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## Flood Control District of Maricopa County

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*Skunk Creek Floodplain Delineation Study  
FCD 95-16*

## Technical Data Notebook

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June 1997



MONTGOMERY WATSON



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**Flood Control District  
of Maricopa County**

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*Skunk Creek Floodplain Delineation Study  
FCD 95-16*

**Technical Data Notebook**

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June 1997



MONTGOMERY WATSON

**SKUNK CREEK  
FLOODPLAIN DELINEATION STUDY**

**Between the Central Arizona Project Aqueduct  
and New River Mountain**

**FCDMC CONTRACT 95-16**

**TECHNICAL DATA NOTEBOOK**

June 1997

Prepared for:

Flood Control District of Maricopa County  
2801 W. Durango Street  
Phoenix, AZ 85009  
(602) 506-1601

Prepared by:

Montgomery Watson Americas, Inc.  
6245 North 24th Parkway, Suite 208  
Phoenix, AZ 85016  
(602) 954-6781

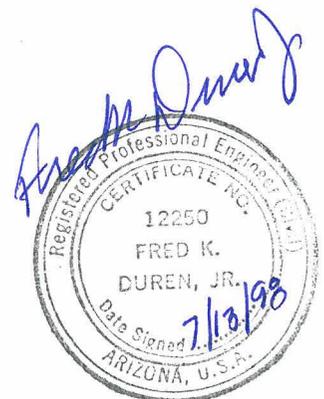


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**PREFACE**

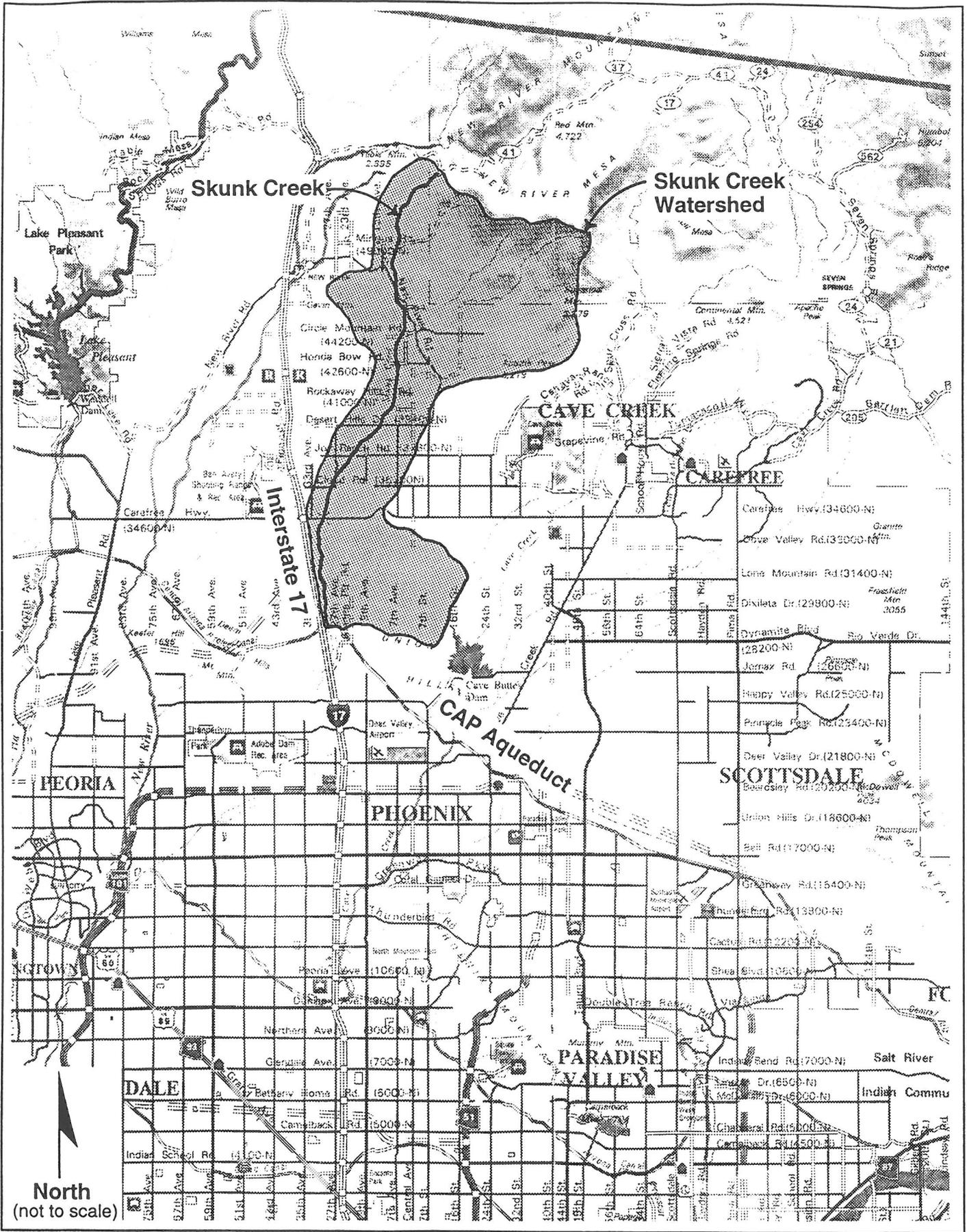
SKUNK CREEK FLOODPLAIN DELINEATION STUDY  
FCD 95-16

PREFACE

Montgomery Watson Americas, Inc., (Montgomery Watson) was retained by the Flood Control District of Maricopa County (District) to perform a floodplain delineation re-study of a portion of Skunk Creek located in north-central Maricopa County, Arizona (**Figure 1**). The objectives of this study are to (1) obtain updated topographic mapping in digital form, (2) review and update existing hydrology, and (3) revise existing 100-year floodplain and floodway boundaries based on updated information.

The scope of the project consists of topographic mapping and floodplain delineation of approximately 10 river miles of Skunk Creek from the Central Arizona Project (CAP) Aqueduct to New River Mountain. Approximately 2.6 miles of existing floodplain mapping, located within the Montgomery Watson study area and performed by another consultant for a developer, were incorporated into the project.

Revised hydrology was developed for the entire Skunk Creek watershed tributary to the CAP Aqueduct (approximately 43 square miles) using the U.S. Army Corps of Engineer's (Corps) HEC-1 computer model. Backwater analysis was performed for the mainstream Skunk Creek using the Corps HEC-2 computer model. Floodplain and floodway delineations were determined based on the 100-year peak discharges estimated by the revised hydrology. Please refer to the following Study Documentation Abstract for specific information about this project.



Location Map  
Figure 1

**STUDY DOCUMENTATION  
ABSTRACT**

## STUDY DOCUMENTATION ABSTRACT

STUDY DOCUMENTATION ABSTRACT	INITIAL STUDY	RE STUDY	X	LOMR	OTHER
<b>SECTION 1: GENERAL INFORMATION</b>					
1A	COMMUNITY	Maricopa County, Arizona, and Incorporated Areas			
1B	COMMUNITY NUMBER	04013			
1C	COUNTY	Maricopa			
1D	STATE	Arizona			
1E	DATE STUDY ACCEPTED				
1F	STUDY CONTRACTOR CONTACT(S) ADDRESS PHONE INTERNAL REF #	Montgomery Watson Americas, Inc. Fred K. Duren, Jr., P.E., P.G. 6245 North 24th Parkway, Suite 208 Phoenix, AZ 85016 (602) 954-6781			
1G	TECH. REVIEWER (FEMA) PHONE				
1H	FEMA REGIONAL REVIEWER PHONE				
1I	STATE REVIEWER PHONE				
1J	LOCAL REVIEWER PHONE	Flood Control District of Maricopa County Hasan Mushtaq, P.E. 2801 W. Durango Phoenix, AZ 85009 (602) 506-1501			
1K	RIVER OR STREAM NAME	Skunk Creek			
1L	REACH DESCRIPTION (FIRM PANEL & EPA REACH #)	Between New River Mountain and the Central Arizona Project Aqueduct			
1M	STUDY TYPE (RIVERINE, ALLUVIAL FAN, ETC.)	Riverine			
<b>SECTION 2: MAPPING INFORMATION</b>					
2A	USGS QUAD SHEET(S)	7.5 Minute: New River (1981); Daisy Mountain (1964); Biscuit Flat (1981); New River SE (1981); Hedgepeth Hills (1981); Union Hills (1981)			
2B	MAPPING FOR HYDROLOGIC STUDY TYPE/SOURCE SCALE DATE	USGS 7.5 Minute Quadrangle (see above) 1" = 2000' (see above)			





**Section 1**



## SECTION 1 - GENERAL DOCUMENTATION AND CORRESPONDENCE

### 1.1 Special Problem Reports

Several unique situations were identified and evaluated during the hydraulic analysis portion of the study. An explanation of these special problems and associated solutions are included in the Special Problems section (Section 4.5) of the Hydraulic Analysis Report, which is Section 4.0 of this Technical Data Notebook.

### 1.2 Contact (Telephone) Reports, Memoranda, And Letters

With the exception of meetings, correspondence with the District and other agencies/consultants was typically made through telephone conversations, facsimiles, transmittals, and letters. Most telephone conversations, especially those related to project scope, contract agreements, or project decisions, were documented with telephone memoranda; and copies were kept of all pertinent facsimiles, transmittals, and letters. Copies of these Communication Documentation, memoranda, and letters are included in **Appendix A**.

### 1.3 Meeting Minutes

Coordination with the District was primarily through monthly progress, coordination, and/or technical submittal review meetings. It was Montgomery Watson's responsibility to prepare minutes for all meetings and distribute copies to attendees for review. Based on review comments from attendees, the draft minutes were revised, finalized, and once again distributed. Copies of these meeting minutes are included in **Appendix B**.

### 1.4 General Correspondence

#### 1.4.1 Community

Montgomery Watson, in cooperation with the District, notified the public of the initiation of the Skunk Creek Floodplain Delineation Study (FDS). The purpose of this notification was to inform local residents and all other effected parties (e.g., land owners) of the study, and to provide them with the opportunity to comment. Further, the notification was used to inform land owners that surveying needs of this project may require that survey crews enter their properties.

Notification of the project was published two separate times in two local newspapers, with approximately one to two weeks between runs (see sub-section 1.4.7). In addition, a news release was prepared and distributed by the District announcing the public meeting for the Skunk Creek FDS.

Property owners within the study limits were researched through the District's GIS database. A form letter was prepared by Montgomery Watson and a copy was sent to each property owner whose property may need to be entered for surveying activities. Copies of the Affidavits of Publication, Right of Entry letters, and ownership list are included in **Appendix C**.

A second public meeting is scheduled to be held when the floodplain delineation study is substantially complete. The purpose of this meeting will be to inform property owners, local residents, and interested parties of the results of the study. This will not be held before submission of the Technical Data Notebook; however, the public notification documents that will be released for this meeting are included in **Appendix D**.

#### **1.4.2 State Coordinator**

The Arizona Department of Water Resources (ADWR) is the state coordinator for floodplain delineation studies performed within Arizona. All relevant coordination with ADWR during this project is included in **Appendix E**.

(Hasan provides copies of correspondence)

#### **1.4.3 Other Agencies**

The Maricopa County Department of Transportation was contacted in order to acquire as-built drawings for the Carefree Highway and New River Road bridges.

#### **1.4.4 FEMA Regional Officer**

(See Appendix F)

#### **1.4.5 FEMA Washington**

(See Appendix F)

#### **1.4.6 FEMA Technical Consultant**

(See Appendix F)

#### **1.4.7 Copies of Public Notices**

A Public Notice was prepared by the District and reviewed by Montgomery Watson. It was cooperatively determined that the Public Notice would be published in The Arizona Republic on December 14 and 28, 1995, and the Foothills Sentinel on December 13 and 20, 1995. Copies of the Affidavits of Publication are included in **Appendix C**.

### **1.5 Contract Documents**

A copy of the contract between the District and Montgomery Watson, which includes the project scope of work, is provided in **Appendix G**.

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## Section 2

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**MONTGOMERY WATSON**

## SECTION 2 - MAPPING AND SURVEY INFORMATION

### 2.1 Description Of Mapping

The topographic mapping used for the hydrologic analysis of the Skunk Creek watershed was the United States Geological Survey (USGS) 7.5 minute quadrangle maps, including:

New River, AZ 1981;  
Daisy Mountain, AZ 1964;  
Biscuit Flat, AZ 1981;  
New River SE, AZ 1981;  
Hedgepeth Hills, AZ 1981; and  
Union Hills, AZ 1981.

The mapping used for the hydraulic analysis was 1 inch = 200 feet aerial topography with a 2-foot contour interval. The aerial mapping was prepared by Kenney Aerial Mapping, Inc. for the Skunk Creek FDS, and was photographed on December 1, 1995, and on May 14, 1996 (extension). The horizontal datum used for the aerial mapping is the Arizona State Plane Coordination System 1983 NAD, and the vertical datum used is the National Geodetic Vertical Datum of 1929 (NGVD 1929). Horizontal and vertical control tabulation and the conversion factor which allows comparison of NGVD 1929 elevations to NAVD 1988 elevations are provided in the Surveyor's Report, under separate cover.

### 2.2 Index Of Maps

An index of the aerial topographic maps prepared for this study are presented as **Figure 2**.

### 2.3 Survey Field Notes

Survey control for the aerial mapping was performed by Collins/Pina Consulting Engineers, Inc. Survey field notes, control points, raw data, and all pertinent information is provided in the Surveyor's Report, under separate cover.

### 2.4 Watershed Maps

The hydrologic analysis maps prepared for this study are provided in Section 3 of the Technical Data Notebook (Hydrologic Analysis), under separate cover.

### 2.5 Hydraulic Analysis Maps

Maps presenting the 100-year floodplain and floodway delineations for Skunk Creek are provided in Section 4 of the Technical Data Notebook (Hydraulic Analysis), under separate cover.

### 2.6 FIRM Maps

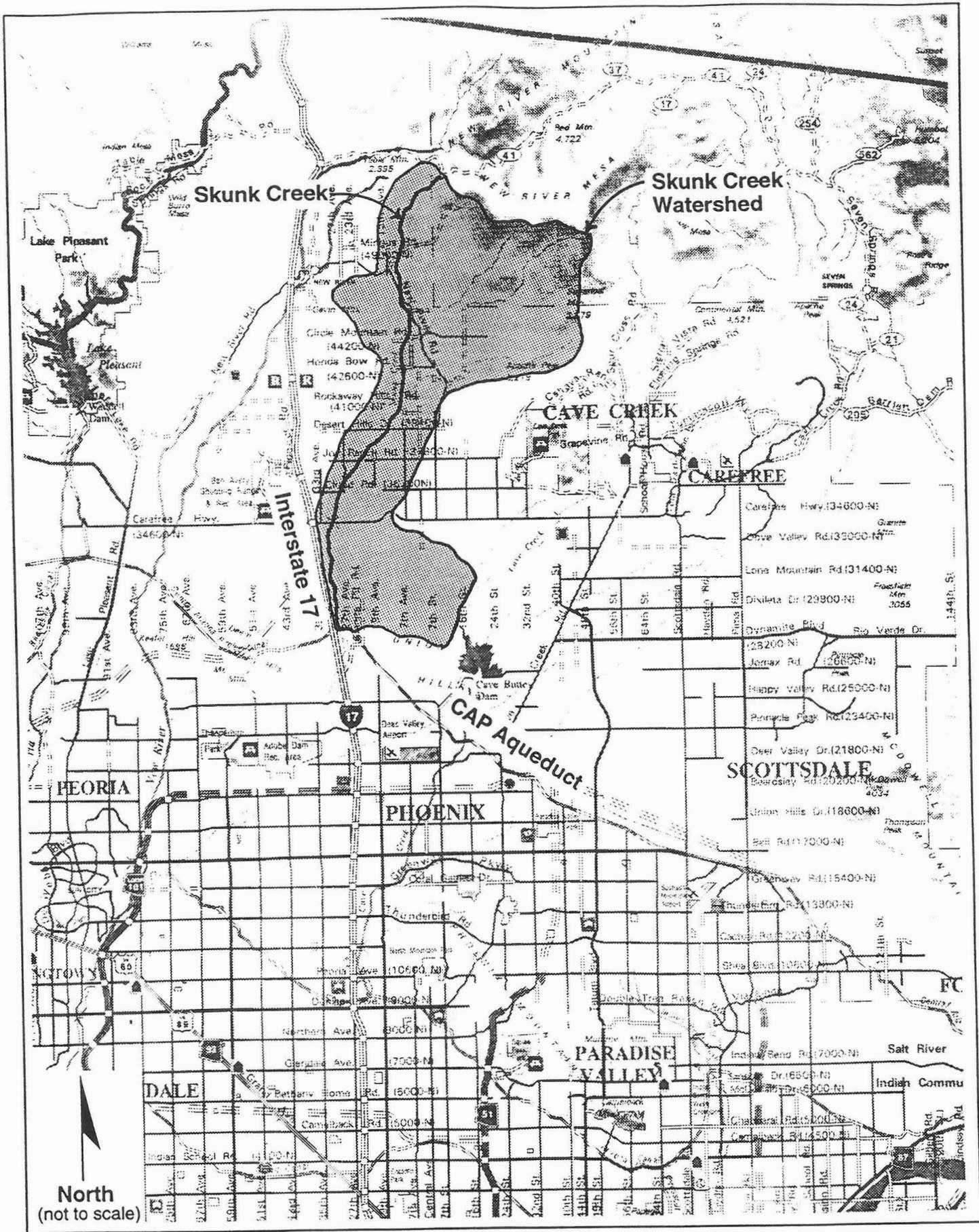
The current (effective) Flood Insurance Rate Maps (FIRMs) for the study area include: Maricopa County, Arizona and Incorporated Area, Map numbers 04013C1205E (rev. December 3, 1993), 04013C0790D (rev. April 15, 1988), 04013C0770D (rev. April 15, 1988), 04013C0780E (rev. December 3, 1993), and 04013C0390E (rev. December 3, 1993). Copies of the proposed 100-year floodplain superimposed on the floodplain delineation from the current (effective) FIRMs are included in **Appendix H**.

## **2.7 Community Map**

A location map of the Skunk Creek watershed and surrounding communities is included as **Figure 3**.

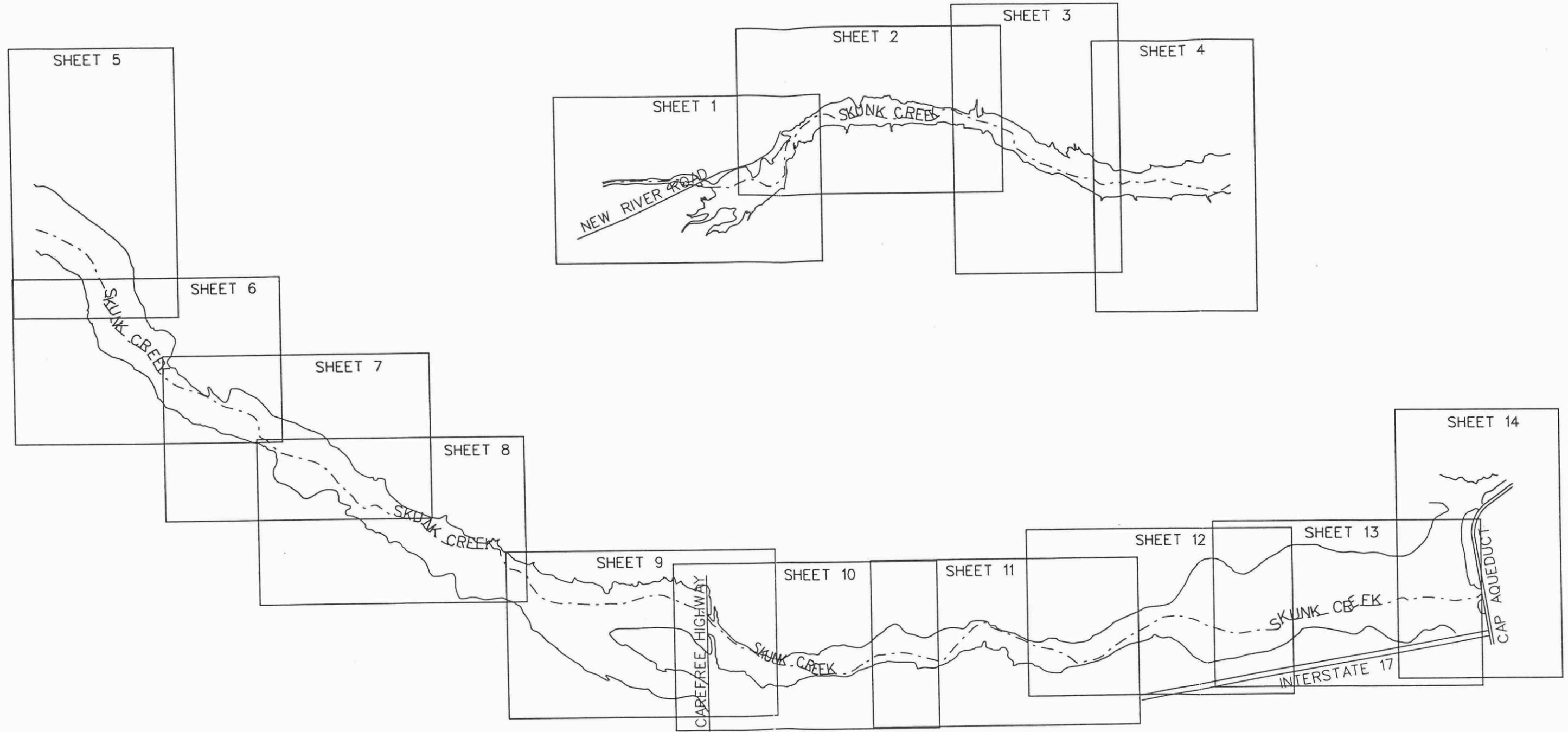
## **2.8 Miscellaneous Maps**

Other maps containing information such as hydrologic subareas, soils units, and existing land use are included in Section 3 of the Technical Data Notebook (Hydrologic Analysis), under separate cover.



Location Map  
Figure 3

DATE: 12-JUN-1997  
 JOB No. 1327034\_02090070  
 s:\skunk\_creek\plan\_sheets\cover.dgn



LEGEND	
100-YR FLOODPLAIN BOUNDARY	—————
THALWEG/HYDRAULIC BASE AND RIVER MILE	- - - - -

Figure 2

REV	DATE	BY	DESCRIPTION

SCALE: 1"=200'  
 WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED: \_\_\_\_\_  
 DRAWN: \_\_\_\_\_  
 CHECKED: \_\_\_\_\_

SUBMITTED: LAURIE T. MILLER 20934  
 PROJECT ENGINEER R. C. E. NO. DATE  
 RECOMMENDED: FRED K. DUREN, JR. 12250  
 MONTGOMERY WATSON R. C. E. NO. DATE

 **MONTGOMERY WATSON**  
 Las Vegas, Nevada

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 3014 WEST CHARLESTON BLVD  
 LAS VEGAS, NV 89102-1944  
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
 FLOOD DELINEATION STUDY  
 SKUNK CREEK  
 FCDMC CONTRACT NO. 95-16

INDEX MAP

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**Section 3**

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**SECTION 3 - HYDROLOGIC ANALYSIS**

Information pertaining to the hydrologic analysis portion of the Skunk Creek FDS is presented in the Hydrology Report, under separate cover.

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## **Section 4**

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**SECTION 4 - HYDRAULIC ANALYSIS**

Information pertaining to the hydraulic analysis portion of the Skunk Creek FDS is presented in the Hydraulics Report, under separate cover.

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**Section 5**

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**SECTION 5 - EROSION/SEDIMENT TRANSPORT ANALYSIS**

Analysis of the erosion and sediment transport characteristics of Skunk Creek and its tributaries was not performed for this study.

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## Section 6

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## **SECTION 6 - REFERENCE MATERIALS**

### **6.1 Other Published Flood Studies**

The current Flood Insurance Study (FIS) for Skunk Creek was performed by Harris-Toups Associates in the late 1970s.

### **6.2 Previous FEMA Studies**

As stated in Section 6.1, a previous FIS for Skunk Creek was performed by Harris-Toups Associates in the late 1970s. This study was submitted to and accepted by FEMA, and the current FIRMs for the study area are based on results from this study.

### **6.3 Other Applicable Studies**

Floodplain delineation studies were performed for Cline Creek and Rodger Creek, both of which are tributaries to Skunk Creek, by Baker Engineers for the District in 1989. In addition, a floodplain delineation study for Skunk Creek downstream of the CAP Aqueduct was prepared by Coe & Van Loo Consultants, Inc., for the District in 1990.

### **6.4 Historical Flood Information**

No information on historical flooding exists for the study area.

### **6.5 Technical Papers/Documents**

The technical analyses utilized in this study are discussed and documented in Sections 3 (Hydrologic Analysis) and 4 (Hydraulics Analysis) of the Technical Data Notebook, under separate covers.

