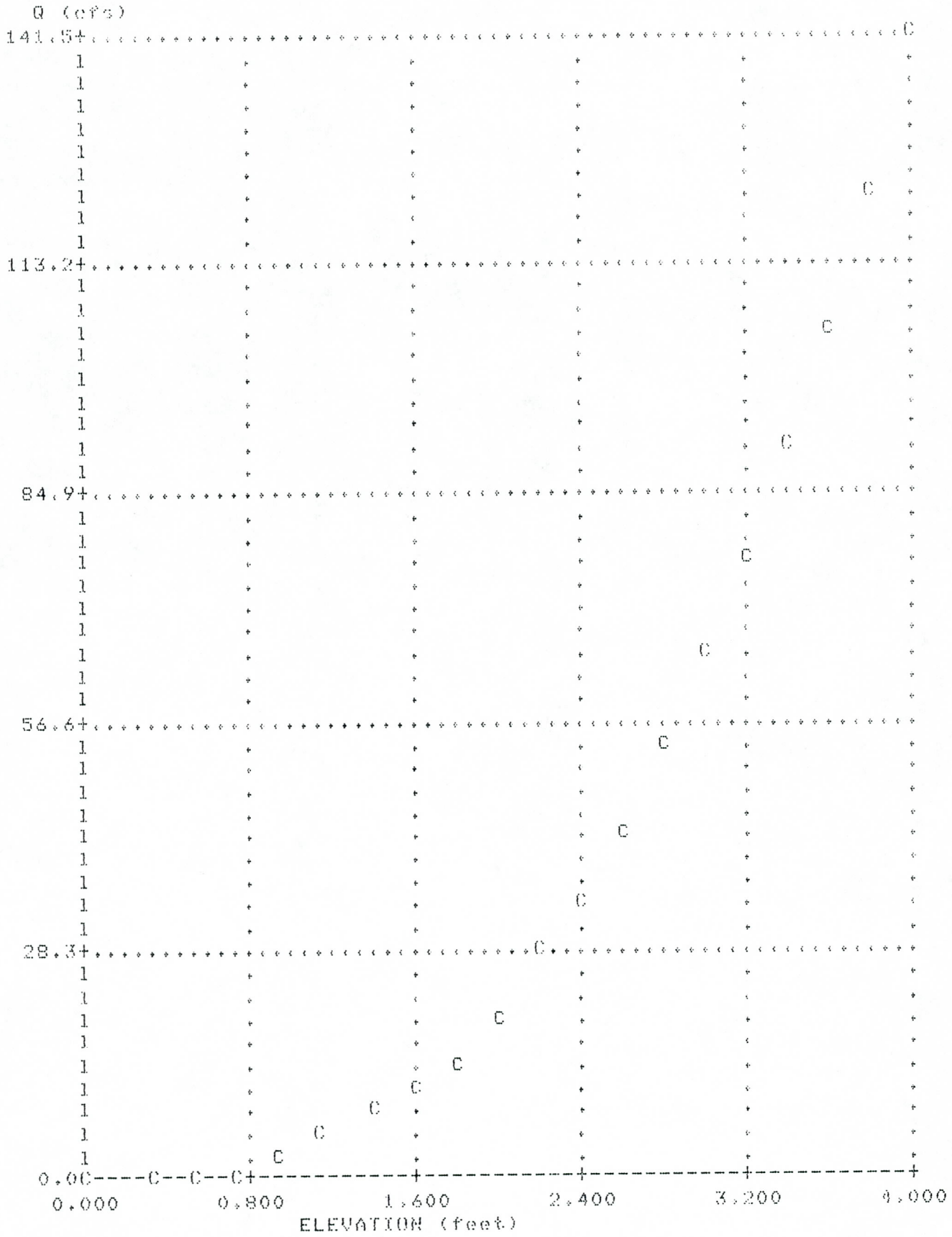
0.00	3.60	21.60	38.88	3.0:1	3.0:1	22.77
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.36	2.75	0.00150	106.85	0.03000	2.40	6.21