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## Section 7

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## SECTION 7 - CROSS-REFERENCING AND LABELING INFORMATION

### 7.1 Other Studies Impacted

Results of the Skunk Creek FDS will have an impact on water surface elevations and floodplain delineations at the downstream ends of the Cline Creek and Rodger Creek studies. Additionally, it is anticipated that floodplain delineations at the downstream and upstream ends of the Del Webb study area of Skunk Creek will be impacted.

### 7.2 Key To Cross-Section Labeling

All cross sections developed for this study are stationed from left to right looking downstream with the hydraulic baseline (i.e., thalweg) set at station 10000. Cross section identification numbers represent distances in river miles upstream from the confluence of Skunk Creek with New River. A key to the cross section labeling method used in this study is included in **Appendix I**.

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**Section 8**

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**SECTION 1  
INTRODUCTION**

**1.1 Purpose of Study**

This project involves a floodplain delineation re-study of a portion of Skunk Creek located in north-central Maricopa County, Arizona. The objectives of this study are to (1) obtain updated topographic mapping in digital form, (2) review and update existing hydrology, and (3) revise existing 100-year floodplain and floodway boundaries based on updated information. The Location Map included as Figure 1 displays the boundaries of the Skunk Creek watershed and illustrates its location relative to the Phoenix metropolitan area.

**1.2 Authority for Study**

The authority for this study is the Flood Disaster Protection Act of 1973 and the National Flood Insurance Act of 1968, enacted by Title XIII of the Housing and Urban Development Act of 1968 (L. 90-448, August 1, 1968).

The Skunk Creek Floodplain Delineation Study was initiated by the Flood Control District of Maricopa County (District). The hydrologic and hydraulic analyses were performed by Montgomery Watson Americas, Inc., and their subconsultants, under Flood Control District Contract No. 95-16. The hydrologic analyses were completed in May 1996 and the hydraulic analyses were completed in May 1997.

**1.3 Coordination and Acknowledgments**

Montgomery Watson coordinated with several agencies and firms throughout this study, including: (1) District; (2) Hoskin Engineering Consultants (HEC); (3) Castro, Fleet, Fisher Engineering, Inc.; and (4) Erie and Associates, Inc. Coordination with the District was through frequent meetings and telephone conversations, and the District reviewed all technical work products developed for this project.

HEC performed the initial 100-year floodplain delineation for the lower 4.9 river miles of the study area. Castro, Fleet, Fisher Engineering, Inc., performed surveying and Erie and Associates, Inc., prepared the floodplain delineation for the Del Webb Company's 2.6-mile portion of the study area. Del Webb's consultants were contacted in order to gain information about mapping criteria for their study area.

**1.4 Public Notification and Contact**

Montgomery Watson, in cooperation with the District, notified the public of the initiation of the project. The purpose of this notification was to inform local residents and all other effected parties (e.g., land owners) of the study, and to provide them with the opportunity to comment. Further, the

notification was used to inform land owners that surveying needs of the may require that survey crews enter their properties.

Notification of the project initiation was published two separate times in two local newspapers, with approximately one to two weeks between runs. In addition, a news release was prepared and distributed by the District announcing the public meeting for the project. A form letter was sent to each property owner whose property may need to be entered for surveying activities.

A final public meeting is scheduled to be held in late June 1997. The purpose of this meeting will be to inform property owners, local residents, and interested parties of the results of the study. A public announcement will be distributed by the District. These documents are included as Appendix C in the Technical Data Notebook (TDN).

## SECTION 2 AREA STUDIED

### 2.1 Scope of Study

The project consists of topographic mapping and floodplain delineation of approximately 10 river miles of Skunk Creek from the Central Arizona Project (CAP) Aqueduct to the New River Mountains. Approximately 2.6 miles of existing floodplain mapping performed by another consultant for a developer were incorporated into the HEC-2 computer model for the Skunk Creek study area.

Specifically, the study area is bounded by the CAP Aqueduct to the south, the New River Mountains to the north, Daisy Mountain to the west, and Apache Peak to the east (Figure 1). The tributaries of Skunk Creek, including Cline Creek and Rodger Creek, were considered for hydrologic analysis but were not evaluated for the 100-year floodplain delineation.

### 2.2 Community Description

Maricopa County is located in south-central Arizona and encompasses an area of 9,238 square miles. In 1994, the projected county population was about 2.4 million. Surrounding counties include Yavapai to the north, Gila to the northeast, Pinal to the northwest, Pima to the south, Yuma to the west, and La Paz to the northwest.

Skunk Creek begins in north-central Maricopa County and primarily drains southerly toward the New River, which joins the Gila River southwest of Phoenix. The upper portions of the study area consist of mountainous terrain, steep slopes, and sparse vegetation; whereas, the lower portions slope more gradually and vegetation is consistent with desert rangeland. The climate is desert with mild winters, hot summers, and an average annual precipitation value of about 7 inches.

### 2.3 Principal Flood Problems

The main flood problems associated with the Skunk Creek study area include: (1) several bridge/road crossings; (2) ponding behind the CAP Aqueduct; and (3) weir flow over Interstate 17 and into the CAP Aqueduct. In addition, split flow occurs upstream of the Carefree Highway bridge. The flow that separates from the main channel upstream of Carefree Highway is conveyed underneath the highway via a triple-barrel culvert, and progresses outside the limits of the study area. Results indicate that the 100-year flow will not reach low chord at either of the two bridge crossings of Skunk Creek. However, it is expected that the 100-year flow will overtop Cloud Road where it crosses a portion of the Skunk Creek with the benefit of 3 CMPs. Additionally, split flow occurs upstream of New River Road Bridge, where flow breaks out on the left overbank before returning to the main wash approximately 0.5 miles downstream.

## **2.4 Flood Protection Measures**

Existing flood protection measures within the Skunk Creek study area include: (1) bridge crossings at Carefree Highway and New River Road; (2) a culvert crossing at Carefree Highway west of the bridge; (3) a levee in the left overbank just north of Carefree Highway; (4) two overchutes at the CAP Aqueduct crossing; and (5) a culvert crossing at the intersection of Cloud Road with Skunk Creek.

**SECTION 3  
ENGINEERING METHODS**

**3.1 Hydrologic Analysis**

Revised hydrology for the Skunk Creek watershed was determined using the Corps HEC-1 Flood Hydrograph Package program, version 4.0.1 (May 1991). Analyses and parameter estimation were conducted in accordance with the Hydrologic Design Manual for Maricopa County, Arizona (Hydrology Manual) (FCDMC, 1995).

A rainfall/runoff model was developed and peak discharges for the 100-year, 6-hour local storm and the 100-year, 24-hour general storm were determined. The highest peak discharges were produced by the 100-year, 24-hour simulation, and, therefore, adopted as the design storm for all further analyses (Table 1). It is important to note that an Hydrology Report Addendum was prepared which addresses modifications in the hydrology that have resulted since that report was completed. Flow changes presented in the addendum are the result of the detailed hydraulic analysis that determined that a flow diversion might occur within the study area upstream of Carefree Highway. A detailed discussion of hydrologic results is included in Section 3 of the TDN, under separate cover.

**Table 1  
100-Year Peak Discharges**

<b>Wash Name</b>	<b>Cross Sections</b>	<b>HEC-1 Combination Point</b>	<b>*100-year Peak Discharge (cfs)</b>
Skunk Creek	13.00 thru 13.28	N/A	15700**
	13.41 thru 16.68	CAP	23300**
	16.87 thru 17.40	S22C	23700**
	17.48 thru 17.95	N/A	27300
	18.09 thru 18.57	S21C2	27700
	18.74 thru 22.84	S16C	27300
	22.91 thru 23.69	S14C	24400
	23.79 thru 24.26	S13C	11800
	24.39 thru 24.88	S10C	9700
	25.02 thru 26.31	S6C	7800

\* All peak discharges presented are for the 100-year, 24-hour storm.

\*\* Peak discharge values represent a 3,600 cfs reduction due to split flow upstream of Carefree Highway.

Runoff model input includes the Green and Ampt infiltration loss method, Phoenix area S-Graphs, and the Muskingum stream routing method. The hydrologic model development criteria, assumptions, and parameters used in the preparation of the HEC-1 model for the Skunk Creek watershed are also documented in Section 3 of the TDN, under separate cover.

### 3.2 Hydraulic Analysis

Approximately 10 river miles of floodplain delineations were determined for portions of Skunk Creek from the CAP Aqueduct (south) to the New River Mountains (north). Approximately 2.6 miles of existing floodplain mapping, which was prepared by another consultant, was incorporated into this study. The 100-year floodplain and floodway were modeled using the Corps HEC-2 Water Surface Profiles computer program, version 4.6.2 (May 1991), and peak discharges developed for the 100-year, 24-hour storm.

The mapping used for the hydraulic analysis was 1 inch = 200 feet aerial topography with a 2-foot contour interval. The cross sections for the HEC-2 model are derived directly from the aerial topography. Some cross section data is derived from topographic maps due to later changes in cross section geometry and/or addition of cross sections.

Roughness factors (i.e., Manning's "n" values) for Skunk Creek were determined based on field investigation and photographs of the study area. The methodology and results of the Manning's "n" value determination were submitted as a technical memorandum and reviewed by the District. Manning's "n" values ranged from 0.03 to 0.052 for the channel and from 0.031 to 0.069 for the overbanks. For a detailed discussion of the methodology used and results of the Manning's "n" value determination, refer to Technical Memorandum No. 3 in Appendix J of the TDN.

Cross sections were stationed perpendicular to flow at an average spacing of 500 feet, and, where possible, cross section stationing is consistent with that of the effective FIS. Cross sections were located at the upstream and downstream faces of Carefree Highway and New River Road bridges in order to simulate the backwater effects of these structures. As-built drawings were obtained for both bridges in order to develop elevation and structural geometry data for model input. For detailed information regarding cross-section stationing, refer to the 100-year floodplain delineation maps included in Section 4 (Hydraulics Analysis) of the TDN (under separate cover).

The study area is divided into two separate reaches due to incorporation of existing floodplain mapping. From downstream to upstream, these reaches include: (1) from the CAP Aqueduct to the southern boundary of the Del Webb property (approximately 7.5 miles); and (2) from the northern boundary of the Del Webb property to approximately 0.45 river miles north of New River Road bridge (approximately 3.0 miles). The HEC-2 model for the Del Webb portion was inserted into Montgomery Watson's model and cross section identification numbers were modified for consistency with Montgomery Watson modeling.

The aforementioned study reaches were modeled as fixed-bed, sub-critical profiles, and an estimate of the starting water surface elevation was derived from the effective FIS (Harris-Toups Associates, circa 1976). The 100-year floodplain was determined initially and encroachment records were

utilized at certain cross sections to restrict flow from entering noneffective flow areas. The bridge crossings at Carefree Highway and New River Road were modeled using the special bridge routine in HEC-2. Culvert capacity at a couple crossings was ignored due to its relative insignificance compared to the 100-year flow.

Once the 100-year floodplain was finalized, the floodway was initially delineated using the equal conveyance encroachment method (i.e., Method 4). Results from the Method 4 floodway analysis were then used to develop the final, Method 1 floodway model. For a more detailed discussion of floodway modeling, refer to Section 4 of the TDN (under separate cover).

### 3.3 Problem Areas

During delineation of the 100-year floodplain, it was determined that split flow occurs upstream of Carefree Highway and upstream of New River Road Bridge and that split flow and divided flow occur at the overchutes of the CAP Aqueduct. Separate HEC-2 models were developed in order to estimate (1) the amount of flow diverted from the study area upstream of New River Road Bridge and upstream of Carefree Highway and (2) the distribution of flow between the two CAP Aqueduct overchutes. Additionally, a split flow analysis by weir flow was included in the primary model in order to determine the amount of flow lost over Interstate Highway 17 and into the CAP Aqueduct.

It is important to note that the floodway delineation upstream of Carefree Highway uses the entire 100-year peak discharge; however, due to loss of flow from the main channel (split flow), the floodplain delineation uses the reduced flow (3,600 cfs less). A more detailed discussion of these areas and the modeling methodologies utilized is provided in Section 4 of the TDN (under separate cover).

**SECTION 4  
FLOODPLAIN MANAGEMENT APPLICATIONS**

A primary purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound floodplain management programs. Therefore, included with the Skunk Creek Floodplain Delineation Study is a flood boundary map designed to assist communities in developing sound floodplain management measures.

This study has been performed to meet the standards of the National Flood Insurance Program as defined by the Flood Insurance Study Guidelines (Federal Emergency Management Agency, 1993).

**4.1 Flood Boundaries**

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency (FEMA) as the base flood for the purposes of floodplain management measures. For this study, the boundary of the 100-year floodplain has been delineated using the water surface elevation calculated by the HEC-2 model at each cross section. Between cross sections, floodplain boundaries have been interpolated using contour information from the aerial topographic maps with a 2-foot contour interval. The proposed boundaries of the 100-year floodplain and floodway are presented in Appendix E in Section 4 of the TDN (under separate cover).

**4.2 Floodways**

The purpose of the floodway as a floodplain management tool is to show the effect of encroachment (e.g., walls, fences, buildings, fill materials, etc.) within the floodplain without increasing the flood depth more than 1 foot, and without producing hazardous velocities. The 1-foot or less rise in flood depth is according to national and local standards, and the floodway must be excluded from encroachment so that the 100-year flood can be safely conveyed.

The floodway delineation methodology adopted for this study is based on equal conveyance reduction on each side of the floodplain. In general, the floodway is significantly narrower than the floodplain. In some areas, however, the floodway is coincident with the floodplain. This may be caused by previous channelization or the result of bank stations existing above the 100-year flood elevation. At these locations, encroachment would not be feasible. The floodway delineation for the Skunk Creek study area is included in Appendix E of Section 4 of the TDN (under separate cover).

**SECTION 5  
INSURANCE APPLICATION AND CRS SUMMARY**

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. Those zones applicable to the Skunk Creek Floodplain Delineation Study are as follows:

**Zone AE:** Zone AE is the flood insurance rate zone that corresponds to 100-year floodplains that are determined in the Floodplain Delineation Study by detailed methods. In most instances, whole-foot base flood elevations derived from detailed hydraulic analyses are shown at selected intervals within this zone.

**SECTION 6  
OTHER STUDIES**

Harris-Toups Associates (circa 1976) performed the effective Skunk Creek FIS. A floodplain delineation study for Skunk Creek downstream of the CAP Aqueduct was prepared by Coe & Van Loo Consultants, Inc., for the District in 1990. Floodplain delineation studies were performed for Cline Creek and Rodger Creek, which are tributaries to Skunk Creek, by Baker Engineers for the District in 1989. This study incorporated approximately 2.6 miles of existing floodplain delineation for a portion of Skunk Creek, which was performed by Erie and Associates, Inc., for Del Webb in 1996.

**SECTION 7  
LOCATION OF DATA**

The majority of data developed during this study is contained in the Technical Data Notebook (TDN), in which this report represents Section 8. All other survey, hydrologic, and hydraulic data developed during this study may be obtained from the Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, Arizona 85009.

**SECTION 8  
REFERENCES**

- Arizona Department of Water Resources, Engineering Division, Flood Management Section, Instructions for Organizing and Submitting Technical Documentation for Flood Studies, September, 1991.
- Baker Engineers, Floodplain Delineation of Cline Creek, 1989.
- Castro, Fleet, Fisher Engineering, Inc., Skunk Creek Floodplain Delineation: The Villages at Desert Hills, December, 1996.
- Coe & Van Loo Consultants, Inc., Luke Wash Flood Insurance Study Between the Gila river Floodplain and the Southern Pacific Railroad, Technical Data Notebook Section 4, Hydraulic Analysis, March, 1993.
- Flood Control District of Maricopa County, Special Projects Branch, Hydrology Division, Hydrologic Design Manual for Maricopa County, Arizona, 1995.
- Harris-Toups Associates, Skunk Creek Flood Insurance Study, circa 1976.
- U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles Users Manual, September, 1990.
- U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles Version 4.6.0, February, 1991.
- U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-1 Flood Hydrograph Package Version 4.0.1, May, 1991.
- U. S. Federal Emergency Management Agency, Flood Insurance Study, Maricopa County, Arizona and Incorporated Areas, September, 1993.
- U. S. Geological Survey, Water Resources Division, Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona, 1991.

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## Appendix A

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MONTGOMERY WATSON







LAND OWNERSHIP AT SELECTED  
PANEL POINTS

# 2000

- 1) 6287 - Arizona Board of Regents  
HT Lucas Land Agent U  
Tucson, AZ 85721

# 2002

—

# 2010

- 1) Terminus Ad Quem Ass  
(202 21 008N)
- 2) Colaric, Jack A.  
8526 E. Hazelwood St.  
Scottsdale, AZ 85251  
(202 21 031C)

# 2003

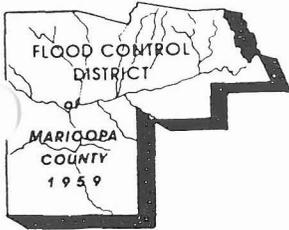
- Not Assessed

# 2005

—

# 2006

- Not Assessed



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

---

BOARD OF DIRECTORS  
Betsey Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

**DATE :** December 6, 1995.

**MEMO TO :** Laurie Miller, P.E., Montgomery Watson.

**FROM :** Hasan Mushtaq, Flood Control District of Maricopa County.

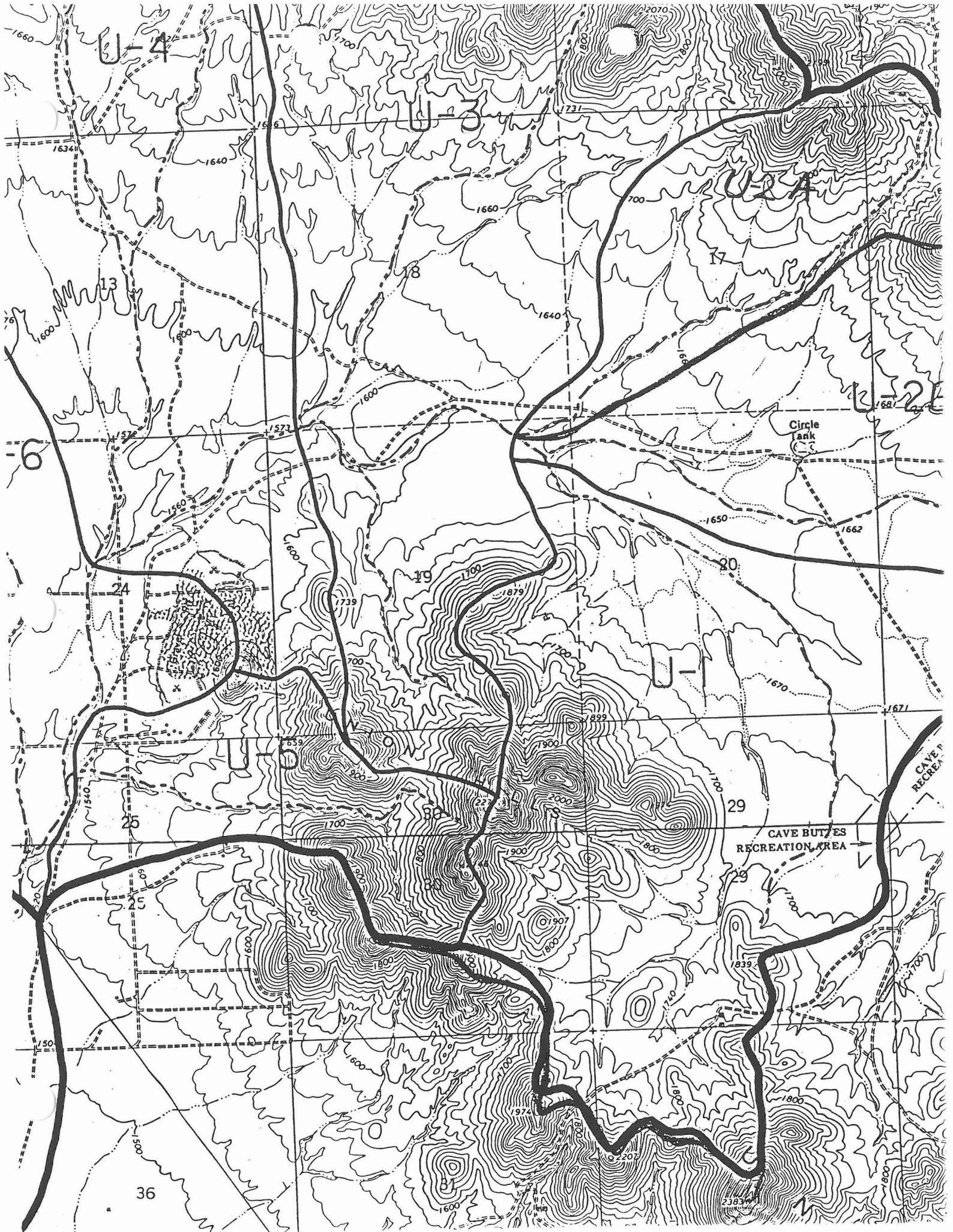
**SUBJECT :** Skunk Creek Wash Topography and Floodplain Delineation, Contract No. 95-16  
(Subbasin delineation).

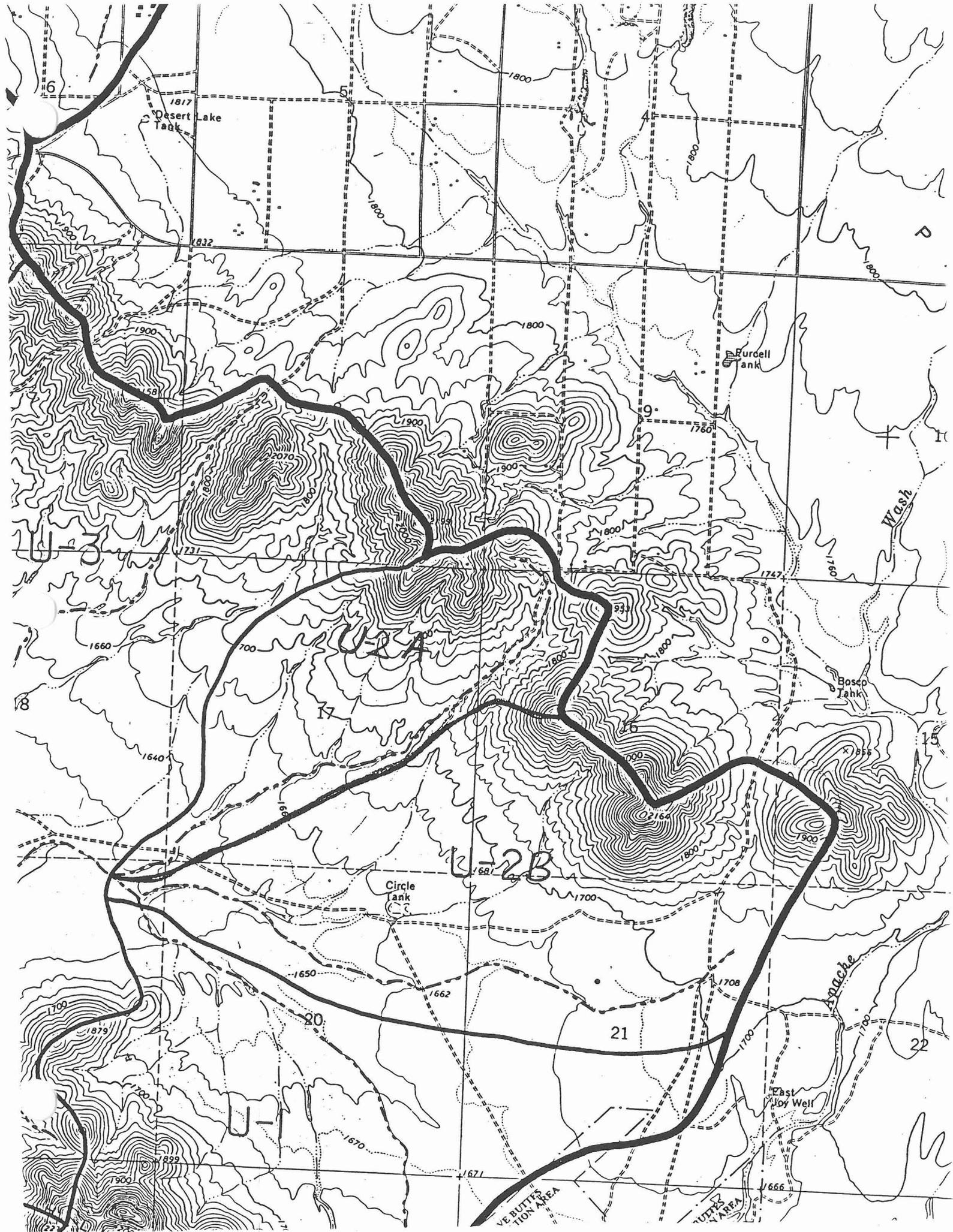
I have completed the review of the subbasin delineation. No significant errors were found. Following are the recommended modifications.

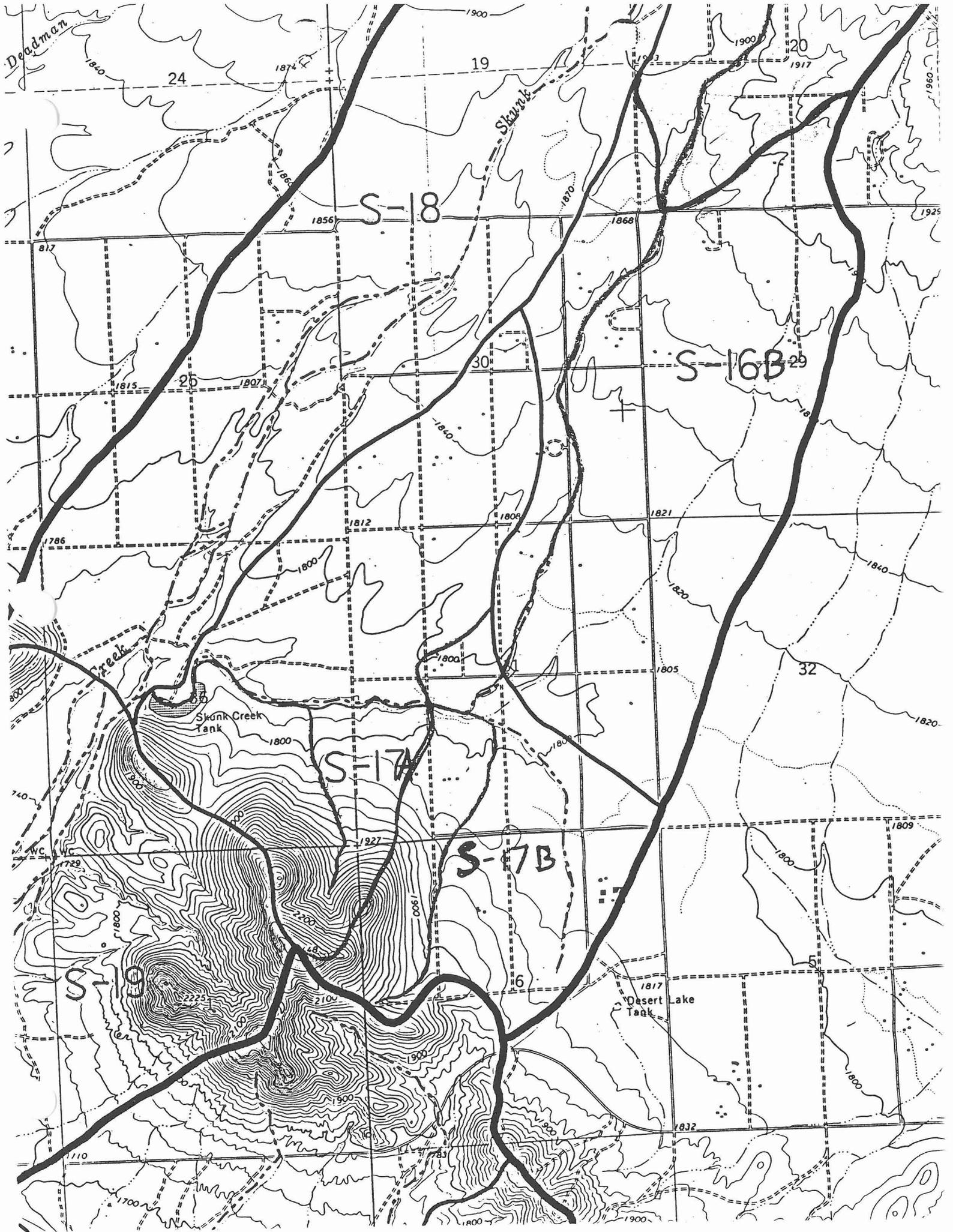
- (1) Please include a proper scale to the watershed subbasin map.
- (2) Subbasins S-2, S-10, S-13, and S-15 may have longer flow paths than shown on the current map (please see attached map).
- (3) It is also recommended that subbasins S-15, S-16, S-17, and U-2 be divided furthermore to create S-15A, S-15B, S-16A, S-16B, S-17A, S-17B, U-2A, and U-2B (please see attached map).

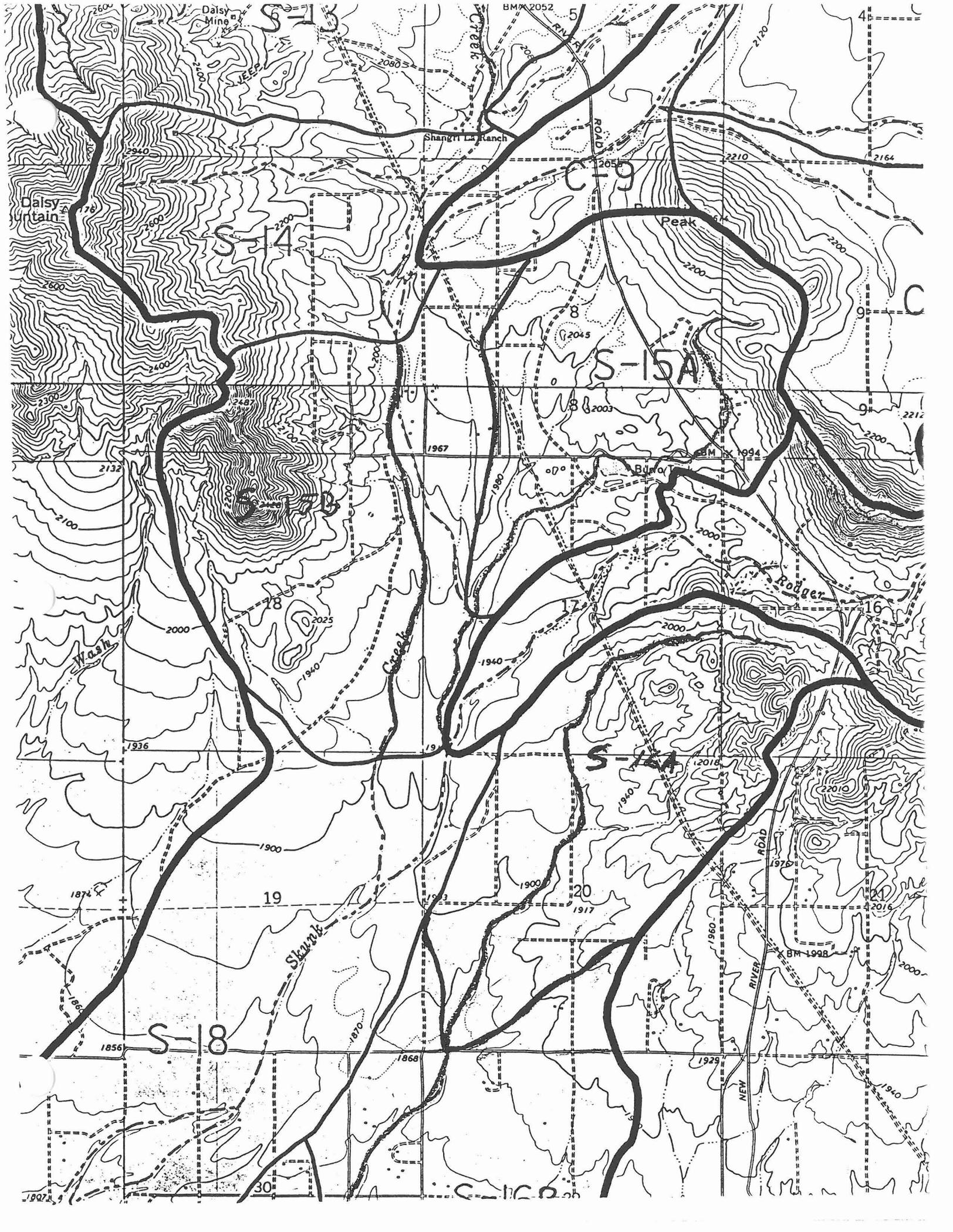
Please do not hesitate to contact me for further information at 506-1501.

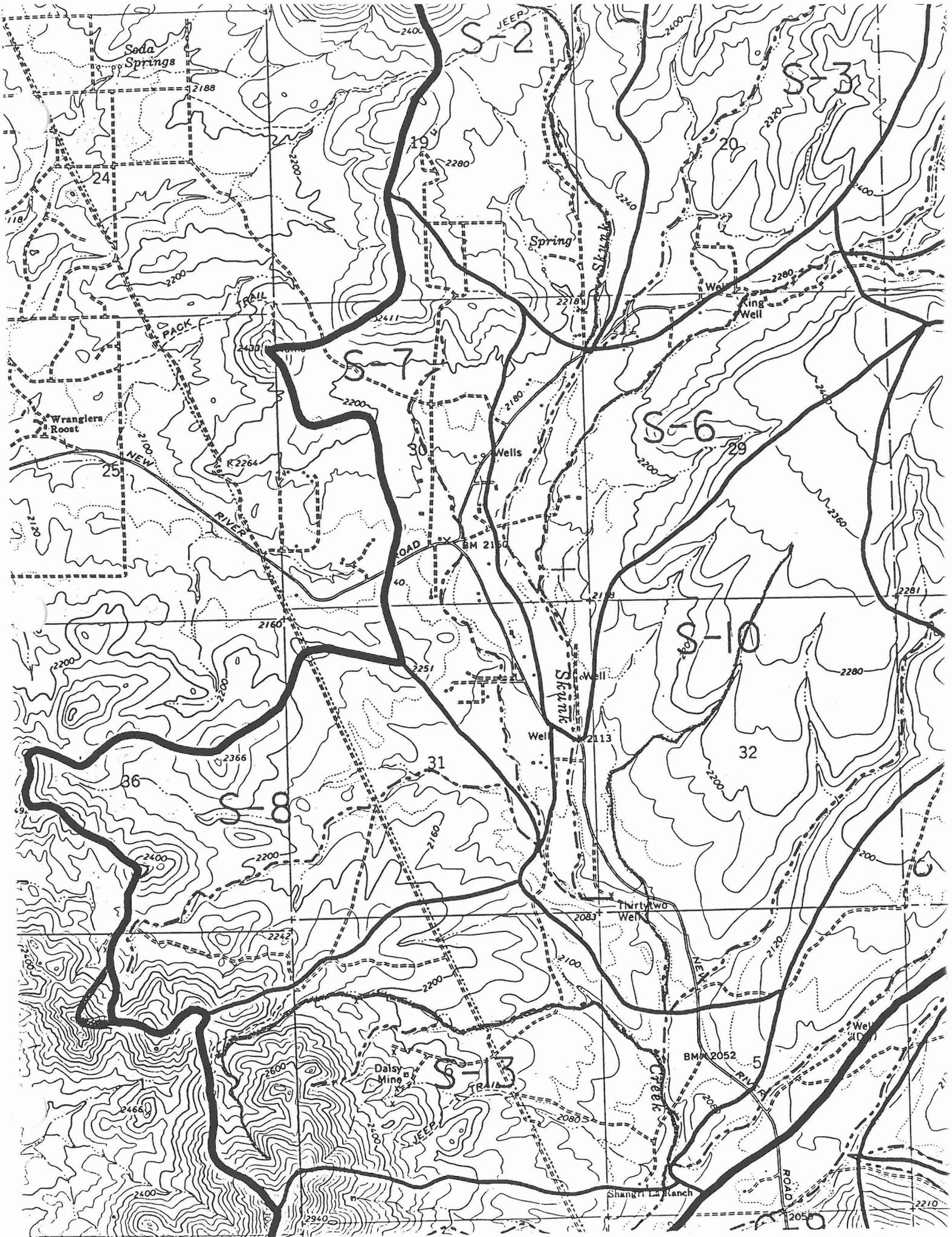
Hasan Mushtaq

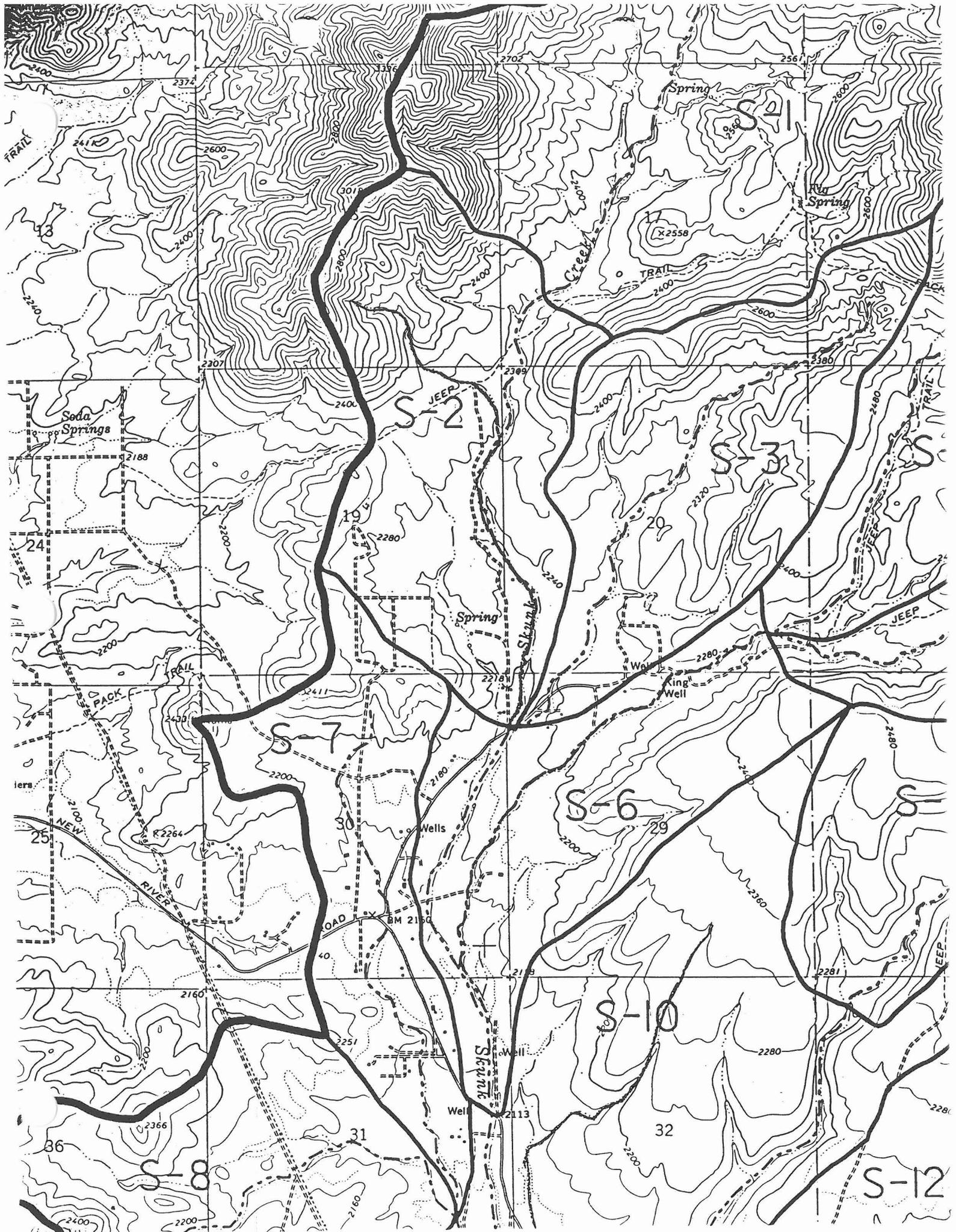














MONTGOMERY WATSON

December 11, 1995

Mr. Hasan Mushtaq  
Hydrologist  
Flood Control District of Maricopa County  
2801 West Durango Street  
Phoenix, Arizona 85009

Subject: Request for Adding Subconsultant  
Contract FCD 95-16 Skunk Creek Floodplain Delineation Study

Dear Mr. Mushtaq:

After further in-house discussions regarding development of the HIS submittals and in consideration of an internal time constraint, Montgomery Watson requests that the District approve the adding of a subconsultant to our contract for the Skunk Creek project.

The reason for our request is based on two factors. First, our in-house GIS specialist is busy with prior work that makes it impossible for him to provide the necessary services during the timeframe dictated by our project schedule. The second reason is that further evaluation of the work involved in the HIS task indicates to us that it would be better to utilize a GIS specialist that has significant prior experience on this specific work. We are concerned that our GIS specialist would be susceptible to "re-inventing the wheel" in some of the tasks required as part of the HIS submittal.

Based on these reasons, we request that Mapping Automation be added as a subconsultant to Montgomery Watson for this project. Mapping Automation has a good understanding of the level of effort necessary to meet the District's requirements. Additionally, the firm has worked with Kenny Aerial Mapping on prior projects. We believe that this addition of Mapping Automation would allow us to provide a more timely and sound HIS submittal to the District. There would not be a change in fee or completion time associated with this request.

We have met with Mr. Rudy Strickland of Mapping Automation and have found that he is available to participate on the project in timely fashion. The first involvement of Mapping Automation would be to coordinate the aerial survey work with Kenny Aerial during next week. As a result of this time constraint, your review of this request at your earliest convenience is requested.

We apologize for submitting this request with such limited advance time for review. However, in the flurry of activities associated with project start-up, we did not arrive at our present conclusion as early as we would have preferred. We hope you will understand our situation.

Should you have any questions or comments on this matter, please do not hesitate to contact myself or Laurie Miller.

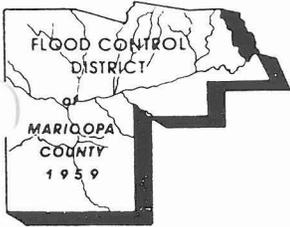
Thank you for your consideration of our request.

Sincerely,



Fred K. Duren, Jr., P.E., P.G.  
Phoenix Regional Office Manager

c: Pedro Calza  
Laurie Miller  
1213.0050.3.1.2



# FLOOD CONTROL DISTRICT

of

## Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

---

BOARD OF DIRECTORS  
Betsey Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

December 12, 1995.

DEC 14 1995

Fred K. Duren, Jr., P.E., P.G.  
6245 North 24th Parkway  
Phoenix, Arizona 85016-2030

MONTGOMERY WATSON  
PHOENIX OFFICE

Subject : Request for Adding Subconsultant  
Skunk Creek Wash Topographic Mapping and Floodplain Delineation, Contract No. 95-16

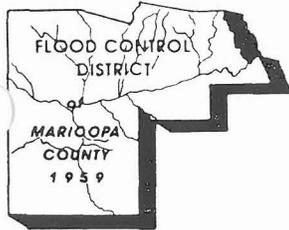
Dear Mr. Duren,

After careful consideration to your request for adding a subconsultant to the above mentioned project, the Flood Control District does not have any objections against it. However, since Mapping Automation was not a part of the technical proposal at the time of the selection process, we assume that Montgomery Watson is fully responsible for the level of effort necessary to meet the District's HIS requirements. We would also not be able to authorize any change order for fees or time due to this request for adding a subconsultant.

This letter serves as a confirmation of your request dated December 11, 1995. Should you have any questions on this matter, please do not hesitate to contact me at 506-1501.

Sincerely,

Hasan Mushtaq  
Hydrologist



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

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Fax (602) 506-4601  
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---

BOARD OF DIRECTORS  
Betsey Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

February 27, 1996

Laurie Miller, P.E.  
6245 North 24th Parkway  
Phoenix, Arizona 85016-2030

Subject : Comments on Hydrology developed for Skunk Creek Watershed.  
Skunk Creek Wash Topographic Mapping and Floodplain Delineation  
Contract No. FCD 95-16

Dear Ms. Miller :

Please find the following comments on the Hydrology developed for the Skunk Creek Watershed. We recommend that the comments are incorporated in the Draft Hydrology Report.

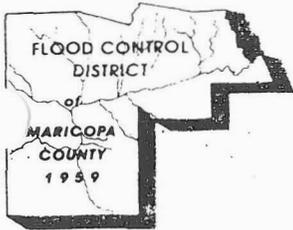
- (1) Please check for typographical errors in the text of the report.
- (2) Tables D and E list too much information; please reduce the amount of information provided in each page.
- (3) Create a continuous HEC-1 model including Cline Creek and Roger Creek.
- (4) Use a 100-yr. 24 hr. storm; we would also like to investigate the 100-yr. 6-hr storm.
- (5) Please be consistent in describing the KM records in the HEC-1 modeling.
- (6) We suggest that the actual contributing area be determined at each HC record.
- (7) Please investigate the WARNING messages at the end of the HEC-1 model output.

If you need further information, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,

Hasan Mushtaq  
Hydrologist

MAR 1 1996



# FLOOD CONTROL DISTRICT

of

## Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009

Telephone (602) 506-1501

Fax (602) 506-4601

TT (602) 506-5859

### BOARD OF DIRECTORS

Betsy Bayless

Ed King

Tom Rawles

Don Stapley

Mary Rose Garrido Wilcox

APR 30 1996

Fred Duren, Jr., P.E., P.G.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16).

Dear Mr. Duren :

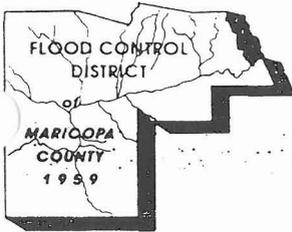
This letter serves as written authorization to proceed on Phase II of the subject contract which was approved by the Board of Directors on November 1, 1995. Phase II will consist of approximately 10 river miles of floodplain delineation for the portion of the Skunk Creek Wash from the Central Arizona Project (CAP) Aqueduct to the south to 13.1 river miles to the north, upstream of the New River Bridge crossing (cross section CN), excluding 2.6 river miles of floodplain delineation on the Del Webb property. However, the final hydraulics model should cover the entire length of the Skunk Creek wash as mentioned above, incorporating the 2.6 river miles of floodplain delineation on the Del Webb property. As specified in the contract, Phase II is a negotiated lump sum amount of \$62,900.

If you have further questions, please do not hesitate to contact me at 506-1501.

Sincerely,

Hasan Mushtaq  
Hydrologist

MAY 1 1996



# FLOOD CONTROL DISTRICT

of

## Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009

Telephone (602) 506-1501

Fax (602) 506-4601

TT (602) 506-5859

### BOARD OF DIRECTORS

Betsey Bayless

Ed King

Tom Rawles

Don Stapley

Mary Rose Garrido Wilcox

JUN 18 1996

Laurie Miller, P.E.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

JUN 18 1996

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
Final Hydrology Report.

Dear Ms. Miller :

The final Hydrology Report : Skunk Creek Floodplain Delineation Study, is accepted as submitted with a minor correction as following.

- (1) Please specify the correct discharge for the X1SUB in the Cline Creek subwatershed in Table 12.

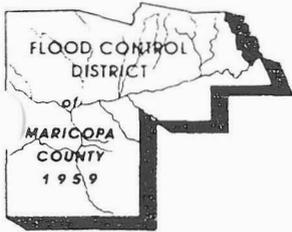
If you have further questions, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,

Hasan Mushtaq  
Engineering Division.

Table 12  
Subarea Peak and Unit Discharges

Subarea	Area (sq mi)	Q (cfs)	Unit Q (cfs/sq mi)
<b>Upper Main Skunk Creek</b>			
S1	2.08	2911	1400
S2	1.17	1738	1485
S3	1.03	1415	1374
S4	0.97	1295	1335
S5	1.85	2007	1085
S6	0.94	1339	1424
S7	0.68	1061	1560
S8	1.12	1650	1473
S9	1.02	1254	1229
S10	1.80	2350	1306
S11	0.92	1161	1262
S12	0.91	1307	1436
S13	1.27	1734	1365
Average =			1364
<b>Lower Main Skunk Creek</b>			
S14	0.83	1336	1610
S15	0.99	1564	1580
S16	1.32	1930	1462
S17	1.03	1422	1381
S18	1.71	2537	1484
S19	0.77	1368	1777
S20	1.27	1900	1496
S21	2.22	2946	1327
S22	1.47	1987	1352
S23	1.72	2027	1178
S24	0.64	1113	1739
Average =			1490
<b>Cline Creek</b>			
X1SUB	0.61	1391	2280 <i>2110</i>
X2SUB	0.43	876	2037
X3SUB	0.56	1121	2002
X4SUB	0.28	650	2321
X5SUB	0.38	776	2042
SUBC1	1.26	2552	2025
SUBC2	2.19	3321	1516
SUBC3	1.24	2149	1733
SUBC4	2.54	4326	1703
SUBC5	3.39	5968	1760
SUBC7	1.20	2462	2052
SUBC8	1.42	2713	1911
SUBC9	0.58	979	1688
Average =			1929 <i>1910</i>



**FLOOD CONTROL DISTRICT**  
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Fax (602) 506-4601  
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---

BOARD OF DIRECTORS  
Betsey Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

Laurie Miller, P.E.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
Preliminary Cross-Section Location - CAP through the upper limit of the study.

Dear Ms. Miller :

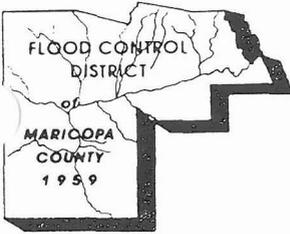
Please find the following comments on the above mentioned subject.