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	3.80	22.80	43.32	3.0:1	3.0:1	24.03
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.36	2.85	0.00150	123.42	0.03000	2.54	6.39

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	4.00	24.00	48.00	3.0:1	3.0:1	25.30
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.37	2.95	0.00150	141.51	0.03000	2.68	6.57

ELEVATION - DISCHARGE CURVE

DISCHARGE	EG/YR	DISCHARGE	EG/YR
0.00	0.00	0.30	0.40
0.90	0.60	1.94	0.80
3.51	1.00	5.71	1.20
8.61	1.40	12.29	1.60
16.83	1.80	22.29	2.00
28.74	2.20	36.24	2.40
44.86	2.60	54.67	2.80
65.71	3.00	78.05	3.20
91.74	3.40	106.85	3.60
123.42	3.80	141.51	4.00



C : CULVERT/CHANNEL Q

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USER : SHI-EN SHIAU

****
MCFCD
99TH STREET AND CAMELBACK ROAD
1-54'x150' RCP
****

** CULVERT COMPUTATION **

CIRCULAR CULVERT

OUTLET WSEL IS 3.67 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 4.90
U.S. FREE BOARD IS 1.10 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
4.902	4.902	3.982	0.000	4.902

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
2.845	8.868	0.000	5.910	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
0.000	3.673	0.225	4.902	6.000
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
94.000	15.904	150.000	0.150	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
4.500	0.000	0.000	1.000	2.132

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

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USER : SHI-EN SHIAU

****
MCFCD
107TH STREET AND CAMELBACK ROAD
1-30'x150' RCP
****

** CULVERT COMPUTATION **

CIRCULAR CULVERT

OUTLET WSEL IS 2.20 NOT 0.00 (IF PRESSURE FLOW CONTROL)
OUTLET CONTROL- PRESSURE FLOW
TOTAL ENERGY (MAXIMUM PONDING ELEVATION) IS 3.98
U.S. FREE BOARD IS 2.02 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
3.984	3.523	3.195	0.000	3.984

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
1.897	7.756	0.000	6.315	0.000
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
0.000	2.199	0.225	3.984	6.000
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
31.000	4.909	150.000	0.150	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
2.500	0.000	0.000	1.000	2.883

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000

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USER : SHI-EN SHIAU

****
MCFCD
99TH STREET AND INDIAN SCHOOL ROAD
PHASE 2
1-8'x4'x150' RCBC
****

** CULVERT COMPUTATION **

BOX CULVERT

DOWNSTREAM CONTROL -
TOTAL ENERGY (MAXIMUN PONDING ELEVATION) IS 4.77
NORMAL DEPTH = 3.49
VELOCITY = 6.73 FROUDE NUMBER = 0.63
U.S. FREE BOARD IS 1.23 FEET

SUMMARY OF ENERGY COMPUTATION

CONTROL ENERGY	INLET CRITICAL	ORIFICE FLOW	NORMAL FLOW	PRESSURE FLOW
4.773	4.738	3.714	4.773	4.073

SUMMARY OF HYDRAULIC CHARACTERS

CRITICAL DEPTH	CRITICAL VEL	NORMAL DEPTH	VELOCITY	FROUDE
2.579	9.113	3.494	6.726	0.634
D.S. ELEM	D.S. WSEL	U.S. ELEM	U.S. WSEL	SHOULDER ELEV.
0.000	3.000	0.225	4.773	6.000
DISCHARGE	AREA	LENGTH	SLOPE %	MANNINGS N
188.000	32.000	150.000	0.150	0.013
PIPE DIAMETER	BOX HEIGHT	BOX WIDTH	# OF CELLS	XKOR
0.000	4.000	8.000	1.000	2.003

SUMMARY OF LOSS COEFFICIENT

BEND	CONTRACTION	EXPANSION	ORIFICE	INTERMEDIATE
0.000	0.500	0.000	0.600	0.000