- (1) It is suggested that the "marked" cross-sections be re-oriented.
- (2) Several locations within the study limit suggest that addition of cross-sections would help define the hydraulic characteristics of the wash with a better accuracy.
- (3) The cross-section at the New River bridge location is suggested to be revised.
- (4) In general, it is found that the cross-sections are sketched too far apart; please revise the cross-section locations, in order to reduce distances between cross-sections.

If you have further questions, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,

Hasan Mushtaq  
Hydrologist



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

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Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

---

BOARD OF DIRECTORS  
Betsey Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

JUL 25 1996

Laurie Miller, P.E.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

JUL 26 1996

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
Technical Memorandum No. 3 : Field Estimation of Manning's "n" Values.

Dear Ms. Miller :

I have completed reviewing the Technical Memorandum No. 3 : Field Estimation of Manning's "n" Values, dated July 3, 1996. In general, the Manning's roughness values for the different reaches of the study area, are recommended to be used for future Hydraulic analysis.

If you have further questions, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,

Hasan Mushtaq, P.E.  
Engineering Division



MONTGOMERY WATSON

## TELEPHONE CONVERSATION

---

<b>With:</b>	Rudy Stricklan Mapping Automation	<b>Date:</b>	August 5, 1996
<b>From:</b>	Fred Duren <i>FVD</i>	<b>Time:</b>	10:30 a.m.
<b>Subject:</b>	GIS Subcontract Skunk Creek FDP	<b>Phone No.:</b>	732-0382
		<b>Reference:</b>	1213.0070

---

**Discussion:**

Rudy called in reference to the draft subcontract I sent him Friday and in response to my call of earlier this morning.

Rudy has reviewed the subcontract and has two problems, which are defined on the fax attached to this phone memo. (I believe we can eliminate the professional liability insurance since he cannot get this type of insurance. Relative to Task 9.2, Laurie needs to clarify.)

I also discussed with Rudy two other issues: (1) the need to provide a continuous DTM, including the Del Webb portion of Skunk Creek, and (2) the provision of a DTM in advance of the other GIS submittals.

Relative to 1, Rudy said that he does not have this task in his scope of work and, thus, this would cause him to increase his fee. We discussed what was involved in this task, and I recalled that the DTM provided by Del Webb, as done by Kenney, would have contours blended at the margins to agree with our DTM and would have been translated to the state plane coordinate system to agree with our DTM. We discussed having Rudy call Gary Finney at Kenney to discuss the DTM that is being provided by Del Webb. I suggested we wait to allow some time for Del Webb and Kenney to iron out any difficulties they may have in negotiating Kenney's work to produce this revised DTM

Relative to 2, Rudy said there would be no problem in doing the DTM in advance of the other GIS submittals. He typically does this, and this task would be covered in MA's current scope of work.

I said that Laurie would get back to him, either Friday or the first part of next week, to discuss the DTM submittal and his questions on the subcontract. At that time it may be appropriate for Rudy to contact Kenney regarding the DTM Kenney is preparing.

attachment

c: Laurie Miller  
1213.0070.3.2.1  
1213.0050.1.3.4



October 23, 1996

Mr. Hasan Mushtaq, P.E.  
Flood Control District of Maricopa County  
2801 W. Durango  
Phoenix, Arizona 85009

Subject: Digital Terrain Model for Skunk Creek Floodplain Delineation Study

Reference: Contract No. FCD 95-16

Dear Mr. Mushtaq:

As you are aware, Montgomery Watson was asked by the District to provide a continuous Digital Terrain Model (DTM) of the subject project, including a portion of Skunk Creek currently being developed by Del Webb. This letter is to inform you of the status of this effort and request direction on how to proceed with finalizing this task. A summary of the issues involved is provided for your convenience.

## BACKGROUND

The Scope of Work for the Skunk Creek Floodplain Delineation Study (Skunk Creek Study) included a portion of Skunk Creek from the CAP Aqueduct to 13.1 river miles upstream (existing FIS cross section CN). The Scope of Work excluded 2.6 river miles which traverse the proposed Desert Foothills project currently under development by Del Webb. The HEC-2 model performed by others for the Del Webb LOMR analysis was to be integrated directly into Montgomery Watson's new model to provide the District with a continuous HEC-2 model.

At the November 9, 1995, kickoff meeting for the Skunk Creek Study, the District requested that a continuous DTM be provided to include the Del Webb portion of Skunk Creek. The Del Webb portion of Skunk Creek would be delivered to the District without modification or HIS data conversion since this reach is outside the Scope of Work and effort to include the additional miles was not part of the fee estimate for this study. At this time, the District believed that Kenney Aerial Mapping, Inc., (Kenney Aerial) had performed new mapping on behalf of Del Webb for the entire portion of Skunk Creek within the Del Webb property.

It was subsequently determined that Del Webb had retained Kenney Aerial to prepare new mapping for only a small portion of Skunk Creek at the northern and southern ends. For the remainder of Skunk Creek, Del Webb elected to use existing mapping. The existing mapping was approximately ten years old and Del Webb's consultant created digital mapping by digitizing the contours from the existing maps.

## MAPPING RESOLUTION MEETING

On July 31, 1996, a meeting was held to resolve differences between the Del Webb development project and the District's Skunk Creek Study. Representatives from the District, Montgomery Watson, Del Webb, Castro-Fleet-Fisher, and Erie & Associates attended the meeting. At this meeting, Del Webb agreed to authorize its consultants to:

1. blend contours at the north and south margins of its study reach to match those generated for the Skunk Creek Study
2. convert the horizontal control of its DTM to state plane coordinates to be consistent with the Skunk Creek Study.

Upon completion of the above actions, Montgomery Watson would then incorporate the Del Webb DTM into the District's DTM to provide a continuous model. It was agreed that Montgomery Watson would not be responsible for resolving any questions on the Del Webb portion of the DTM.

### **CURRENT MAPPING STATUS**

Kenney Aerial has informed us that the Del Webb contours have been blended as planned to match those generated for the Skunk Creek Study. However, Del Webb did not provide a DTM for its study reach and Kenney Aerial believes that one does not exist. In order to incorporate the Del Webb portion of Skunk Creek, a Triangulated Integrated Network (TIN) would have to be created. However, Kenney stated that if a TIN model is generated, data accuracy would be significantly compromised at the meeting points of the two models.

Additionally, we have been informed by Mapping Automation, our HIS data conversion subconsultant, that inclusion of the Del Webb portion of Skunk Creek poses additional difficulties in the data conversion task. First, it is not possible to provide HIS data conversion to only a portion of the model. Therefore, if the Del Webb portion is to be included, either Del Webb must generate a TIN model and perform HIS data conversion, or Montgomery Watson could perform the work. However, the generation of a TIN model and subsequent HIS data conversion is a significant effort and would require a change order to include it in the existing Scope of Work for the Skunk Creek Study.

Additionally, you should be aware that the quality and usefulness of data to be provided would be compromised should you decide to proceed with incorporating the Del Webb portion of Skunk Creek in the DTM. We have been informed by Mapping Automation that, because of the format in which the 10-year-old mapping exists, mass points only (and not break lines) can be provided. Additionally, the number of mass points as generated from existing contours is very large, and this condition causes very large files with limited usefulness.

### **DECISION ON STUDY DIRECTION**

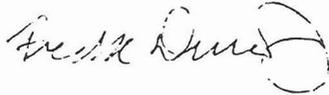
From the information provided above, it appears that the following options are available to the District to obtain a continuous DTM:

1. Request a TIN model and HIS data conversion from Del Webb, to be incorporated into the Skunk Creek Study, at a compromised data quality and usefulness.
2. Request Montgomery Watson to perform the work in (1), with a change order to provide the additional services. Limitations on the data remain as stated.
3. Proceed with the Skunk Creek Study portion only, eliminating the Del Webb study reach from the DTM and HIS data conversion work products.

It is requested that you consider the options identified above and inform us as to the direction you wish to take. We would be happy to meet with you at your convenience to discuss these further or other options you may wish to consider.

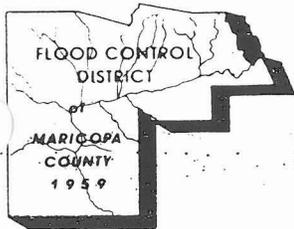
Please contact Laurie Miller or myself if you have any questions.

MONTGOMERY WATSON



Fred K. Duren, Jr., P.E., P.G.  
Project Manager

c: Laurie Miller  
1213.0050.3.1.2  
1213.0070.3.1.2



# FLOOD CONTROL DISTRICT

of

## Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009

Telephone (602) 506-1501

Fax (602) 506-4601

TT (602) 506-5859

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6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
Request for releasing survey information.

Dear Ms. Miller :

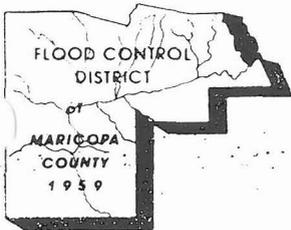
The intent of this letter is to authorize Montgomery Watson to release necessary survey information on the above mentioned project. Recently, McLaughlin Kmetty Engineers, Inc. (MKE), has been retained by the Flood Control District of Maricopa County, to perform a Floodplain Delineation Study on an Unnamed Tributary to Skunk Creek. At this time, MKE has requested to obtain available survey information on the Skunk Creek Wash. Therefore, it is requested that Montgomery Watson releases all necessary and relevant survey information, on the above mentioned project, to McLaughlin Kmetty Engineers, Inc (MKE).

If you have further questions, please do not hesitate to contact me at 506-1501 or Frank Brown, P.E. at 248-7702. Thank you very much for your time and cooperation.

Sincerely,

Hasan Mushtaq, P.E.  
Engineering Division

OCT 25 1998



# FLOOD CONTROL DISTRICT

of

**Maricopa County**

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OCT 3 1 1996

Fred K. Duren, Jr., P.E., P.G.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
Digital Terrain Model (DTM)

Dear Mr. Duren :

This is in reply to your letter dated October 23, 1996, regarding the Digital Terrain Model for the above mentioned project. Based on the facts presented in your letter, the District is recommending the third option mentioned in the Decision on Study Direction. This should enable the current study to be completed on time without further delay.

Please note that the hydraulic model for the entire reach of the project should be a continuous one regardless of the above decision. The District will furnish a final hydraulic model for the portion of the Skunk Creek being delineated by Del Webb. The final version of the model is expected to be submitted to the District in the next few days.

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,

Hasan Mushtaq, P.E.  
Engineering Division

NOV 4 1996



MONTGOMERY WATSON

## TELEPHONE CONVERSATION

---

<b>With:</b>	Pedro Calza FCDMC	<b>Date:</b>	November 27, 1996
<b>From:</b>	Fred Duren <i>FD</i>	<b>Time:</b>	8:15 a.m.
<b>Subject:</b>	Time Extension Skunk Creek FDP	<b>Phone No.:</b>	506-1501
		<b>Reference:</b>	1213.0070

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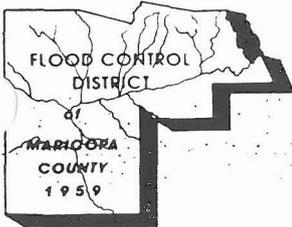
**Discussion:**

Pedro called to ask about the time extension. It seemed too long to him. He has to justify the reason why this extension is needed and has been getting criticism from his superiors about the floodplain delineation projects taking longer to get completed than in the past.

I explained that this project was probably unique because of the third-party (i.e., Del Webb) involvement and that this involvement was what has been primarily responsible for the delay in project completion. He understood but still was reluctant to agree to an extension to the end of May. I explained that we were trying to be conservative in our request to avoid having to go back to the District requesting another extension. He said that he would guarantee a one-week turn-around on all future District reviews on this project, and I said we had assumed three weeks for each of the remaining District reviews. I asked him what time extension he would be comfortable with, and he said to the end of April. I agreed that we could meet, and hopefully beat, this completion date assuming a one-week District review.

(Hasan, who was in Pedro's office when Pedro called, subsequently called to ask for us to fax the reason for the time extension. Hasan will type the reason on the form before sending to us for signature. He hoped to get it out to us today by courier. We will return to him by Friday or Monday, December 2. He will get the necessary sign-offs from District management and return the completed form to us, probably sometime next week.)

c: Laurie Miller  
Cortney Brand



# FLOOD CONTROL DISTRICT

of

## Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009-6399  
Telephone (602) 506-1501  
Fax (602) 506-4601  
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JAN 10 1997

Laurie Miller, P.E.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

RECEIVED

JAN 13 1997

MONTGOMERYWATSON  
PHOENIX OFFICE

SUBJECT : Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
HEC-2 review comments

Dear Ms. Miller :

Please find following review comments on the above mentioned project. It is recommended that these concerns are satisfied prior to the subsequent submittal with floodway delineations.

### General

- (1) Plot the floodplain/floodway maps at a 1"=400' scale.
- (2) It is advisable to eliminate the cross-section extended messages from the hydraulic modeling.
- (3) Please remove/eliminate small islands from the floodplain/floodway delineation.
- (4) The floodplain/floodway delineation should match with the Cline Creek FDS.
- (5) Several bank stations are suggested to be relocated as marked.
- (6) Please show bank stations on the floodplain/floodway delineation maps.

### HEC2 Modeling

- (7) Top width at cross sections X1 14.54 and X1 15.75 does not match the HEC-2 results. Please explain.
- (8) Floodplain boundary is suggested to be revised at cross sections X1 15.22 through X1 15.55, X1 18.96 through X1 19.18.
- (9) It is recommended that cross sections X1 16.96, X1 18.16, X1 19.92, X1 23.45 be realigned.
- (10) Error message exists, when EDIT2 is run, at the carefree highway bridge. Please revise and/or edit the current bridge modeling to remove the error message.
- (11) Possible over bank flooding is found between cross-sections 17.95 through 18.29. Please investigate the situation.
- (12) Please investigate the ineffective flow area situation at cross section X1 19.41.
- (13) The GR record at cross-section 19.92 may be erroneous as shown in the x-section plot. Please

adjust accordingly.

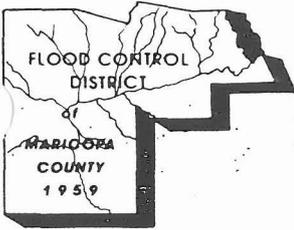
- (14) The house(s) at cross-section X1 24.87 has not been modeled in the hydraulic analysis.
- (15) The x-section plots from X1 25.12 through X1 25.63 suggests a possible split flow situation. Please investigate and adjust the model accordingly.
- (16) It is recommended that the orientation of cross-sections X1 25.78 and X1 25.79 be revised to better represent the New River bridge modeling.
- (17) The New River bridge has not been modeled to account for the severe skewness that exists. Please revise the modeling to account for the proper skewness.
- (18) The x-section plots from X1 25.91 through X1 26.24 strongly suggests of possible flooding on both right and left over bank areas. Please investigate the situation and adjust the hydraulic model accordingly.

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,



Hasan Mushtaq, P.E.  
Engineering Division



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009-6399  
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Fax (602) 506-4601  
TT (602) 506-5859

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JAN 15 1997

Laurie Miller, P.E.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
DTM files : Arc/Info deliverables

Dear Ms. Miller :

Please find attached comments on the above mentioned submittal. These comments need to be addressed prior to any subsequent submittal.

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501.

Sincerely,

Hasan Mushtaq, P.E.  
Engineering Division

**RECEIVED**

JAN 17 1997

MONTGOMERY WATSON  
PHOENIX OFFICE

1-14/97

The Flood Control District of  
Maricopa County  
2801 West Durango Street  
Phoenix, Arizona 85009

**DTM, Revision 1.0, database review of the Skunk Creek Arc/Info deliverables.**

**Reviewed by: Mark Brewer, HIS Database Administrator**

This memo is for the review of the DTM files supplied to the Flood Control District of Maricopa County.

The following DTM files were reviewed as follows. A [X] means that the item passed the review. Comments left as [ ] need to be addressed.

Submitted: 1-9/97

Reviewed: 1-14/97

**LINE FILES:** (north.lf, south.lf)

4.[ ] There are no lines coded with an id of 7. This is the exterior exclusion boundary, which is a REQUIRED feature. This feature was delivered as two polygon coverages. There was a dangle error in one of the polygons that causes an error in processing. It would need to be fixed before including their definitions in the dtm line files.

**POINT FILES:** (north.pf, south.pf)

The point files look acceptable at this time. Final acceptance is pending on the resubmittal of the revised dtm line files and the resulting dtm processed.

7.[x] File(s), north.pf and south.pf, has/have a missing or misplaced end statement. A double end statement was found at the end of both files. This was corrected in-house, but please make sure there is only a single end statement, per specifications, in the future.

hm  
/od38b/skunk1/  
c:\wp\sknkdtm1.wpd

# TELEPHONE CONVERSATION

---

<b>With:</b>	Paul Hoskin HEC	<b>Date:</b>	January 15, 1996
<b>From:</b>	Laurie Miller	<b>Time:</b>	11:30 a.m.
<b>Subject:</b>	December 1996 Progress Report and Invoice	<b>Phone No.:</b>	
		<b>Reference:</b>	

---

## Discussion:

I called Paul to request clarification on the December 1996 progress report and attached invoice I received today. The progress report showed no work performed, yet included 3.5 hours under Task 1.4 for coordination with Montgomery Watson and preparing the invoice. Additionally, similar time was included for each month of October and November (1.5 and 3.5 hours, respectively), although only one combined progress report and invoice was submitted for October/November.

I informed Paul that according to his contract scope of work, Task 1.4 is to provide written monthly progress reports based on assigned work tasks. He said the hours expended were from telephone conversations he has had with Cortney Brand on the floodplain delineation portion of the project (Task 8). He believes we have not been inviting him to formal progress meetings with the District, and therefore felt justified in charging time to this task. I reminded Paul that his participation in scheduled progress meetings with the District is limited to 5 of 10 meetings as noted in his Task 1.2, and that he has attended at least three or four of these meetings to date.

I requested that Paul review the two invoices covering October-December 1996 and provide clarification/justification for the hours spent, or revise the invoice if appropriate. I gave an example that if the hours expended and shown under Task 1 were in fact discussions associated with technical work covered in Task 8, Floodplain Delineation, then the invoice should be revised accordingly to show that the hours were actually expended.

Paul was very indignant that his invoices are being questioned. He said his invoices should not be scrutinized in light of the fact that Montgomery Watson did not authorize a prior request for additional fees. Although I asked a number of times during the conversation, he did not agree to review the invoices or provide additional documentation unless I told him how he should change the progress reports and invoices to guarantee approval of them. I told him I could not do this as it would not be appropriate for me to write his progress reports or invoices.

Paul made a number of comments throughout the conversation which were very hostile to me, to Fred Duren, and to Montgomery Watson. In the interests of keeping our discussions to a professional level, I informed Paul at 11:55 that I would end the conversation. The issue of his provided clarifications and/or revisions to the invoices was not resolved.



January 15, 1997

Mr. Hasan Mushtaq, P.E.  
Hydrologist  
Flood Control District of Maricopa County  
2801 West Durango  
Phoenix, AZ 85009

Subject: Request for Change Order No. 3 - Additional Funds for GIS Services

Project: Skunk Creek Floodplain Delineation (FCD 95-16)

Dear Mr. Mushtaq:

The purpose of this letter is to request additional funds to perform out-of-scope services under Task 9.2 of the Scope of Work for the Skunk Creek Floodplain Delineation project. This task involves the production of check plots (i.e., map composition files) from the digital database(s).

For this subtask, it was assumed that the Flood Control District of Maricopa County (District) possessed the Arc Macro Languages (AML's) necessary to enable conversion of digital data to map composition files and check plots. Subsequent discussions with the District revealed that several of the AML's necessary to produce map composition files from the digital database(s) have not been developed. In addition, the necessary specifications have not been developed by the District as to the development and required format of the check plots.

In order to perform Task 9.2, which would include the development of AML's and production of check plots from the digital database(s), an additional \$12,270 is requested.

Please do not hesitate to contact myself or Laurie Miller if you have questions or need additional information.

Sincerely,

MONTGOMERY WATSON

Fred K. Duren, Jr., P.E., P.G.  
Project Manager

c: Laurie Miller  
Cortney Brand  
1213.0050.1.2  
1213.0070.3.1.2



MONTGOMERY WATSON

## TELEPHONE CONVERSATION

---

<b>With:</b>	Rudy Strickland	<b>Date:</b>	January 22, 1997
	Mapping Automation	<b>Time:</b>	2:00 p.m.
<b>From:</b>	Fred Duren	<b>Phone No.:</b>	732-0382
<b>Subject:</b>	FCDMC Comments on DTM Files Submittal	<b>Reference:</b>	1327034.02090070

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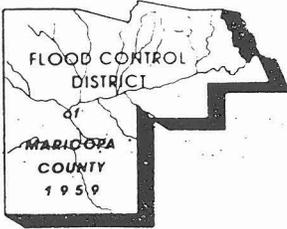
**Discussion:**

Rudy called to talk to Laurie. I handled the call since she was in a meeting.

Rudy had reviewed the comments from the FCDMC regarding the DTM submittal. He believes that the questions raised by the District can be readily addressed. He thinks that there is a misunderstanding on the District's part as to what it really needs, as reflected in the comments.

Rudy said he would like to talk over the District's comments with a contact he has in the District's GIS group. He thought he could resolve the District's two comments in this manner. I agreed with this approach and asked to get back to us if an impasse develops. He thought that he should be able to respond to us by the end of the week regarding whether he would be able to appease the District regarding the two comments.

c: Laurie Miller  
Cortney Brand



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

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Telephone (602) 506-1501  
Fax (602) 506-4601  
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JAN 28 1997  
JAN 28 1997

Laurie Miller, P.E.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
DTM files : Arc/Info deliverables

Dear Ms. Miller :

According to the attached review comments, the above submittal is accepted at this time. However, it should be noted that the in-house GIS personnel made some changes in the submittal, as explained in the enclosed letter.

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501.

Sincerely,

Hasan Mushtaq, P.E.  
Engineering Division

**RECEIVED**

JAN 30 1997

MONTGOMERY WATSON  
PHOENIX OFFICE

1-27/97

The Flood Control District of  
Maricopa County  
2801 West Durango Street  
Phoenix, Arizona 85009

**DTM, Revision 1.0, database review of the Skunk Creek Arc/Info deliverables.**

**Reviewed by: Mark Brewer, HIS Database Administrator**

This memo is for the review of the DTM files supplied to the Flood Control District of Maricopa County.

The following DTM files were reviewed as follows. A [X] means that the item passed the review. Comments left as [ ] need to be addressed. DTM files ARE APPROVED.

Submitted: 1-23/97

Reviewed: 1-24/97

Submitted: 1-9/97

Reviewed: 1-14/97

**LINE FILES:** (north.lf, south.lf) (north\_bdy.lf, south\_bdy.lf)

4. [X] There are no lines coded with an id of 7. This is the exterior exclusion boundary, which is a REQUIRED feature. This feature was delivered as two polygon coverages. There was a dangle error in one of the polygons that causes an error in processing. It would need to be fixed before including their definitions in the dtm line files.

The exterior exclusion boundaries were delivered separate from the rest of the line files as north\_bdy.lf and south\_bdy.lf. The dangle that existed in the south polygon coverage still existed in the south\_bdy.lf line file, so it was edited out in-house by removing one vertex and changing the closing vertex elevation so that it would match the beginning elevation.

**POINT FILES:** (north.pf, south.pf)

The point files look acceptable at this time. Final acceptance is pending on the resubmittal of the revised dtm line files and the resulting dtm processed.

7. [X] File(s), north.pf and south.pf, has/have a missing or misplaced end statement. A double end statement was found at the end of both files. This was corrected in-house, but please make sure there is only a single end statement, per specifications, in the future.

hm

/od38b/skunk1/

c:\wp\sknkdtm2.wpd

## Hasan Mushtaq - FCD

---

**From:** Mark Brewer - FCD  
**To:** Hasan Mushtaq - FCD  
**Cc:** Marta Dent - FCD; Mark Brewer - FCD  
**Subject:** Skunk Creek DTM files  
**Date:** Tuesday, January 28, 1997 12:37PM

The Skunk Creek DTM files are now accepted. Please make sure Rudy still gets a copy of the final review comments since some things were again modified in-house. I'm also forwarding the fax he sent with this submittal to you.

If you have any questions or concerns, please let me know...

<<File Attachment: SKNKDTM2.WPD>>



February 4, 1997

Mr. Hasan Mushtaq, P.E.  
Hydrologist  
Flood Control District of Maricopa County  
2801 West Durango  
Phoenix, AZ 85009

Subject: Modification of Task 9.2

Project: Skunk Creek Floodplain Delineation (FCD 95-16)

Dear Mr. Mushtaq:

At your request, we have prepared a revised Subtask 9.2 of the contract scope of work for the Skunk Creek Floodplain Delineation Study. The subtask is being revised to reflect modifications of responsibilities in developing check plots. It is our understanding that the District will develop the check plots and Montgomery Watson will be responsible for comparing the check plots with to the contractor maps. The following revisions to Task 9.2 is suggested:

The District will prepare and deliver check plots at the same scale as original contractor-supplied hydrologic and planimetric delineation maps. The check plots will be provided on scale-stable mylars, transparencies, or other high transparency medium. Montgomery Watson will overlay the check plots; and the positioning of well-defined planimetric mapping features will be compared, noting any such features that obviously fall outside National Map Accuracy Standards for 1"=200' scale mapping as specified in the General Scope of Services. Positioning of all hydrologic design features developed by Montgomery Watson subsequent to the planimetric mapping will be compared and corrected for any locational discrepancies, as governed by National Map Accuracy Standards.

We have revised our estimate of fees to perform this modified Subtask 9.2. The basis of fee estimate is two hours per sheet for each of ten project maps. The estimate of fees is based on the rates in our original contract and is as follows:

<u>Contract</u>	<u>Task/Subtask</u>	<u>Supv. Eng. Hours</u>	<u>Total Fee</u>
9.2	Check Plots	20	

This represents a reduction in fees of from the original fees for this subtask of  
Therefore, the revised contract amount is as follows:

Total Original Contract Amount:  
Modify Subtask 9.2

**Revised Total Contract Amount**

Please note that the project schedule may need to be modified to allow time for the District to develop the Arc Macro Languages (AML's) necessary to enable conversion of digital data to map composition files and check plots and for generation of the check plots.

Please do not hesitate to contact myself or Laurie Miller if you have questions or need additional information.

Sincerely,

MONTGOMERY WATSON



Fred K. Duren, Jr., P.E., P.G.  
Project Manager

c: Laurie Miller  
Cortney Brand  
1213.0050.1.2  
1213.0070.3.1.2



March 6, 1997

Mr. Hasan Mushtaq  
Hydrologist  
Flood Control District of Maricopa County  
2801 West Durango Street  
Phoenix, Arizona 85009

Subject: Submittal of Floodway Analysis- Method 4  
Contract FCD 95-16 Skunk Creek Floodplain Delineation Study

Dear Mr. Mushtaq:

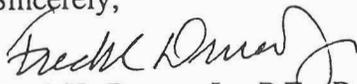
With this letter we are submitting several items relative to the floodway analysis performed for Skunk Creek using encroachment method 4. These items include:

1. Work maps showing the 100-year floodplain and floodway boundaries.
2. The original floodplain work maps containing District review comments.
3. A summary of the changes made to the 100-year floodplain analysis based on District review comments (i.e., HEC-2 Revisions Based on Meeting of January 9, 1997, with FCDMC).
4. Minutes of the January 9 meeting containing action items addressed in item 3.
5. Floodway Analysis Methodology Summary.
6. Printouts of the following output files:
  - a. revised 100-year floodplain (i.e., CAPTOEND.OUT)
  - b. floodway run for the main channel of Skunk Creek based on encroachment method 4 (i.e., SCMTHD4.OUT)
  - c. floodway run for the split flow from cross sections 16.87 through 17.48 (i.e., ROBHWYE4.OUT)
  - d. divided flow analysis for flow conveyed through the eastern overchute (i.e., overchute no. 2) at the CAP Aqueduct (i.e., TRIBCP6.O)
7. A computer disk with the following input and output files
  - a. item 6a, also including input file CAPTOEND.DAT
  - b. item 6b, also including input file SCMTHD4.DAT
  - c. item 6c, also including input file ROBHWYE4.DAT
  - d. item 6d, also including input file TRIBCP6.H2I

Should you have any questions or comments on this matter, please do not hesitate to contact us. We are available to meet with the District if needed to assist in facilitating your review.

We will prepare the floodway analysis using encroachment method 1 upon receipt of District review comments on the encroachment method 4 analysis.

Sincerely,



Fred K. Duren, Jr., P.E., P.G.  
Project Manager

Attachments

c: Pedro Calza  
Laurie Miller  
Cortney Brand  
1327034.02090070

**SKUNK CREEK  
HEC-2 REVISIONS  
BASED ON MEETING OF JAN. 9, 1997  
WITH FCDMC**

January 22 to February 27, 1997  
1327034.02090070  
Montgomery Watson

**BACKGROUND**

The following comments and revisions directly relate to the General Comments contained in the minutes of the subject meeting. The revisions made in this HEC-2 input file will be reflected in the encroachment HEC-2 run to be submitted for FCDMC approval as Montgomery Watson's next submittal.

In making the changes resulting from FCDMC comments, several other changes were made. These are described at the end of this document.

**REVISIONS (Based on FCDMC Comments)**

1. No revision necessary. Work maps will continue to be submitted at the 1 inch = 200 foot scale.
2. Cross sections containing the comment "cross section extended" are:  
19.92  
22.96  
23.13  
23.55

Revision: Change comment cards to read "Cross section lengthened using topo map." The original message referring to cross-section extension needed to be revised to eliminate confusion regarding the cross section modification used.

3. All small, inter-channel islands have been shown within the 100-year floodplain. Additionally, backwater flooding has been shown on several cross sections.
4. The plotting of the Skunk Creek floodplain boundary up Cline Creek has been made using the FIRM showing Cline Creek by finding the match point for the Skunk Creek profile water surface elevation with the corresponding Cline Creek profile water surface elevation.
5. FCDMC suggested reviewing the bank stations for the following cross sections, as noted on the work maps reviewed by the FCDMC. The bank stations noted below were changed as a result of a further review by Montgomery Watson.

Section	HEC-2 Input		Selected	
	STCHL	STCHR	STCHL	STCHR
X1 13.16	-----	10215	-----	10288
X1 13.28	9484	-----	9439	-----
X1 13.55	9742	10432	9688	10494
X1 14.54	-----	10306	-----	10480
X1 16.49	-----	10316	-----	10130
X1 18.16	9951	-----	9836	-----
X1 18.84	9987	-----	9915	-----
X1 19.18	9943	-----	9874	-----
X1 19.62	-----	10046	-----	10120
X1 23.94	9919	-----	9880	-----
X1 24.74	-----	10036	-----	10086
X1 25.91	9938	-----	9914	-----

6. See 5 above.

7. Top widths at cross sections X1 14.54 and X1 15.75 were checked and the following was found. At X1 14.54, the HEC-2 output shows a TOPWID of 604 feet, vs a plotted TOPWID of 775 feet. The difference is explained by the presence of two islands in the left overbank which account for the 171-foot difference between the HEC-2 TOPWID and the plotted TOPWID. At X1 15.75, the HEC-2 output TOPWID is 769 feet vs. a plotted TOPWID of 770 feet. Therefore, both the plotted and HEC-2 TOPWID's at both of these sections are consistent.

8. For X1 15.22 through X1 15.55, the floodplain boundary was adjusted slightly to agree with the FCDMC comment. For X1 18.96 through X1 19.18, the sand bar was eliminated at X1 19.07; and the right floodplain boundary was adjusted to agree with the FCDMC comment.

9. The following cross section modifications were made.

X1 16.96 (Sheet 5 - original work map):

The left end of cross section was re-drawn to be 494 feet from thalweg. This corrects the map depiction that erroneously shows this cross section to be overlapping X1 16.87.

X1 18.16 (Sheet 6 - original work map) (Also see item 21):

All GR record data starting at station 10249 and continuing to the end station at 11463 were eliminated and replaced with the following GR data:

<u>EL</u>	<u>STA</u>
1730	10330
1730	10380
1734	10430
1736	10650
1736.9	10750
1738	10930
1738	11040
1740	11130

The number of GR data points was changed from 58 to 34.

X1 18.20 (Sheet 6 - original work map):

The GR record data were changed based on the following analysis.

1. The projection of the Cloud Road embankment that is perpendicular to the 100-year flow path was computed.
  - a. Length of Cloud Road embankment at a skew to flow = 400 ft.
  - b. Skew angle = 55 degrees from perpendicular projection
  - c. Perpendicular projection length/400 ft. =  $\cos 55$  degrees  
Perpendicular projection = 229 ft., say 230 ft.
2. The GR record data were adjusted to reflect a 230-foot long flow obstruction due to Cloud Road
  - a. The obstruction was started at cross section station 10075, using elevation 1738.8, per original section GR data. All GR data was replaced from original section, starting with station 10200 with the following:

<u>EL</u>	<u>STA</u>
1740	10305
1741	10349
1741	10561
1742	10742
1744	10973
1746	11158
1748	11198

The above GR data were developed by inserting the perpendicular projection of the Cloud Road embankment starting at station 10075, which is taken as the beginning point for adding the perpendicular projection onto the original GR data. The 230-foot perpendicular projection addition at this station results in a termination of the projection at station 10305, which is taken to represent an elevation of 1740 as indicated in the original GR data for station 10471. From that station on (i.e., from new station 10305), the remaining original GR data were tacked onto the end of the revised data, using the next data point at original station 10515 to now be converted to 10349 (i.e., 44 feet past the prior station).

The number of GR data points was changed from 20 to 19.

X1 19.92 (Sheet 8 - original work map):

Re-aligning the left side of the cross section as shown on FCDMC's map was considered; however, it was concluded that the alignment of the original section in the left overbank is more appropriate than that recommended by the FCDMC. The low spot in the left overbank was incorporated by adding new GR data between stations 9241 and 9529, as follows (difference in GR data points = +1) The left floodplain boundary was moved farther out in response to the HEC-2 output:

<u>EL</u>	<u>STA</u>
1813.1	9365

The number of GR data points was changed from 58 to 59.

X1 23.45 (Long Roll - original work map):

All GR data were eliminated from station 9572 to 9111 and replaced with (difference in GR data points = -17):

<u>EL</u>	<u>STA</u>
2004	9460

The number of GR data points was changed from 56 to 39.

10. The HEC Carefree Bridge modified data have been inserted in the current HEC-2 model and the floodplain boundary drawn accordingly (Also see item 19).
11. The encroachments were eliminated at this reach (i.e., X1 17.95 and 18.06); and the floodplain boundary extended into the right overbank, as dictated by the HEC-2 output. It was not considered reasonable to eliminate flooding in the right overbank, as requested to be analyzed in the FCDMC comment.
12. Encroachments were removed from X1 19.41 and 19.52. Backwater was plotted on the floodplain boundary map in the left overbank. The plotted TOPWID is, thus, greater than the TOPWID shown in the HEC-2 output.
13. See 9, above.
14. The following changes were made in the GR record data to reflect the house in the left overbank:

Eliminate the data for station 9705

Add the following two GR data points after station 9659

<u>EL</u>	<u>STA</u>
2071	9690
2071	9750

Change the number of GR data points from 26 to 27.

15. No change necessary.
16. New River Bridge revisions (Special Bridge Routine)

No re-orientation needed for the bridge, which is skewed. The skewness has been taken care of in the SB card, where the bottom width of bridge opening (i.e., BWC) is shown to be 197 feet vs. 320 feet along the bridge profile. The skewness was not taken care of in variable, BAREA, net area of bridge opening, which is shown to be 1,528 square feet. The value of BAREA was changed to 1,410 square feet (avg. bridge height =  $(7+8.5)/2$  feet = 7.75 feet; open area = height x (total width-obstruction width) =  $7.75 \times (197-15) = 1,410$  square feet).

Both sections 25.78 and 25.79 were lengthened as follows:

For section 25.78, the data for station 10432 and following stations were eliminated and the following GR data points were added after station 10410:

<u>EL</u>	<u>STA</u>
2108	10740

2108	10800
2106	10880
2106	11950
2116	11010
2116	11070
2106	11340

The number of GR data points was changed from 18 to 21.

For section 25.78, the following GR data points were added after station 10490:

<u>EL</u>	<u>STA</u>
2110	10550
2113	10570
2113	10610
2109	10770
2108	10950
2108	11320

The number of GR data points was changed from 41 to 47.

17. Modification of the HEC-2 model at New River Road bridge to allow for consistency in skewness analysis with Carefree Highway bridge analysis was not needed since: (1) the New River Road bridge skewness and the appropriate portions of the non-bridge cross section containing skewness were taken care of directly in the input data, as indicated above in item 16, and (2) since the remaining, non-bridge cross section portions are oriented perpendicular to the flow path and, thus, do not need to be skewed. Exact consistency between the bridge modeling at New River Road and Carefree Highway is not necessary because the Carefree Highway bridge is modeled with a skewness applied to all bridge and cross section data, whereas the New River Road bridge incorporates skewness directly into the bridge input data, as described above, and in that portion of the GR data which is skewed to flow. Therefore, with the adjustments to GR record data specified in item 16, the New River Road bridge modeling analysis is correct and reasonably consistent with that performed for the Carefree Highway bridge.
18. Based on the original HEC-2 model output, which included encroachments at X1 25.79 through X1 26.24 (top of study area), the 100-year CWSEL is below the elevation of the encroachment stations. Therefore, the only potential for flow to leave the channel and be conveyed into the right and left overbanks is for erosion of the channel banks to occur. Since a fixed-bed assumption is used in flood insurance studies, it is consistent to assume no bank erosion and, thus, conclude that flow is contained in the channel within this reach.

The above conclusion is based on the assumption that all flow at the uppermost section (i.e., X1 26.24) is contained in the channel. Should it be possible for flow to occur in the overbanks due to conditions farther upstream, above our study reach, then the assumption that all flow at X1 26.24 is within the channel would need to be modified.

#### REVISIONS (In Addition to Those Based on FCDMC Comments)

19. At the Carefree Highway bridge (X1 16.86 and 16.87), the bank stations were plotted on the floodplain boundary map as dictated by bridge geometry. The HEC-

2 output bank stations are affected by the 83-percent skew that was applied to this cross section and do not properly represent the bank stations.

20. At X1 17.18, the right floodplain boundary was re-drawn to agree with the HEC-2 output. This is an area of split flow.
21. At X1 18.20 another modification was made in addition to that described above in item 9. The GR record data in the left overbank were modified as follows:

<u>EL</u>	<u>STA</u>
1750	9540
1740	9570
1738	9580
1736	9660
1734	9680
1732	9690
1734	9710
1736	9745
1736	9835
1734	9980

(Continue with previous GR record data starting at station 10000.)

22. At X1 19.62, an ET record was used to confine the flow within the left channel bank to eliminate flow conveyance in the backwater area in the left overbank.
23. At X1 25.12, backwater was plotted in the left overbank. The plotted TOPWID, therefore, is greater than that shown in the HEC-2 output.

**SKUNK CREEK  
FLOODWAY ANALYSIS - EQUAL CONVEYANCE  
METHODOLOGY SUMMARY**

March 6, 1997  
1327034.02090070  
Montgomery Watson

**BACKGROUND**

The Equal Conveyance Method (i.e., Method 4) is the first floodway analysis to be used for the Skunk Creek Floodplain Delineation Study. Encroachment Method 4 is used to perform this floodway analysis. The following describes the development of revised input data to the HEC-2 100-year floodplain model for running Encroachment Method 4.

The original HEC-2 100-year floodplain model utilizes the split flow option at the lower end of the delineation study area. Since Method 4 cannot be used with the HEC-2 split flow option and, since the 100-year floodplain model after removing the split flow option will correctly model the flow in the main channel, the split flow records were removed from the model prior to running the floodway analysis.

**Sections 13.00 through 13.28**

This lowermost reach of the floodplain delineation is immediately upstream of the CAP Aqueduct, where two overchutes convey Skunk Creek flow over the Aqueduct. Additionally, in this reach Skunk Creek flow is lost to the west as water enters the Aqueduct and also flows over Interstate Highway 17. This reach requires a complex model, incorporating subdivision of flow between the two overchutes in addition to a split flow analysis to evaluate flow lost to the west. As a result, it is not feasible to apply the floodway analysis concept to this reach of the delineation study; and the 100-year floodplain boundary is taken as the floodway boundary for the reach defined by these cross sections.

**Sections 13.40 through 20.62**

This reach covers the downstream portion of Montgomery Watson's lower study reach. The Del Webb analysis starts at section 20.64 and continues upstream to section 22.95. Encroachment Method 4 was utilized with an initial target of 1 foot.

**Sections 22.96 through 26.24**

This reach covers the upstream portion of Montgomery Watson's delineation study. Section 22.96 is the section immediately upstream of the terminus of the Del Webb delineation. Section 26.24 is the upstream limit of Montgomery Watson's delineation study. As with the prior reach, Encroachment Method 4 was utilized with an initial target of 1 foot.

**FLOODWAY ANALYSIS**

The Equal Conveyance method of floodway analysis was applied by creating a second run in the original HEC-2 input file (i.e., CAPTOEND.DAT). Floodway Encroachment Method 4 was specified in the third field of the ET record and a 1.0-foot target water

surface elevation rise was assigned (i.e., 10.4). In general, the analysis was an iterative process requiring several revisions to achieve a rise in water surface elevation at all cross sections that did not exceed 1 foot. The following discussion summarizes the step-by-step revision process used in the floodway analysis.

### **Revision 1**

1. If a cross section did not contain pre-defined encroachments for the 100-yr floodplain, a 10.4 was inserted into the third field of the ET record.
2. If a cross section contained pre-defined encroachments for the 100-yr floodplain, a 9.1 was placed in the third field of the ET record and the original encroachment stations were maintained.
3. No modifications were made to the floodway analysis for the Del Webb portion of the Skunk Creek study area.
4. The original encroachments defined in the Carefree Highway and New River Road bridge routines were maintained.
5. All QT records were modified by inserting a 2 in the first field and specifying the same flow in the third field as assigned in the second field. This modification ensured that the same flows would be used during the second run of the model.
6. The model was run and a summary table of encroachment data was developed.

### **Revision 2**

Results from Revision 1 were analyzed and used to make the following modifications to the encroachment data:

1. If a cross section did not contain pre-defined encroachments for the 100-yr floodplain, the target rise in water surface elevation was adjusted based on results from Revision 1. For example, if the calculated water surface elevation rise was greater than 1.0 foot, the target was lowered (e.g., from 1.0 foot to 0.8 feet). However, if the water surface rise was significantly lower than 1.0 foot, the target was raised (e.g., from 1.0 foot to 1.2 feet).
2. If a cross section contained pre-defined encroachments for the 100-yr floodplain and an adjustment was required in the water surface elevation from the first floodway run, a 7.1 was placed in the third field of the ET record and new encroachment stations were specified in the seventh and eighth fields. New encroachment stations were developed by analyzing cross section plots and flow distribution data in an attempt to equally reduce/increase conveyance in the overbanks. For example, if the calculated water surface rise was greater than 1.0 foot, new encroachment stations were chosen at greater distances to provide greater conveyance area. Alternatively, new encroachment stations were chosen at lesser distances to decrease conveyance, increasing the calculated water surface rise.
3. New encroachment stations were not chosen at distances greater than the 100-yr floodplain. Therefore, at some cross sections (e.g., X1 24.25), the encroachment station(s) were set at the 100-yr floodplain start and/or end station. In addition, further raising of the water surface at some cross sections could not be achieved because existing encroachment stations were already at pre-defined channel bank stations.

Once revisions were made to the HEC-2 input file, the model was run and results were analyzed for further modification.

### **Revision 3**

Further revisions were made to the encroachment data based on results from Revision 2. Floodway data and cross section plots were analyzed, and modifications were made using the same methodology as discussed in Revision 2.

1. Target water surface rise parameters were increased or decreased depending upon whether the water surface needed to be raised or lowered, respectively. The lowest target assigned was 0.1 feet and the highest target assigned was 3.0 feet.
2. For cross sections having 7.1 in the third field of the ET record, encroachment stations were widened or shortened in order to raise or lower the calculated water surface.

Once revisions were made to the HEC-2 input file, the model was re-run and results were analyzed for further modification.

### **Revision 4**

A fourth and final floodway revision was made based on the results of Revision 3. Encroachment parameters were modified using the same methodology as discussed in Revisions 2 and 3. If a cross section had a water surface elevation rise greater than 1.0 foot, the encroachment stations or target rise value of the prior cross section were modified until results indicated that all cross sections had a water surface elevation rise of less than 1.0 foot.

### **Split Flow from Sections 16.87 through 17.48**

A separate HEC-2 model was created to account for a loss of 3,600 cfs from mainstream of Skunk Creek at cross sections 16.87 through 14.48 (i.e., file ROBHWY.H2I). This model was modified using the same methodology as discussed above to perform a floodway analysis (i.e., file ROBHWY4.DAT). Results from this floodway analysis were combined with results from the mainstream floodway analysis in order to develop a continuous floodway throughout the study area.

### **HEC-2 Files**

- CAPTOEND.DAT: Revised input data file for the Skunk Creek 100-yr floodplain. Incorporates all review comments provided by the Flood Control District of Maricopa County.
- CAPTOEND.OUT: Output data file associated with CAPTOEND.DAT.
- SCMTHD4.DAT: Equal Conveyance Floodway analysis (i.e., Method 4) input data file. Developed from CAPTOEND.DAT.
- SCMTHD4.OUT: Output data file associated with SCMTHD4.DAT.
- ROBHWY4.DAT: Floodway analysis input data file for split flow from cross sections 16.87 through 17.48. Developed from ROBHWY.H2I.

ROBHWYE4.OUT: Output data file associated with ROBHWYE4.DAT.

TRIBCP6.H2I: Input data file for split flow analysis at CAP Overchute No. 2.

TRIBCP6.O: Output data file associated with TRIBCP6.O.

## SUMMARY

The Equal Conveyance floodway analysis for Skunk Creek was successful in that a water surface elevation rise of less than 1.0 foot was achieved at all cross sections. In an attempt to accomplish this goal, the water surface elevation rise at some cross sections was required to be much lower than at others. Numerous revisions were made during the floodway analysis, and the resultant floodway is believed to be a very reasonable interpretation. Additional modification of target rise parameters and encroachment stations will not likely result in significant improvement to this analysis.

From: Cortney Brand (3/28/97),

To: Fred Duren

CC: Laurie Miller, Janene Werner

BCC:

Priority: Normal

Date sent: 3/28/97 7:20 AM

Message from  
**QuickSend**

Conv. w/ Hasan M.

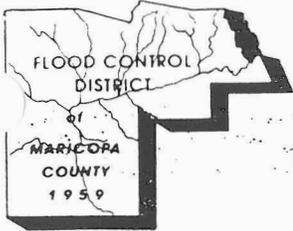
CONVERSATION W/ HASAN MUSHTAQ (3/27/97 @ 3:00 p.m.):

I called Hasan because he noted on his fax of today that he needed to speak to me. He had three requests:

1. Eliminate comment (2), which asks us to revise the locations of selected bank stations. He feels that modifying bank stations at this point will be more trouble than it is worth.
2. Make suggested revisions to Method 4 floodway run, run it, and then keep the revised Method 4 floodway run as a separate file. He said that we may need this file to respond to FEMA review questions.
3. Included with our next submittal, he would like a copy of the following files: Method 1 data/output; Revised Method 4 data/output; CAP Overchute split flow analysis data/output; and the Carefree Highway split flow analysis data/output (not the revised version with the floodway run).

I agreed to his three requests.

Cortney



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009-6399  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

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MAR 2 8 1997

Fred K. Duren, Jr., P.E., P.G.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**RECEIVED**

**MAR 31 1997**

**MONTGOMERY WATSON  
PHOENIX OFFICE**

Subject : Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study  
Submittal of Floodway Analysis - Method 4 (Contract FCD 95-16)

Dear Mr. Duren :

Please find following comments on the above mentioned submittal. It is suggested that the review comments be addressed prior to a final submittal.

General

- (1) There are several cross-section extended message in the HEC-2 output. It is advisable to eliminate the X-section extended messages.
- (2) Several cross sections need to be revisited to determine proper locations of the bank stations.
- (3) Explanation provided in item (7) is not compatible with the original submittal.
- (4) Explanation provided in item (12) is not compatible with the revised HEC-2 (w/ floodway) output.
- (5) The changes suggested in item (21) are not reflected in the HEC-2 modeling.

HEC-2 Modeling

- (6) At cross-section 13.28, the LB encroachment station seems to be inside the LB station. It is recommended that the LB encroachment be set outside the LB station.
- (7) Please investigate if the encroachment was removed from cross-section 16.86.
- (8) 10th field of the X3 record at cross-section 16.87 has a number "75". Please explain.
- (9) Please specify the conversion of the cross section stationing through the Del Webb portion of the HEC-2 modeling.

- (10) Several cross sections, upstream of the Carefree Highway bridge show water to be in the side channel. Since the main channel is being modeled with the reduced discharge, the flows should be confined in the main channel only. The situation needs further evaluation.
- (11) Cross-sections with high target values in the ET records have negative surcharges. The output also shows that the RATIO parameter are negative at these locations. It is suggested that the situations be further investigated and the negative surcharges should be eliminated.
- (12) Several cross-sections have floodway widths greater than the floodplain widths. Please investigate the situations on a case by case basis.
- (13) Please include Tables 110, 115, 150, and 200 in the HEC-2 analysis.

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,



Hasan Mushtaq, P.E.  
Engineering Division



MONTGOMERY WATSON

## TELEPHONE CONVERSATION

---

<b>With:</b>	Pedro Calza	<b>Date:</b>	April 7, 1997
	FCDMC	<b>Time:</b>	3:10 p.m.
<b>From:</b>	Fred Duren <i>FD</i>	<b>Phone No.:</b>	506-4697
<b>Subject:</b>	GIS Submittal	<b>Reference:</b>	1327034.02090070
	Skunk Creek FDP		

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**Discussion:**

Pedro called to ask if we would submit the GIS work product to the District along with the rest of the FEMA submittal. Normally, the GIS submittal isn't made until after FEMA review; however, Pedro needs to have the submittal before the contact completion date in order to be able to pay us for it without writing a change order.

Pedro said that if there are any changes in the GIS submittal due to FEMA review comments, the District will handle these. Conversely, the GIS submittal will still have to pass District review, which will be conducted prior to FEMA review. Any changes to the GIS submittal resulting from District review will be covered under our contract without change order. He asked that the FEMA submittal be made by June 1, 1997.

I told Pedro we should be able to do this, but I would get back to him to confirm. (He is on the spot if we can't pull this off, so we need to comply.)

c: Laurie Miller  
Cortney Brand



MONTGOMERY WATSON

## TELEPHONE CONVERSATION

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<b>With:</b>	Rudy Strickland	<b>Date:</b>	April 9, 1997
	Mapping Automation	<b>Time:</b>	10:15 a.m.
<b>From:</b>	Fred Duren <i>FVD</i>	<b>Phone No.:</b>	732-0382
<b>Subject:</b>	GIS Submittal	<b>Reference:</b>	1327034.02090070

---

**Discussion:**

I called Rudy to coordinate the GIS submittal. I told him of Pedro's request that the GIS submittal be made prior to FEMA review and that Pedro said any changes in the GIS submittal that resulted from FEMA review would be handled by the District. Rudy was in agreement with this request.

It was agreed that Montgomery Watson would get the final mapping information to Rudy by the end of April. This would consist of computer files of the key hydraulic information (e.g., floodplain and floodway boundaries, cross sections, thalweg). I told Rudy we would be submitting this information on Micro-Station, which was agreeable to him. He said it would take 2 to 3 weeks from receipt of this information to get the GIS submittal ready to give to the District. Rudy will provide us with the planimetric computer file for use in plotting our hydraulics information.

Rudy said that the DTM review by the District went well. They only had one small comment, which was easily handled.

c: Laurie Miller  
Cortney Brand



MONTGOMERY WATSON

## TELEPHONE CONVERSATION

---

<b>With:</b>	Hasan Mushtaq FCDMC	<b>Date:</b>	April 11, 1997
<b>From:</b>	Fred Duren <i>FJD</i>	<b>Time:</b>	9:00 a.m.
<b>Subject:</b>	Coordination - Submittals Skunk Creek FDP	<b>Phone No.:</b>	506-1501
		<b>Reference:</b>	1327034.02090070

---

**Discussion:**

I called Hasan to clear up some questions on upcoming submittals. I also told Hasan we would be submitting the Method 1 floodway run on Tuesday, April 15.

1. Submission of Technical Data Notebook

a. Hydraulics Report - Hasan would like to see this submitted separately, in advance of submitting the Technical Data Notebook.

b. FEMA forms - Need to be bound separately.

c. Special Problem Reports - He'll check to see if there are any FEMA forms for use in preparing a SPR and let us know.

d. Table of Contents - A complete table of contents needs to be included at the front of each notebook comprising the entire Technical Data Notebook submittal.

2. Hasan's Schedule for Review of our Method 1 floodway run

He'll look over the submittal when it comes in on Tuesday and get back to us.

3. FEMA Format Requirements

He will prepare a copy of the cover page for the delineation maps and a sample delineation map to show the format required. Regarding the format required for the profiles, we can refer to the CVL Technical Data Notebook examples. Hasan will give the courier that delivers the Method 1 floodway run to him on Tuesday the copies mentioned above for return to us.

#### 4. Split Flow Analysis Ab Carefree Highway Bridge

a. Sensitivity Analysis - Hasan has not done this analysis. He will work on it today. I indicated that we needed this information in order to be able to submit the Method 1 floodway run by Tuesday. Hasan will contact Cortney on his findings from the sensitivity analysis.

b. Use of Different Flows for Floodplain and Floodway - I explained to Hasan the problem with using a larger flow in this reach for setting the floodway than that used for setting the floodplain. Hasan will check a prior FCDMC study to see if this was done and call Cortney back.

#### 5. Affidavits of Publication

These are completed and have been submitted to the FCDMC.

#### 6. Final Submittal Date of June 1 - Pre-FEMA

Hasan said that, although the current contract completion date is the end of June, Pedro wants to get the final submittal in to the FCDMC by June 1. This is necessary in order to have time to review the HIS submittal, which must be completed in order to close out the project. I told Hasan that we have a tight timeframe for meeting this submittal date. Our current schedule shows us making this submittal by May 28.

Regarding the maps submitted for FEMA review, Hasan said that firms only submit hand drawn maps for FEMA review. I said we would do this also, to expedite the preparation of the FEMA submittal. (However, after the call, it became apparent that we have to prepare digitized maps for FEMA review because the digitized map information is necessary for preparing the HIS submittal.) The digitized FEMA maps need to be in AutoCAD format. The FCDMC converts the AutoCAD maps into ARC/Info format for it's HIS system.

#### 7. Second Public Meeting

This meeting needs to be held after the Method 1 floodway analysis is approved by the FCDMC and the maps are prepared.

c: Laurie Miller  
Cortney Brand  
Chip Paulson - Denver

From: Cortney Brand (4/14/97)

To: Fred Duren

CC: Janene Werner

BCC:

Priority: Normal

Date sent: 4/14/97 2:39 PM

Message from  
QuickSend

Conv. w/ Hasan Mushtaq

TELEPHONE CONVERSATION W/ HASAN MUSHTAQ (4/14/97):

The purpose of this conversation was to clarify several issues associated with the Skunk Creek FDS.

1. Hasan said that there are no FEMA Special Problem Report forms. Special problems/analyses are discussed in Section 4 (4.5) - Hydraulics. He is sending us a copy of one of these sections for our use.
2. Hasan referenced the previous Star Wash FDS to check how split flows were dealt with. He said they used the split flow analysis for the floodplain and then constrained the full flow to the mainstream for the floodway analysis. Therefore, we are to proceed with this methodology.
3. Hasan will perform the water surface elevation matching with Cline Creek once the floodway has been finalized.
4. Hasan has not completed the sensitivity analysis at Carefree Highway. However, we are to submit the Method 1 floodway and final floodplain models using the original flows (i.e., 3,600 cfs diversion).
5. I told Hasan that we would most likely submit digitized maps to FEMA since we have to generate them for the prior HIS submittal. He had no objections to this, but reminded that changes may need to be made to the computer file based on FEMA's review comments.
6. Hasan will provide MW with: (1) a copy of a FEMA submittal map and cover page; and (2) a copy of a previous special problem report (Section 4.5 - Hydraulics). It was agreed that the courier which delivers the Method 1 floodway analysis to the District will pick up these materials and deliver them to MW.



April 15, 1997

Mr. Hasan Mushtaq, P.E.  
Engineer  
Flood Control District of Maricopa County  
2801 West Durango Street  
Phoenix, Arizona 85009

Subject: Submittal of Final Floodway Analysis - Method 1  
Contract FCD 95-16 Skunk Creek Floodplain Delineation Study

Dear Mr. Mushtaq:

With this letter we are submitting several items relative to the floodway analysis performed for Skunk Creek using encroachment Method 1. These items include:

1. Work maps showing the final 100-year floodplain and floodway boundaries.
2. A summary of the changes made to the Method 4 floodway analysis based on District review comments (i.e., Method 4 Floodway Revisions Based On Meeting of March 27, 1997, With FCDMC).
3. Minutes of the March 27, 1997, meeting containing action items addressed in item 2.
4. Method 1 Floodway Analysis Methodology Summary.
5. Printouts of the following HEC-2 files:
  - a. revised Method 4 floodway analysis (i.e., SCMTHD4.OUT)
  - b. Method 1 floodway analysis (i.e., SCMTHD1.OUT)
  - c. original input data file for split flow analysis upstream of Carefree Highway (i.e., ROBHWY.H2I)
6. Two computer diskettes containing the following HEC-2 input and output files:
  - a. CAPTOEND.DAT/OUT (final 100-year floodplain model)
  - b. SCMTHD4.DAT/OUT
  - c. SCMTHD1.DAT/OUT
  - d. ROBHWY.H2I
7. Completion Schedule, showing milestone completion dates through the FEMA Submittal.

Should you have any questions or comments on this matter, please do not hesitate to contact us. We are available to meet with the District if needed to assist in facilitating your review.

Very Truly Yours,



Fred K. Duren, Jr., P.E., P.G.  
Project Manager

Attachments

c: Pedro Calza  
Laurie Miller  
Cortney Brand  
1327034.02090070

**SKUNK CREEK  
METHOD 4 FLOODWAY REVISIONS  
BASED ON MEETING OF MARCH 27, 1997  
WITH FCDMC**

April 15, 1997

**BACKGROUND**

The following comments explain the various revisions made to the Method 4 floodway run based on FCDMC comments received in a March 27, 1997, meeting. The organization of the explanations directly follows that of the minutes (see attached) prepared by Montgomery Watson for the meeting.

**REVISIONS (based on FCDMC Comments)**

1. The cause of the "cross section extended" messages was investigated. It was found that at each cross section of interest, the elevation at the last GR record station (right overbank) is less than the CWSEL at that cross section. However, encroachment stations were used at these sections to prevent flow from occurring in the right overbank at the location where the cross section was extended by the model. This does not appear to have any affect on model results, and there appears to be no way to eliminate these messages. For cross sections whose CWSEL does not exceed the elevation of the last GR record station, the model does not give this message.
2. In a communication by Hasan after the March 27 meeting, he asked that MW disregard this comment concerning the re-location of several bank stations. However, it was decided that bank station locations at X1 25.63 should be modified to be consistent with the bank station location of adjacent cross sections. The revised bank stations are:

STCHL = 9934  
STCHR = 10088

This change was made to both the Method 4 floodway model and the 100-year floodplain model (i.e., CAPTOEND.DAT).

3. No action required, by mutual agreement.
4. No action required, by mutual agreement.
5. It was confirmed that the revised GR record data presented in the Summary of Revisions for the 100-year floodplain was mistakenly not included in the Method 4 floodway model. The data were, therefore, included with the 100-year floodplain and Method 4 floodway models.
- 5a. A comment card was inserted prior to the New River Road bridge routine which explains how skewness is incorporated into the input data set and that the Carefree Highway bridge routine accounts for skewness with a slightly different method.
6. The location of the left overbank encroachment station at X1 13.28 serves as division between the mainstream HEC-2 model and the split flow model for CAP overchute #2 (eastern overchute). Therefore, it was decided that the location of the encroachment station should be maintained while the left bank station be re-located inside the

encroachment. The revised left bank station is: 9671. This revision was made to both the 100-year floodplain and Method 4 floodway models.

7. An appropriate ET record was re-inserted at X1 16.86. In addition, the left encroachment specified in the X3 record was removed because the 100-year floodplain exceeds the height of the levee at this location.
8. The improper positioning of the number "1679.75" in the 10th field of the X3 record in X1 16.87 was corrected.
9. A comment card explaining that a +0.25 mile adjustment factor was applied to all cross section identification numbers in the Del Webb HEC-2 model was inserted prior to X1 20.64.

In addition, a comment card was included at the beginning of the floodway model which explains why a floodway analysis was not performed for cross sections X1 13.00 through 13.28.

10. Per direction by FCDMC, the QT record (i.e.,  $Q = 23,700$  cfs) located prior to X1 17.48 in the Method 4 floodway model was re-located ahead of X1 16.96. In this way, the full flow ( $Q = 27,300$  cfs) is conveyed through the mainstream for the floodway analysis until the Carefree Highway bridge, where the discharge is reduced to 23,700 cfs (at X1 16.96).
11. All negative surcharges were eliminated except for those at the following cross sections:

24.87 (-.03)  
25.12 (-.18)  
26.03 (-.28)  
26.24 (-.06)

At several cross sections, it was necessary to use Method 1 to eliminate a negative surcharge. Additionally, the elimination of negative surcharges at some cross sections resulted in surcharges greater than 1 foot at adjacent cross sections (e.g., X1 17.39). After several attempts to eliminate this problem, it was decided that the remaining invalid surcharges would be resolved during the Method 1 floodway analysis, which is discussed in the following "Method 1 Floodway Analysis Methodology Summary".

12. The encroachment stations at all cross sections where the floodway exceeded that of the floodplain were modified so that the floodway boundaries lie within those of the floodplain. Caution must be used when comparing the top widths of the floodplain and floodway. In several cases, inter-channel islands exist within the floodplain and not for the floodway. As a result, the top width of the floodplain is calculated to be less than the floodway; however, the floodway is actually within the start and end stations of the floodplain.

# MEMORANDUM



MONTGOMERY WATSON

## MEETING MINUTES

---

**Project:** Skunk Creek Floodplain Delineation  
**Date:** March 27, 1997  
**Subject:** Floodway Delineation  
**Time:** 9:00 a.m.  
Method 4 Review Comments  
**Place:** FCDMC  
**Reference:** 1327034

---

<b>Attendees:</b>	<b>Affiliation:</b>	<b>Phone:</b>
Pedro Calza	Flood Control District of Maricopa County	506-1501
Hasan Mushtaq	Flood Control District of Maricopa County	506-1501
Fred Duren	Montgomery Watson	954-6781
Cortney Brand	Montgomery Watson	954-6781

### Discussion:

The purpose of this meeting with the Flood Control District of Maricopa County (District) was to discuss the District's review comments on Montgomery Watson's March 6, 1997, Skunk Creek HEC-2 model, natural floodplain delineation, and floodway (Method 4) submittal. The format of these minutes directly follows the final review comments letter prepared by the District and faxed to Montgomery Watson after the meeting. It is noted that the letter utilized in the meeting is a partial draft, covering items 1 through 5 in the General section and items 6 through 13 in the HEC-2 Modeling section. A copy of both the final and partial draft versions of the review comments letter are attached. Also attached are the summary discussions that describe the revised floodplain model development and the Method 4 floodway analysis.

### General Comments

- (1) Hasan pointed out that there were still error messages stating that cross sections were extended. The sections where these messages occur are:

- 13.04
- 13.08
- 16.86
- 16.87
- 17.39
- 17.48
- 26.24

Montgomery Watson will check these sections and any others where this error message is found to resolve the problem and eliminate the messages. A Special Problem Report (SPR) will be required for submission to FEMA where these messages can't be eliminated. Fred

asked if the District has a copy of the SPR form, and Hasan said that a copy had been provided to Laurie. Montgomery Watson will check to see if we have the SPR copy.

- (2) Per later correspondence with Hasan, Montgomery Watson is to disregard this comment.
- (3) No action required on this comment.
- (4) No action required on this comment.
- (5) Montgomery Watson will check section 18.20 to: (1) confirm that the revised left overbank GR record data presented in the summary discussion was mistakenly not included in the revised HEC-2 floodplain model and (2) to review the topography in the left overbank at this section to see if the GR record data should be changed as indicated in the summary discussion. The appropriate GR record data will be used in the revised HEC-2 floodplain and floodway models.
- (5a) This is a comment not contained on either of the review comment letters prepared by Hasan. It refers to the particular method to handle skew at the New River Road bridge. Montgomery Watson will add a comment card which states that the skewness in that portion of the cross section skewed to flow (i.e., basically the bridge section and adjacent embankments) was incorporated by computing the distances along a projection normal to flow direction. The GR record data that lie along those portions of the section normal to flow have not been skewed. This method is different than that used for the Carefree Highway bridge, where the entire section was adjusted based on a skew factor of 0.83.

### HEC-2 Modeling

- (6) Montgomery Watson will investigate whether to modify the location of the left overbank encroachment station at X1 13.28 so that it lies outside the location of the left bank station.  
  
In addition, a comment card will be inserted which explains why a floodway analysis was not performed for the portion of Skunk Creek immediately upstream of the CAP overchutes (i.e., X1 13.00 through 13.28).
- (7) Montgomery Watson will re-evaluate its reasoning for removing the ET record at X1 16.86 in the Method 4 floodway run and determine whether to re-insert it.
- (8) Montgomery Watson will correct the improper positioning of the number "1679.75" in the 10th field of X3 record in X1 16.87.
- (9) A comment card will be inserted prior to the Del Webb portion of the HEC-2 model that explains the adjustment factor applied to Del Webb's cross section identification numbers for incorporation into Montgomery Watson's model.
- (10) Montgomery Watson will re-evaluate the area north of Carefree Highway and make the necessary modifications to the mainstream floodway model to assure that the floodway is constrained within the mainstream.

The District requested that Montgomery Watson not model a floodway for the split flow that occurs north of Carefree Highway, which is supported by the fact that the previous study confined the floodway to the mainstream. Instead, Montgomery Watson is to model the full flow (i.e.,  $Q = 27,300$  cfs) through the mainstream portion of Skunk Creek for the final floodway run (Method 1). Therefore, the floodway analysis for the split flow portion (i.e., 3,600 cfs) will be eliminated. Montgomery Watson expressed concern that this modification may cause the floodway boundary to exceed that of the floodplain. It was decided that Montgomery Watson would perform the analysis and make a determination based on results.

Pedro asked that Hasan perform a sensitivity analysis of the diverted flow which crosses the upstream face of Carefree Highway. The purpose of this analysis will be to confirm the accuracy of the originally estimated diversion amount (i.e., 3,600 cfs) from the model at this point. Pedro noted that he would only request a revision of the original diversion amount if Hasan's analysis yielded a significantly lesser value.

- (11) The Method 4 floodway run will be revised to eliminate all negative surcharges. Pedro suggested relaxing the floodway at the cross section downstream from the problem cross section and restricting the floodway at the cross section immediately upstream. The revised Method 4 floodway run will be saved as a separate file and included with submittal of the Method 1 (final) floodway run.

Pedro also asked that Montgomery Watson streamline the floodway boundary for the Method 1 submittal.

- (12) Montgomery Watson will make the necessary modifications to its floodway analysis so that the floodway width never exceeds that of the floodplain. Hasan noted that the following sections have floodway top widths greater than the 100-year floodplain:

- 17.18
- 17.39
- 20.16
- 23.64
- 23.98
- 25.45
- 25.63

- (13) Montgomery Watson will include Tables 110, 115, 150, and 200 in the HEC-2 output of its final floodway submittal (Method 1).

Another comment by the District was that the comment card for X1 17.48 needs to be moved up one section to X1 17.39.

The District gave Montgomery Watson the work maps and input/output print-outs containing District review comments for use in revising the model.

#### Action Items

Montgomery Watson will:

1. Make all suggested and necessary adjustments to the HEC-2 floodway model, as specified in these minutes.
2. Submit to the District the revised Method 4 floodway model and final floodway model (Method 1), incorporating all suggested adjustments.
3. Incorporate District's HEC-2 modeling results at the Cline Creek confluence in its floodplain and floodway plots.

District will:

1. Perform a sensitivity analysis of the diverted flow north of the Carefree Highway bridge and inform Montgomery Watson of the results.
2. Perform HEC-2 modeling necessary to match water surface elevations generated from Montgomery Watson's model with that of Cline Creek modeling and provide Montgomery Watson with results.

- 3. Provide Montgomery Watson with examples of the final floodway (Method 1) and floodplain maps submittal.

The preceding minutes were prepared by Cortney Brand and are his interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise him in writing or verbally of any discrepancies and/or omissions.

MONTGOMERY WATSON  
  
Cortney C. Brand, G.I.T.

March 28, 1997  
Date Prepared

\_\_\_\_\_  
Date Revised

Attachments

- c: Attendees  
Laurie Miller  
1327034.02090070

**SKUNK CREEK  
METHOD 1 FLOODWAY ANALYSIS  
METHODOLOGY SUMMARY**

April 15, 1997

## **BACKGROUND**

Method 1 is the final encroachment method to be used for the floodway analysis of Skunk Creek. The following describes the development of revised input data to the Method 4 floodway model for running Encroachment Method 1.

## **FLOODWAY ANALYSIS**

The Method 1 floodway analysis was performed by modifying the HEC-2 input data in the Method 4 floodway analysis. Method 1 was substituted at every cross section where encroachment Method 4 was originally specified. The Del Webb portion of the model (i.e., X1 20.64 to X1 22.95) was not modified. The following describes the step-by-step process used in performing the Method 1 floodway analysis.

### **Revision 1**

Results from the Method 4 floodway analysis were used to manually set encroachment stations for the Method 1 run. Specifically, the start (i.e., SSTA) and end (i.e., ENDST) stations of the floodway from the Method 4 run were used as the encroachment stations for the first Method 1 run. All ET records which called for Method 4 were revised to call for Method 1. In addition, the start and end stations of the floodplain and floodway were compared to assure that the floodway never exceeded the boundaries of the floodplain. Where this was found to occur, the floodway boundaries were restricted to those of the floodplain.

The Method 1 floodway model was run and results were analyzed to determine where further revisions needed to be made.

### **Revision 2**

Analysis of results from Revision 1 displayed that there were several cross sections with negative surcharges or surcharges greater than 1 foot. Based on these results, further modifications were made to the Method 1 floodway model.

Cross section plots and encroachment data were analyzed in order to correct surcharges that were negative or greater than 1 foot. Negative surcharges were typically eliminated by restricting the floodway at the cross section of interest and/or at the cross section immediately downstream. Surcharges greater than 1 foot were typically eliminated by relaxing the floodway at the cross section of interest and/or at the cross section immediately downstream. Once these revisions were made, the model was run and results were analyzed for further revisions.

### **Revision 3**

Analysis of results from Revision 2 displayed that there were still several cross sections with negative surcharges or surcharges greater than 1 foot. It was determined that these cross sections existed in areas where the floodway oscillated (i.e., widened or thinned).

Revised encroachment data were inserted in order to stream-line the floodway in these areas. This method of revision eliminated all surcharges which were negative or greater than 1 foot.

The revised Method 1 floodway was then plotted on the work maps along with the 100-year floodplain. The floodway delineation was analyzed and areas where the floodway oscillated significantly were noted. The final revision was focused upon stream-lining the floodway in these areas.

#### **Revision 4**

This was the final revision to the Method 1 floodway analysis. Based on results from Revision 3, revised encroachment stations were inserted into the floodway model in order to eliminate areas where the floodway oscillated. Once revisions were made, the model was run once more and results were plotted. This process resulted in effectively stream-lining the floodway in all areas except for at X1 17.39, where the split flow was eliminated for the floodway analysis. Several attempts were made to restrict the floodway further at this location, but each attempt resulted in a surcharge greater than 1 foot. Thus, the floodway could not be restricted any more at X1 17.39.

#### **HEC-2 Files**

The following is a list of files included with the final floodway (Method 1) submittal.

CAPTOEND.DAT: Revised input data file for the Skunk Creek 100-yr floodplain. Incorporates all review comments provided by the Flood Control District of Maricopa County.

CAPTOEND.OUT: Output data file associated with CAPTOEND.DAT.

SCMTHD4.DAT: Revised Equal Conveyance Floodway analysis (i.e., Method 4) data file, based on review comments received from the District.

SCMTHD4.OUT: Output data file associated with SCMTHD4.DAT.

SCMTHD1.DAT: Method 1 (final) floodway analysis input data file. Developed from SCMTHD4.DAT.

SCMTHD1.OUT: Output data file associated with SCMTHD1.DAT.

ROBHWY.H2I: Original split flow model for the area upstream of Carefree Highway developed by Hoskin Engineering Consultants. This file is submitted for the District's use in performing a sensitivity analysis of the flow removed at this portion of the study area.

#### **SUMMARY**

The Method 1 floodway analysis was an iterative process performed by using results from the Method 4 run and making modifications where necessary. The analysis yielded a generally stream-lined floodway, and all negative surcharges and surcharges greater than 1 foot were eliminated. Additional modification of encroachment stations will not likely result in significant improvement to this analysis.

COMPLETION SCHEDULE

SKUNK CREEK FLOODPLAIN DELINEATION STUDY  
1327034.02090070

ITEM	TARGET COMPLETION DATE (1) (2)	
1.8 Coordination		
- schedule last public meeting	4/28	
- hold last public meeting	TBD	
8.10.d. Floodway Delineation Using Equal Conveyance		
- analysis	2/28	(3/5)
- plotting	3/4	(3/5)
- submittal	3/6	(3/6)
- call Hasan re: FCDMC review schedule	3/10	(3/10)
8.10.e. Floodway Delineation Using Method 1		
- receipt of FCDMC Method 4 review	3/20	(3/27)
- analysis using Method 1	3/27	(4/8)
- plotting	4/11	(4/14)
- submittal	4/15	(4/15)
- receipt of FCDMC review	4/25	
- submit maps to MW/Denver for digitizing	4/28	
- maps digitized by MW/Denver	5/2	
- digitized map file received from MW/Denver	5/2	
8.10.f. Final Technical Data Notebook (Containing Final Hydraulics Report)		
- submit Hydrology Report Addendum No. 1	5/8	
- submit Hydraulics Report	5/8	
- draft submittal	5/12	
- receipt of FCDMC review comments	5/26	
- final submitted to FCDMC	5/30	
9.1.2 HIS Data		
- submit digitized map file to MAI	5/2	
- MAI submits GIS mapping file to MW	5/23	
- MW submits GIS mapping file to FCDMC	5/26	
- receipt of FCDMC review comments	6/13	
- MAI completes revisions and submits to MW	6/27	
10.1 FEMA Submittal		
10.1.1 Original Affidavits of Publication	completed	
10.1.2 Two sets of flood maps by Denver	5/8	
10.1.3 Two Technical Data Notebooks	5/30	
10.1.4 Two sets of FEMA forms	5/30	
10.1.5 DTM	completed	
10.1.6 Three sets of survey notes	completed	
10.1.7 Two copies of FIRM panels by Denver	5/30	
Submittal Date	6/1	

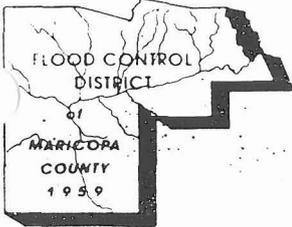
## 10.2 Final District Submittal

10.2.1 One set of mylars of work study maps	TBD
10.2.2 One set of mylars and four blue-line flood maps	TBD
10.2.3 One set of transparent overlays	TBD
10.2.4 One set of aerial contact prints	TBD
10.2.5 Digitized HIS data	TBD
10.2.6 Four Technical Data Notebooks	TBD

(1) The dates shown represent goals for completion of the various tasks. The submittal dates represent contractual milestone dates.

(2) Date in parentheses represents actual completion date. Tasks shown as "completed" were completed prior to preparation of this schedule and, thus, do not have completion dates shown.

c: Laurie Miller  
Cortney Brand  
Chip Paulson - Denver  
file



# FLOOD CONTROL DISTRICT

of

**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009-6399  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

BOARD OF DIRECTORS

Betsey Bayless  
Jan Brewer  
Fulton Brock  
Don Stapley

Mary Rose Garrido Wilcox

**RECEIVED**

APR 25 1997

Fred K. Duren, Jr., P.E., P.G.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

APR 28 1997

MONTGOMERYWATSON  
PHOENIX OFFICE

Subject : Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study  
Submittal of Floodway Analysis - Method 4 & Method 1 (Contract FCD 95-16).

Dear Mr. Duren :

Please find following comments on your April 15, 1997 submittal. The comments need to be addressed prior to finalizing the Hydraulic analysis for the Skunk Creek FDS using Method 1.

- (1) Several cross-sections still have extended message in the HEC-2 output (Method 4 and Method 1). Following are suggestions to eliminate the cross-section extended messages.

X1 13.04	-	delete GR information beyond station 10398.
X1 13.08	-	delete GR information beyond station 10679. revise ET record; set RB station at 10679 or less.
X1 16.86	-	cannot eliminate; explain in the special problem section 4.5.
X1 16.87	-	cannot eliminate; explain in the special problem section 4.5.
X1 17.39	-	re-orient and extend cross section as suggested on the map.
X1 17.48	-	re-orient and extend cross section as suggested on the map.
X1 26.24	-	delete GR information beyond station 11050.
- (2) Modification suggested in Item 2, is not reflected in the Method 4 floodway analysis (SCMTHD4.DAT).
- (3) Please clarify Item 7. However, X3 record is still present at X1 16.86 & X1 16.87.
- (4) The adjustment factor, for the Skunk Creek FDS from cross section 20.64 to 22.95, is not a constant. It varies as following :

from	X1 20.64	to	X1 21.63,	factor =	0.25
from	X1 21.69	to	X1 22.56,	factor =	0.23
from	X1 22.68	to	X1 22.86,	factor =	0.24

at X1 22.95 factor = 0.14

Please explain the reasoning for different factors used for adjusting the cross-section identifications.

- (5) The comment card at the beginning of the HEC-2 modeling should say "13.28" instead of "13.2".
- (6) It was decided in the last review meeting (March 27, 1997) that the FLOODPLAIN analysis will have a split flow of 3,600 cfs. between cross sections 16.96 and 17.48. Therefore, the main channel will be analyzed for the remaining portion of the 100 yr. discharge (23,700 cfs.) only. It was also decided that the FLOODWAY analysis will be performed assuming that the entire 100 yr. flow is conveyed through the main channel. However, this is not properly reflected in the HEC-2 modeling. A revision of the hydraulic analysis of cross sections 16.96 - 17.48 is required.
- (7) Floodway widths at cross-sections 16.87, 20.16, and 23.94 are greater than the floodplain widths. Please set the limits of the floodplain boundaries equal to the limits of the floodway boundaries at these locations.
- (8) Please do not suppress the detailed (cross section by cross section) and summary print out. This can be achieved by eliminating the J5 record.
- (9) Please revisit the floodway boundaries as marked on the maps in "green" color.
- (10) Skunk Creek FDS by Erie & Associates, from cross section 20.64 to 22.95, needs the following modification :
  - (a) 100 yr. discharge from section 20.64 - 22.79 = 27,300 (new hydrology)
  - (b) 100 yr. discharge from section 22.86 - 22.95 = 24,400 (new hydrology)

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,



Hasan Mushtaq, P.E.  
Engineering Division



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## Appendix B

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MONTGOMERY WATSON

# MEMORANDUM



MONTGOMERY WATSON

## MEETING MINUTES

---

**Project:** Skunk Creek Floodplain Delineation  
**Subject:** Floodway Delineation Method 4 Review Comments  
**Date:** March 27, 1997  
**Time:** 9:00 a.m.  
**Place:** FCDMC  
**Reference:** 1327034

---

<b>Attendees:</b>	<b>Affiliation:</b>	<b>Phone:</b>
Pedro Calza	Flood Control District of Maricopa County	506-1501
Hasan Mushtaq	Flood Control District of Maricopa County	506-1501
Fred Duren	Montgomery Watson	954-6781
Cortney Brand	Montgomery Watson	954-6781

### Discussion:

The purpose of this meeting with the Flood Control District of Maricopa County (District) was to discuss the District's review comments on Montgomery Watson's March 6, 1997, Skunk Creek HEC-2 model, natural floodplain delineation, and floodway (Method 4) submittal. The format of these minutes directly follows the final review comments letter prepared by the District and faxed to Montgomery Watson after the meeting. It is noted that the letter utilized in the meeting is a partial draft, covering items 1 through 5 in the General section and items 6 through 13 in the HEC-2 Modeling section. A copy of both the final and partial draft versions of the review comments letter are attached. Also attached are the summary discussions that describe the revised floodplain model development and the Method 4 floodway analysis.

### General Comments

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- 13.04
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Montgomery Watson will check these sections and any others where this error message is found to resolve the problem and eliminate the messages. A Special Problem Report (SPR) will be required for submission to FEMA where these messages can't be eliminated. Fred

asked if the District has a copy of the SPR form, and Hasan said that a copy had been provided to Laurie. Montgomery Watson will check to see if we have the SPR copy.

- (2) Per later correspondence with Hasan, Montgomery Watson is to disregard this comment.
- (3) No action required on this comment.
- (4) No action required on this comment.
- (5) Montgomery Watson will check section 18.20 to: (1) confirm that the revised left overbank GR record data presented in the summary discussion was mistakenly not included in the revised HEC-2 floodplain model and (2) to review the topography in the left overbank at this section to see if the GR record data should be changed as indicated in the summary discussion. The appropriate GR record data will be used in the revised HEC-2 floodplain and floodway models.
- (5a) This is a comment not contained on either of the review comment letters prepared by Hasan. It refers to the particular method to handle skew at the New River Road bridge. Montgomery Watson will add a comment card which states that the skewness in that portion of the cross section skewed to flow (i.e., basically the bridge section and adjacent embankments) was incorporated by computing the distances along a projection normal to flow direction. The GR record data that lie along those portions of the section normal to flow have not been skewed. This method is different than that used for the Carefree Highway bridge, where the entire section was adjusted based on a skew factor of 0.83.

### HEC-2 Modeling

- (6) Montgomery Watson will investigate whether to modify the location of the left overbank encroachment station at X1 13.28 so that it lies outside the location of the left bank station.

In addition, a comment card will be inserted which explains why a floodway analysis was not performed for the portion of Skunk Creek immediately upstream of the CAP overchutes (i.e., X1 13.00 through 13.28).

- (7) Montgomery Watson will re-evaluate its reasoning for removing the ET record at X1 16.86 in the Method 4 floodway run and determine whether to re-insert it.
- (8) Montgomery Watson will correct the improper positioning of the number "1679.75" in the 10th field of X3 record in X1 16.87.
- (9) A comment card will be inserted prior to the Del Webb portion of the HEC-2 model that explains the adjustment factor applied to Del Webb's cross section identification numbers for incorporation into Montgomery Watson's model.
- (10) Montgomery Watson will re-evaluate the area north of Carefree Highway and make the necessary modifications to the mainstream floodway model to assure that the floodway is constrained within the mainstream.

The District requested that Montgomery Watson not model a floodway for the split flow that occurs north of Carefree Highway, which is supported by the fact that the previous study confined the floodway to the mainstream. Instead, Montgomery Watson is to model the full flow (i.e.,  $Q = 27,300$  cfs) through the mainstream portion of Skunk Creek for the final floodway run (Method 1). Therefore, the floodway analysis for the split flow portion (i.e., 3,600 cfs) will be eliminated. Montgomery Watson expressed concern that this modification may cause the floodway boundary to exceed that of the floodplain. It was decided that Montgomery Watson would perform the analysis and make a determination based on results.

Pedro asked that Hasan perform a sensitivity analysis of the diverted flow which crosses the upstream face of Carefree Highway. The purpose of this analysis will be to confirm the accuracy of the originally estimated diversion amount (i.e., 3,600 cfs) from the model at this point. Pedro noted that he would only request a revision of the original diversion amount if Hasan's analysis yielded a significantly lesser value.

- (11) The Method 4 floodway run will be revised to eliminate all negative surcharges. Pedro suggested relaxing the floodway at the cross section downstream from the problem cross section and restricting the floodway at the cross section immediately upstream. The revised Method 4 floodway run will be saved as a separate file and included with submittal of the Method 1 (final) floodway run.

Pedro also asked that Montgomery Watson streamline the floodway boundary for the Method 1 submittal.

- (12) Montgomery Watson will make the necessary modifications to its floodway analysis so that the floodway width never exceeds that of the floodplain. Hasan noted that the following sections have floodway top widths greater than the 100-year floodplain:

- 17.18
- 17.39
- 20.16
- 23.64
- 23.98
- 25.45
- 25.63

- (13) Montgomery Watson will include Tables 110, 115, 150, and 200 in the HEC-2 output of its final floodway submittal (Method 1).

Another comment by the District was that the comment card for X1 17.48 needs to be moved up one section to X1 17.39.

The District gave Montgomery Watson the work maps and input/output print-outs containing District review comments for use in revising the model.

### Action Items

Montgomery Watson will:

1. Make all suggested and necessary adjustments to the HEC-2 floodway model, as specified in these minutes.
2. Submit to the District the revised Method 4 floodway model and final floodway model (Method 1), incorporating all suggested adjustments.
3. Incorporate District's HEC-2 modeling results at the Cline Creek confluence in its floodplain and floodway plots.

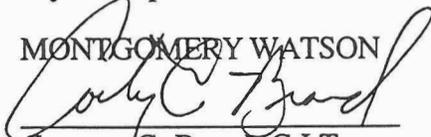
District will:

1. Perform a sensitivity analysis of the diverted flow north of the Carefree Highway bridge and inform Montgomery Watson of the results.
2. Perform HEC-2 modeling necessary to match water surface elevations generated from Montgomery Watson's model with that of Cline Creek modeling and provide Montgomery Watson with results.

3. Provide Montgomery Watson with examples of the final floodway (Method 1) and floodplain maps submittal.

The preceding minutes were prepared by Cortney Brand and are his interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise him in writing or verbally of any discrepancies and/or omissions.

MONTGOMERY WATSON

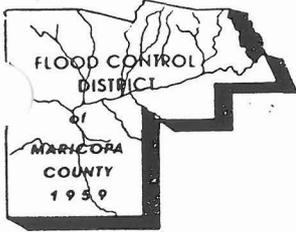
  
Cortney C. Brand, G.I.T.

March 28, 1997  
Date Prepared

\_\_\_\_\_  
Date Revised

#### Attachments

c: Attendees  
Laurie Miller  
1327034.02090070



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009-6399  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

BOARD OF DIRECTORS  
Betsey Bayless  
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MAR 26 1997

Fred K. Duren, Jr., P.E., P.G.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**RECEIVED**

MAR 31 1997

MONTGOMERY WATSON  
PHOENIX OFFICE

Subject : Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study  
Submittal of Floodway Analysis - Method 4 (Contract FCD 95-16)

Dear Mr. Duren :

Please find following comments on the above mentioned submittal. It is suggested that the review comments be addressed prior to a final submittal.

General

- (1) There are several cross-section extended message in the HEC-2 output. It is advisable to eliminate the X-section extended messages.
- (2) Several cross sections need to be revisited to determine proper locations of the bank stations.
- (3) Explanation provided in item (7) is not compatible with the original submittal.
- (4) Explanation provided in item (12) is not compatible with the revised HEC-2 (w/ floodway) output.
- (5) The changes suggested in item (21) are not reflected in the HEC-2 modeling.

HEC-2 Modeling

- (6) At cross-section 13.28, the LB encroachment station seems to be inside the LB station. It is recommended that the LB encroachment be set outside the LB station.
- (7) Please investigate if the encroachment was removed from cross-section 16.86.
- (8) 10th field of the X3 record at cross-section 16.87 has a number "75". Please explain.
- (9) Please specify the conversion of the cross section stationing through the Del Webb portion of the HEC-2 modeling.

- (10) Several cross sections, upstream of the Carefree Highway bridge show water to be in the side channel. Since the main channel is being modeled with the reduced discharge, the flows should be confined in the main channel only. The situation needs further evaluation.
- (11) Cross-sections with high target values in the ET records have negative surcharges. The output also shows that the RATIO parameter are negative at these locations. It is suggested that the situations be further investigated and the negative surcharges should be eliminated.
- (12) Several cross-sections have floodway widths greater than the floodplain widths. Please investigate the situations on a case by case basis.
- (13) Please include Tables 110, 115, 150, and 200 in the HEC-2 analysis.

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,



Hasan Mushtaq, P.E.  
Engineering Division

Fred K. Duren, Jr., P.E., P.G.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

Subject : Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study  
          Submittal of Floodway Analysis - Method 4 (Contract FCD 95-16)

Dear Mr. Duren :

Please find following comments on the above mentioned submittal. It is suggested that the review comments be addressed prior to a final submittal.

General

- (1) There are several cross-section extended message in the HEC-2 output. It is advisable to eliminate the X-section extended messages.
- (2) Several cross sections need to be revisited to determine proper locations of the bank stations.
- (3) Explanation provided in item (7) is not compatible with the original submittal.
- (4) Changes suggested in item (9) at cross section 16.96, are not reflected in the revised HEC-2 modeling.
- (5) Explanation provided in item (12) is not compatible with the revised HEC-2 (w/ floodway) output.
- (6) The changes suggested in item (21) are not reflected in the HEC-2 modeling..

HEC-2 Modeling

- (1) There seems to be a high point in the ROB of cross section 13.08. Please investigate if it correct.
- (2) At cross-section 13.28, the LB encroachment station seems to be inside the LB station.
- (3) Please investigate if the encroachment was removed from cross-section 16.86.
- (4) 10th field of the X3 record at cross-section 16.87 has a number "75". Please explain.
- (5) Cross-sections with high target values in the ET records seems to be having negative surcharges. The output also shows the RATIO parameter to be negative also. It is suggested that these situations be further investigated.
- (6) Please specify the conversion of the cross section stationing through the Del Webb portion of the HEC-2 modeling.
- (7) Several cross sections, upstream of the Carefree Highway bridge show water to be in the side channel. Since the main channel is being modeled with the reduced discharge, the side flows should be confined in the main channel only. This situation needs further evaluation.

**SKUNK CREEK  
HEC-2 REVISIONS  
BASED ON MEETING OF JAN. 9, 1997  
WITH FCDMC**

January 22 to February 27, 1997  
1327034.02090070  
Montgomery Watson

**BACKGROUND**

The following comments and revisions directly relate to the General Comments contained in the minutes of the subject meeting. The revisions made in this HEC-2 input file will be reflected in the encroachment HEC-2 run to be submitted for FCDMC approval as Montgomery Watson's next submittal.

In making the changes resulting from FCDMC comments, several other changes were made. These are described at the end of this document.

**REVISIONS (Based on FCDMC Comments)**

1. No revision necessary. Work maps will continue to be submitted at the 1 inch = 200 foot scale.
2. Cross sections containing the comment "cross section extended" are:  
19.92  
22.96  
23.13  
23.55

Revision: Change comment cards to read "Cross section lengthened using topo map." The original message referring to cross-section extension needed to be revised to eliminate confusion regarding the cross section modification used.

3. All small, inter-channel islands have been shown within the 100-year floodplain. Additionally, backwater flooding has been shown on several cross sections.
4. The plotting of the Skunk Creek floodplain boundary up Cline Creek has been made using the FIRM showing Cline Creek by finding the match point for the Skunk Creek profile water surface elevation with the corresponding Cline Creek profile water surface elevation.
5. FCDMC suggested reviewing the bank stations for the following cross sections, as noted on the work maps reviewed by the FCDMC. The bank stations noted below were changed as a result of a further review by Montgomery Watson.

Section	HEC-2 Input		Selected	
	STCHL	STCHR	STCHL	STCHR
X1 13.16	-----	10215	-----	10288
X1 13.28	9484	-----	9439	-----
X1 13.55	9742	10432	9688	10494
X1 14.54	-----	10306	-----	10480
X1 16.49	-----	10316	-----	10130
X1 18.16	9951	-----	9836	-----
X1 18.84	9987	-----	9915	-----
X1 19.18	9943	-----	9874	-----
X1 19.62	-----	10046	-----	10120
X1 23.94	9919	-----	9880	-----
X1 24.74	-----	10036	-----	10086
X1 25.91	9938	-----	9914	-----

6. See 5 above.

7. Top widths at cross sections X1 14.54 and X1 15.75 were checked and the following was found. At X1 14.54, the HEC-2 output shows a TOPWID of 604 feet, vs a plotted TOPWID of 775 feet. The difference is explained by the presence of two islands in the left overbank which account for the 171-foot difference between the HEC-2 TOPWID and the plotted TOPWID. At X1 15.75, the HEC-2 output TOPWID is 769 feet vs. a plotted TOPWID of 770 feet. Therefore, both the plotted and HEC-2 TOPWID's at both of these sections are consistent.

8. For X1 15.22 through X1 15.55, the floodplain boundary was adjusted slightly to agree with the FCDMC comment. For X1 18.96 through X1 19.18, the sand bar was eliminated at X1 19.07; and the right floodplain boundary was adjusted to agree with the FCDMC comment.

9. The following cross section modifications were made.

X1 16.96 (Sheet 5 - original work map):

The left end of cross section was re-drawn to be 494 feet from thalweg. This corrects the map depiction that erroneously shows this cross section to be overlapping X1 16.87.

X1 18.16 (Sheet 6 - original work map) (Also see item 21):

All GR record data starting at station 10249 and continuing to the end station at 11463 were eliminated and replaced with the following GR data:

<u>EL</u>	<u>STA</u>
1730	10330
1730	10380
1734	10430
1736	10650
1736.9	10750
1738	10930
1738	11040
1740	11130

The number of GR data points was changed from 58 to 34.

X1 18.20 (Sheet 6 - original work map):

The GR record data were changed based on the following analysis.

1. The projection of the Cloud Road embankment that is perpendicular to the 100-year flow path was computed.
  - a. Length of Cloud Road embankment at a skew to flow = 400 ft.
  - b. Skew angle = 55 degrees from perpendicular projection
  - c. Perpendicular projection length/400 ft. = cos 55 degrees  
Perpendicular projection = 229 ft., say 230 ft.
2. The GR record data were adjusted to reflect a 230-foot long flow obstruction due to Cloud Road
  - a. The obstruction was started at cross section station 10075, using elevation 1738.8, per original section GR data. All GR data was replaced from original section, starting with station 10200 with the following:

<u>EL</u>	<u>STA</u>
1740	10305
1741	10349
1741	10561
1742	10742
1744	10973
1746	11158
1748	11198

The above GR data were developed by inserting the perpendicular projection of the Cloud Road embankment starting at station 10075, which is taken as the beginning point for adding the perpendicular projection onto the original GR data. The 230-foot perpendicular projection addition at this station results in a termination of the projection at station 10305, which is taken to represent an elevation of 1740 as indicated in the original GR data for station 10471. From that station on (i.e., from new station 10305), the remaining original GR data were tacked onto the end of the revised data, using the next data point at original station 10515 to now be converted to 10349 (i.e., 44 feet past the prior station).

The number of GR data points was changed from 20 to 19.

X1 19.92 (Sheet 8 - original work map):

Re-aligning the left side of the cross section as shown on FCDMC's map was considered; however, it was concluded that the alignment of the original section in the left overbank is more appropriate than that recommended by the FCDMC. The low spot in the left overbank was incorporated by adding new GR data between stations 9241 and 9529, as follows (difference in GR data points = +1) The left floodplain boundary was moved farther out in response to the HEC-2 output:

<u>EL</u>	<u>STA</u>
1813.1	9365

The number of GR data points was changed from 58 to 59.

X1 23.45 (Long Roll - original work map):

All GR data were eliminated from station 9572 to 9111 and replaced with  
(difference in GR data points = -17):

<u>EL</u>	<u>STA</u>
2004	9460

The number of GR data points was changed from 56 to 39.

10. The HEC Carefree Bridge modified data have been inserted in the current HEC-2 model and the floodplain boundary drawn accordingly (Also see item 19).
11. The encroachments were eliminated at this reach (i.e., X1 17.95 and 18.06); and the floodplain boundary extended into the right overbank, as dictated by the HEC-2 output. It was not considered reasonable to eliminate flooding in the right overbank, as requested to be analyzed in the FCDMC comment.
12. Encroachments were removed from X1 19.41 and 19.52. Backwater was plotted on the floodplain boundary map in the left overbank. The plotted TOPWID is, thus, greater than the TOPWID shown in the HEC-2 output.
13. See 9, above.
14. The following changes were made in the GR record data to reflect the house in the left overbank:

Eliminate the data for station 9705

Add the following two GR data points after station 9659

<u>EL</u>	<u>STA</u>
2071	9690
2071	9750

Change the number of GR data points from 26 to 27.

15. No change necessary.
16. New River Bridge revisions (Special Bridge Routine)

No re-orientation needed for the bridge, which is skewed. The skewness has been taken care of in the SB card, where the bottom width of bridge opening (i.e., BWC) is shown to be 197 feet vs. 320 feet along the bridge profile. The skewness was not taken care of in variable, BAREA, net area of bridge opening, which is shown to be 1,528 square feet. The value of BAREA was changed to 1,410 square feet (avg. bridge height =  $(7+8.5)/2$  feet = 7.75 feet; open area = height x (total width-obstruction width) =  $7.75 \times (197-15) = 1,410$  square feet).

Both sections 25.78 and 25.79 were lengthened as follows:

For section 25.78, the data for station 10432 and following stations were eliminated and the following GR data points were added after station 10410:

<u>EL</u>	<u>STA</u>
2108	10740

2108	10800
2106	10880
2106	11950
2116	11010
2116	11070
2106	11340

The number of GR data points was changed from 18 to 21.

For section 25.78, the following GR data points were added after station 10490:

<u>EL</u>	<u>STA</u>
2110	10550
2113	10570
2113	10610
2109	10770
2108	10950
2108	11320

The number of GR data points was changed from 41 to 47.

17. Modification of the HEC-2 model at New River Road bridge to allow for consistency in skewness analysis with Carefree Highway bridge analysis was not needed since: (1) the New River Road bridge skewness and the appropriate portions of the non-bridge cross section containing skewness were taken care of directly in the input data, as indicated above in item 16, and (2) since the remaining, non-bridge cross section portions are oriented perpendicular to the flow path and, thus, do not need to be skewed. Exact consistency between the bridge modeling at New River Road and Carefree Highway is not necessary because the Carefree Highway bridge is modeled with a skewness applied to all bridge and cross section data, whereas the New River Road bridge incorporates skewness directly into the bridge input data, as described above, and in that portion of the GR data which is skewed to flow. Therefore, with the adjustments to GR record data specified in item 16, the New River Road bridge modeling analysis is correct and reasonably consistent with that performed for the Carefree Highway bridge.
18. Based on the original HEC-2 model output, which included encroachments at X1 25.79 through X1 26.24 (top of study area), the 100-year CWSEL is below the elevation of the encroachment stations. Therefore, the only potential for flow to leave the channel and be conveyed into the right and left overbanks is for erosion of the channel banks to occur. Since a fixed-bed assumption is used in flood insurance studies, it is consistent to assume no bank erosion and, thus, conclude that flow is contained in the channel within this reach.

The above conclusion is based on the assumption that all flow at the uppermost section (i.e., X1 26.24) is contained in the channel. Should it be possible for flow to occur in the overbanks due to conditions farther upstream, above our study reach, then the assumption that all flow at X1 26.24 is within the channel would need to be modified.

#### REVISIONS (In Addition to Those Based on FCDFMC Comments)

19. At the Carefree Highway bridge (X1 16.86 and 16.87), the bank stations were plotted on the floodplain boundary map as dictated by bridge geometry. The HEC-

2 output bank stations are affected by the 83-percent skew that was applied to this cross section and do not properly represent the bank stations.

20. At X1 17.18, the right floodplain boundary was re-drawn to agree with the HEC-2 output. This is an area of split flow.
21. At X1 18.20 another modification was made in addition to that described above in item 9. The GR record data in the left overbank were modified as follows:

<u>EL</u>	<u>STA</u>
1750	9540
1740	9570
1738	9580
1736	9660
1734	9680
1732	9690
1734	9710
1736	9745
1736	9835
1734	9980

(Continue with previous GR record data starting at station 10000.)

22. At X1 19.62, an ET record was used to confine the flow within the left channel bank to eliminate flow conveyance in the backwater area in the left overbank.
23. At X1 25.12, backwater was plotted in the left overbank. The plotted TOPWID, therefore, is greater than that shown in the HEC-2 output.

**SKUNK CREEK  
FLOODWAY ANALYSIS - EQUAL CONVEYANCE  
METHODOLOGY SUMMARY**

March 6, 1997  
1327034.02090070  
Montgomery Watson

## **BACKGROUND**

The Equal Conveyance Method (i.e., Method 4) is the first floodway analysis to be used for the Skunk Creek Floodplain Delineation Study. Encroachment Method 4 is used to perform this floodway analysis. The following describes the development of revised input data to the HEC-2 100-year floodplain model for running Encroachment Method 4.

The original HEC-2 100-year floodplain model utilizes the split flow option at the lower end of the delineation study area. Since Method 4 cannot be used with the HEC-2 split flow option and, since the 100-year floodplain model after removing the split flow option will correctly model the flow in the main channel, the split flow records were removed from the model prior to running the floodway analysis.

### **Sections 13.00 through 13.28**

This lowermost reach of the floodplain delineation is immediately upstream of the CAP Aqueduct, where two overchutes convey Skunk Creek flow over the Aqueduct. Additionally, in this reach Skunk Creek flow is lost to the west as water enters the Aqueduct and also flows over Interstate Highway 17. This reach requires a complex model, incorporating subdivision of flow between the two overchutes in addition to a split flow analysis to evaluate flow lost to the west. As a result, it is not feasible to apply the floodway analysis concept to this reach of the delineation study; and the 100-year floodplain boundary is taken as the floodway boundary for the reach defined by these cross sections.

### **Sections 13.40 through 20.62**

This reach covers the downstream portion of Montgomery Watson's lower study reach. The Del Webb analysis starts at section 20.64 and continues upstream to section 22.95. Encroachment Method 4 was utilized with an initial target of 1 foot.

### **Sections 22.96 through 26.24**

This reach covers the upstream portion of Montgomery Watson's delineation study. Section 22.96 is the section immediately upstream of the terminus of the Del Webb delineation. Section 26.24 is the upstream limit of Montgomery Watson's delineation study. As with the prior reach, Encroachment Method 4 was utilized with an initial target of 1 foot.

## **FLOODWAY ANALYSIS**

The Equal Conveyance method of floodway analysis was applied by creating a second run in the original HEC-2 input file (i.e., CAPTOEND.DAT). Floodway Encroachment Method 4 was specified in the third field of the ET record and a 1.0-foot target water

surface elevation rise was assigned (i.e., 10.4). In general, the analysis was an iterative process requiring several revisions to achieve a rise in water surface elevation at all cross sections that did not exceed 1 foot. The following discussion summarizes the step-by-step revision process used in the floodway analysis.

### Revision 1

1. If a cross section did not contain pre-defined encroachments for the 100-yr floodplain, a 10.4 was inserted into the third field of the ET record.
2. If a cross section contained pre-defined encroachments for the 100-yr floodplain, a 9.1 was placed in the third field of the ET record and the original encroachment stations were maintained.
3. No modifications were made to the floodway analysis for the Del Webb portion of the Skunk Creek study area.
4. The original encroachments defined in the Carefree Highway and New River Road bridge routines were maintained.
5. All QT records were modified by inserting a 2 in the first field and specifying the same flow in the third field as assigned in the second field. This modification ensured that the same flows would be used during the second run of the model.
6. The model was run and a summary table of encroachment data was developed.

### Revision 2

Results from Revision 1 were analyzed and used to make the following modifications to the encroachment data:

1. If a cross section did not contain pre-defined encroachments for the 100-yr floodplain, the target rise in water surface elevation was adjusted based on results from Revision 1. For example, if the calculated water surface elevation rise was greater than 1.0 foot, the target was lowered (e.g., from 1.0 foot to 0.8 feet). However, if the water surface rise was significantly lower than 1.0 foot, the target was raised (e.g., from 1.0 foot to 1.2 feet).
2. If a cross section contained pre-defined encroachments for the 100-yr floodplain and an adjustment was required in the water surface elevation from the first floodway run, a 7.1 was placed in the third field of the ET record and new encroachment stations were specified in the seventh and eighth fields. New encroachment stations were developed by analyzing cross section plots and flow distribution data in an attempt to equally reduce/increase conveyance in the overbanks. For example, if the calculated water surface rise was greater than 1.0 foot, new encroachment stations were chosen at greater distances to provide greater conveyance area. Alternatively, new encroachment stations were chosen at lesser distances to decrease conveyance, increasing the calculated water surface rise.
3. New encroachment stations were not chosen at distances greater than the 100-yr floodplain. Therefore, at some cross sections (e.g., X1 24.25), the encroachment station(s) were set at the 100-yr floodplain start and/or end station. In addition, further raising of the water surface at some cross sections could not be achieved because existing encroachment stations were already at pre-defined channel bank stations.

Once revisions were made to the HEC-2 input file, the model was run and results were analyzed for further modification.

### Revision 3

Further revisions were made to the encroachment data based on results from Revision 2. Floodway data and cross section plots were analyzed, and modifications were made using the same methodology as discussed in Revision 2.

1. Target water surface rise parameters were increased or decreased depending upon whether the water surface needed to be raised or lowered, respectively. The lowest target assigned was 0.1 feet and the highest target assigned was 3.0 feet.
2. For cross sections having 7.1 in the third field of the ET record, encroachment stations were widened or shortened in order to raise or lower the calculated water surface.

Once revisions were made to the HEC-2 input file, the model was re-run and results were analyzed for further modification.

### Revision 4

A fourth and final floodway revision was made based on the results of Revision 3. Encroachment parameters were modified using the same methodology as discussed in Revisions 2 and 3. If a cross section had a water surface elevation rise greater than 1.0 foot, the encroachment stations or target rise value of the prior cross section were modified until results indicated that all cross sections had a water surface elevation rise of less than 1.0 foot.

### Split Flow from Sections 16.87 through 17.48

A separate HEC-2 model was created to account for a loss of 3,600 cfs from mainstream of Skunk Creek at cross sections 16.87 through 17.48 (i.e., file ROBHWY.H2I). This model was modified using the same methodology as discussed above to perform a floodway analysis (i.e., file ROBHWYE4.DAT). Results from this floodway analysis were combined with results from the mainstream floodway analysis in order to develop a continuous floodway throughout the study area.

### HEC-2 Files

- CAPTOEND.DAT: Revised input data file for the Skunk Creek 100-yr floodplain. Incorporates all review comments provided by the Flood Control District of Maricopa County.
- CAPTOEND.OUT: Output data file associated with CAPTOEND.DAT.
- SCMTHD4.DAT: Equal Conveyance Floodway analysis (i.e., Method 4) input data file. Developed from CAPTOEND.DAT.
- SCMTHD4.OUT: Output data file associated with SCMTHD4.DAT.
- ROBHWYE4.DAT: Floodway analysis input data file for split flow from cross sections 16.87 through 17.48. Developed from ROBHWY.H2I.

ROBHWYE4.OUT: Output data file associated with ROBHWYE4.DAT.  
TRIBCP6.H2I: Input data file for split flow analysis at CAP Overchute No. 2.  
TRIBCP6.O: Output data file associated with TRIBCP6.O.

## SUMMARY

The Equal Conveyance floodway analysis for Skunk Creek was successful in that a water surface elevation rise of less than 1.0 foot was achieved at all cross sections. In an attempt to accomplish this goal, the water surface elevation rise at some cross sections was required to be much lower than at others. Numerous revisions were made during the floodway analysis, and the resultant floodway is believed to be a very reasonable interpretation. Additional modification of target rise parameters and encroachment stations will not likely result in significant improvement to this analysis.

# MEMORANDUM



MONTGOMERY WATSON

## MEETING MINUTES

---

**Project:** Skunk Creek Floodplain Delineation  
**Subject:** Natural Floodplain Delineation  
**Date:** January 9, 1997  
**Time:** 1:30 p.m.  
**Place:** FCDMC  
**Reference:** 1327034

---

<b>Attendees:</b>	<b>Affiliation:</b>	<b>Phone:</b>
Pedro Calza	Flood Control District of Maricopa County	506-1501
Hasan Mushtaq	Flood Control District of Maricopa County	506-1501
Fred Duren	Montgomery Watson	954-6781
Cortney Brand	Montgomery Watson	954-6781

### Discussion:

The purpose of this meeting with the Flood Control District of Maricopa County (District) was to discuss the District's review comments on Montgomery Watson's December 13, 1996, Skunk Creek HEC-2 model and natural floodplain delineation submittal. The format of these minutes directly follows the review comments letter prepared by the District. A copy of this letter is attached.

### General Comments

- (1) After discussion, the District said that Montgomery Watson could continue to submit maps at a 1" = 200' scale.
- (2) Montgomery Watson agreed to eliminate, if physically possible, the "cross section extended" messages in the HEC-2 model.
- (3) Montgomery Watson agreed to eliminate the small, inter-channel islands from the floodplain/floodway delineation.
- (4) Montgomery Watson agreed to extend the Skunk Creek floodplain/floodway delineation so that it physically ties into the water surface elevation produced from the Cline Creek Floodplain Delineation Study.
- (5/6) Montgomery Watson agreed to review the recommended bank stations specified by the District and to make necessary changes in the bank stations shown in the HEC-2 submittal by Montgomery Watson. In addition, Montgomery Watson will identify bank station locations on future work maps and cross section plots with filled circles.

**HEC-2 Modeling**

- (7) Montgomery Watson will check the top widths at cross sections X1 14.54 and X1 15.75 and adjust as necessary in order to be consistent with HEC-2 results and engineering judgment. Revised top widths for these cross sections will be included in the Floodways submittal.
- (8) Montgomery Watson will evaluate the need to modify the floodplain boundary for cross sections X1 15.22 through X1 15.55. After discussion, the District asked that the floodplain boundary for cross section X1 15.41 not be modified. Montgomery Watson will also evaluate the need to modify the floodplain boundary for cross sections X1 18.96 through X1 19.18, specifically addressing the right floodplain boundary at section X1 19.18. The sand bar at cross section X1 19.07 will be eliminated.
- (9) Montgomery Watson will make the specified modifications to the following cross sections:
  - X1 16.96 - shorten cross section so that it does not intersect downstream cross section X1 16.87
  - X1 18.16 - re-orient cross section to be consistent with the orientation of adjacent cross sections
  - X1 18.20 - shorten the length of the section line which runs along the top of road
  - X1 19.92 - incorporate topographic low in left overbank into GR card data and consider re-alignment in left overbank area; check floodplain boundary and evaluate if an ET record is necessary
  - X1 23.45 - shorten cross section in left overbank area
- (10) Hoskin Engineering Consultants have provided the missing information for the Carefree Highway bridge analysis. Any modifications will be included in the Floodways submittal.
- (11) Montgomery Watson agreed to re-analyze the floodplain between cross sections X1 17.95 and X1 18.29 in order to eliminate the possibility of overbank flooding.
- (12) Montgomery Watson will check the floodplain top width at cross section X1 19.41. The encroachments at this cross section may need to be modified or removed.
- (13) Refer to comment (9), cross section X1 19.92.
- (14) The house in the left overbank of cross section X1 24.87 will be represented in the GR card data as a 10-foot high obstruction.
- (15) HEC-2 model appears to be okay. Hasan's cross section plots do not display the effects of the encroachments at cross sections X1 25.12 to X1 25.63, which eliminate split flow.
- (16) Montgomery Watson agreed to evaluate the necessity of lengthening or re-orienting cross sections X1 25.78 and X1 25.79.
- (17) Montgomery Watson agreed to modify the HEC-2 model at New River bridge as necessary to account for skewness and for consistency with the process used at the Carefree Highway bridge.
- (18) Montgomery Watson will re-analyze the floodplain between cross sections X1 25.79 and X1 26.24. A natural levee situation exists along the river banks in this region, and flow can be constrained to the channel by the use of encroachments. Pedro advised that FEMA would, most likely, not accept the current floodplain delineation due to the possible instability of the

bank levees. Montgomery Watson will decide whether to submit the floodplain as-is or to allow flow into the right and/or left overbank areas.

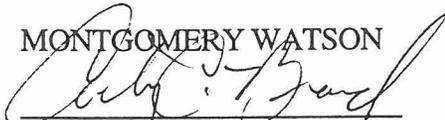
**Action Items**

Montgomery Watson will:

1. Make all suggested and necessary adjustments to the HEC-2 model, as specified in these minutes.
2. Submit to the District the revised HEC-2 model with the floodway delineation using equal conveyance encroachment.

The preceding minutes were prepared by Cortney Brand and are his interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise him in writing or verbally of any discrepancies and/or omissions.

MONTGOMERY WATSON



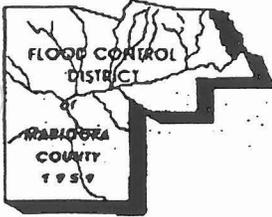
Cortney C. Brand

January 13, 1997  
Date Prepared

January 15, 1997  
(Dates Revised)

Attachment

- c: Attendees  
Laurie Miller  
Janene Werner  
Paul Hoskin



# FLOOD CONTROL DISTRICT

of

**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009-6399  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

## BOARD OF DIRECTORS

Betsy Bayless  
Jan Brewer  
Fulton Brock  
Don Stapley  
Mary Rose Garrido Wilcox

Laurie Miller, P.E.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

**SUBJECT :** Skunk Creek Wash Topographic Mapping and Floodplain Delineation Study.  
Phase II (FCD #95-16)  
HEC-2 review comments

Dear Ms. Miller :

Please find following review comments on the above mentioned project. It is recommended that these concerns are satisfied prior to the subsequent submittal with floodway delineations.

### General

- (1) Plot the floodplain/floodway maps at a 1"=400' scale.
- (2) It is advisable to eliminate the cross-section extended messages from the hydraulic modeling.
- (3) Please remove/eliminate small islands from the floodplain/floodway delineation.
- (4) The floodplain/floodway delineation should match with the Cline Creek FDS.
- (5) Several bank stations are suggested to be relocated as marked.
- (6) Please show bank stations on the floodplain/floodway delineation maps.

### HEC2 Modeling

- (7) Top width at cross sections X1 14.54 and X1 15.75 does not match the HEC-2 results. Please explain.
- (8) Floodplain boundary is suggested to be revised at cross sections X1 15.22 through X1 15.55, X1 18.96 through X1 19.18.
- (9) It is recommended that cross sections X1 16.96, X1 18.16, X1 19.92, X1 23.45 be realigned.
- (10) Error message exists, when EDIT2 is run, at the carefree highway bridge. Please revise and/or edit the current bridge modeling to remove the error message.
- (11) Possible over bank flooding is found between cross-sections 17.95 through 18.29. Please investigate the situation.
- (12) Please investigate the ineffective flow area situation at cross section X1 19.41.
- (13) The GR record at cross-section 19.92 may be erroneous as shown in the x-section plot. Please

adjust accordingly.

- (14) The house(s) at cross-section X1 24.87 has not been modeled in the hydraulic analysis.
- (15) The x-section plots from X1 25.12 through X1 25.63 suggests a possible split flow situation. Please investigate and adjust the model accordingly.
- (16) It is recommended that the orientation of cross-sections X1 25.78 and X1 25.79 be revised to better represent the New River bridge modeling.
- (17) The New River bridge has not been modeled to account for the severe skewness that exists. Please revise the modeling to account for the proper skewness.
- (18) The x-section plots from X1 25.91 through X1 26.24 strongly suggests of possible flooding on both right and left over bank areas. Please investigate the situation and adjust the hydraulic model accordingly.

Should you have further questions in this regard, please do not hesitate to contact me at 506-1501. Thank you very much for your time and cooperation.

Sincerely,



Hasan Mushtaq, P.E.  
Engineering Division

**MONTGOMERY WATSON****MEETING MINUTES**

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<b>Project:</b>	Skunk Creek Floodplain Delineation Study	<b>Date:</b>	November 4, 1996
		<b>Time:</b>	10:30 a.m.
		<b>Place:</b>	Flood Control District
<b>Subject:</b>	HIS Check Plots	<b>Job No. :</b>	1213.0070

---

<b>Attendees:</b>	<b>Affiliation:</b>	<b>Phone:</b>
Hasan Mushtaq	FCDMC	506-1501
Marta Dent	FCDMC	506-1501
Laurie Miller	Montgomery Watson	954-6781
Rudy Stricklan	Mapping Automation, Inc.	829-3090

**Discussion:**

The purpose of the meeting was to define Task 9.2, which involves preparing check plots as part of the HIS data conversion task. Marta Dent identified six separate check plots to be submitted, as defined below.

1. PROJREL and DQ (data quality)
2. Corners and Control (data attributes by control points)
3. Physical facilities: Structures, canals, railroads, lakes, and rivers
4. ELEV
5. Drainage basin and drainage path (basin and subbasin name, area in square miles, path node and flow rate)
6. Baseline thalweg with annotation next to it (e.g., peak flow rate), zones, FEMA control points (if any), WSEL, and cross sections attached to baseline (plan view only with label and flow rate and velocity)

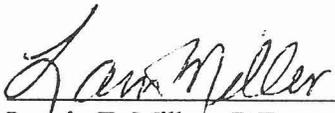
Laurie noted that the District will need to provide Arc Macro Languages (AMLs) in order for Montgomery Watson to develop the check plots. Marta responded that AMLs have been

developed for WSEL and for the zones portion of Check Plot No. 6. Additionally, one may have been developed for ELEV (identified as Check Plot No. 4). Marta will verify that these exist and provide them to Montgomery Watson. However, she said that no AMLs have been developed for the remaining coverages. Rudy noted that the AMLs for all coverages is needed to generate the check plots. If they do not exist, significant additional work would be required to develop the AMLs.

Specifications for development of check plots was also discussed. Rudy stated that such specifications would be needed in order to prepare the check plots for submittal to and review by the District. The specifications would describe District requirements as to the development and required format of the check plots. Marta noted that specifications have not been developed by the District. She said the District is looking for attribution, not annotation, and the scale only needs to be large enough to see the information. However, no additional direction could be provided by the District at this time.

The preceding minutes were prepared by Laurie Miller of Montgomery Watson and are her interpretation/understanding of the issues discussed therein. Meeting attendees are requested to advise the author in writing or verbally of any discrepancies and/or omissions.

MONTGOMERY WATSON

  
Laurie T. Miller, P.E.

January 23, 1997  
Date Prepared

(Dates Revised)

c: Hasan Mushtaq  
file



**MONTGOMERY WATSON**

**MEETING MINUTES**

<b>Project:</b>	Skunk Creek Floodplain Delineation	<b>Date:</b>	October 8, 1996
		<b>Time:</b>	9:30 a.m.
		<b>Place:</b>	Montgomery Watson
<b>Subject:</b>	HEC-2 Modeling	<b>Reference:</b>	1213.0070

<b>Attendees:</b>	<b>Affiliation:</b>	<b>Phone:</b>
Hasan Mushtaq	Flood Control District of Maricopa County	506-1501
Paul Hoskin	Hoskin Engineering Consultants (HEC)	678-4625
Laurie Miller	Montgomery Watson	954-6781
Cortney Brand	Montgomery Watson	954-6781

**Discussion:**

The purpose of this meeting with the Flood Control District of Maricopa County (District) was to discuss hydraulic modeling issues in the lower portion of the study reach. Topics discussed included: (1) split flow analysis north of Carefree Highway; (2) split flow analysis at CAP Aqueduct; (3) cross section alignment changes; and (4) HEC-2 model submittal. The following is a summary of these discussions. A meeting agenda is attached.

**Split Flow Analysis North of Carefree Highway**

Paul Hoskin presented his findings from HEC-2 modeling of Skunk Creek between the CAP Aqueduct and Carefree Highway. Preliminary results indicate that approximately 3,600 cubic feet per second (cfs) of flow is diverted from Skunk Creek north of Carefree Highway via an adjacent channel and culvert. Paul explained that this diverted flow exits the study area and is not retrieved downstream, which results in reduced flow in Skunk Creek below Carefree Highway.

The effects of the diverted flow were discussed and it was agreed that Montgomery Watson will re-run the HEC-1 model for the Skunk Creek watershed with a diversion of 3,600 cfs at the point where split flow occurs. It was agreed that Montgomery Watson will submit a one-page addendum with the Technical Data Notebook explaining this modification and documenting the revised HEC-1 input and output data files.

Hasan noted that the peak flow estimated at the CAP Aqueduct in the HEC-1 model should be used in the section of the HEC-2 model below Carefree Highway.

### Split Flow Analysis at CAP Aqueduct

Paul presented preliminary results of HEC-2 modeling just north of the CAP Aqueduct, which is the downstream limit of the study area. He presented his reasoning for employing a split flow analysis to simulate ponding of water behind the aqueduct and subsequent flow toward the eastern-most overflow structure. Preliminary results indicate that there will be a 2-foot water surface elevation difference between the two overflow structures. In addition, the calculated HEC-2 water surface elevation is higher than the elevation of I-17 and the CAP Aqueduct berm at the intersection of these structures.

Paul suggested modeling a side weir along the eastern edge of I-17 so that outflow from the study area can be quantified, and placing a Limit of Study Area boundary at this location as well as along the CAP Aqueduct boundary. A Limit of Study Area boundary would also be placed near the eastern overflow structure at the Union Hills watershed discharge.

Hasan recommended that Hoskin Engineering proceed with the split flow analysis at this location and include a side weir along the I-17 boundary in the HEC-2 model. A final decision on modeling methodology at this location will be made after the District's review of the model.

### Cross Section Alignment Changes

Paul explained that the topography at the limits of some cross sections barely contains calculated water surface elevations. He suggested that these cross sections be re-aligned, but remain perpendicular to flow direction, to intercept higher topography. Hasan agreed with this suggestion, but asked that both Hoskin Engineering and Montgomery Watson include comment records with these cross sections so that the District recognizes they've been modified. Hasan also explained that FEMA will accept cross sections in which the water surface elevation is less than 0.5 feet above topography at the cross section limit.

In addition, a few cross sections as digitized had to be extended to contain flow within the channel. The GR data was manually extended in the HEC-2 models. Hasan asked that comment records also be added to note these extensions in the initial submittal of the HEC-2 model.

### HEC-2 Model Submittal

Montgomery Watson agreed to submit the HEC-2 model for the portion of Skunk Creek from the CAP Aqueduct to the Del Webb property (Desert Hills Drive) next week. Hasan asked that a copy of the work maps be submitted with the model. He requested that the following items be labeled on the maps: (1) cross sections; (2) new 100-year floodplain; and (3) effective FEMA 100-year floodplain.

### Action Items

Montgomery Watson will:

1. Re-run the HEC-1 hydrologic model to include a flow diversion of 3,600 cfs at Carefree Highway. A one-page addendum will be included in the Technical Data Notebook as documentation of the revised flows.
2. Submit the HEC-2 model from the CAP Aqueduct to Desert Hills Drive, including work maps.
3. Insert comment records in the initial HEC-2 model to note realigned or extended cross sections.

## HEC will:

1. Re-run the HEC-2 model from CAP Aqueduct to Carefree Highway with revised peak flows.
2. Model the split flow at the CAP overchutes as presented and include a side weir at I-17.
3. Insert comment records in the initial HEC-2 model to note realigned or extended cross sections.

The preceding minutes were prepared by Cortney Brand and are his interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise him in writing or verbally of any discrepancies and/or omissions.

MONTGOMERY WATSON

  
Cortney C. Brand

October 8, 1996  
Date Prepared

                      
(Dates Revised)

## Attachment

c: Attendees  
Fred Duren  
1213.0070.3.3

**PROJECT COORDINATION MEETING AGENDA**

**Flood Control District of Maricopa County  
SKUNK CREEK FLOODPLAIN DELINEATION STUDY**

**OCTOBER 8, 1996**

**A. SPLIT FLOW ANALYSIS NORTH OF CAREFREE HIGHWAY**

1. Tributary divergence split flow model
2. Varied water surface elevations and islands
3. Flow exiting study area (~3,600 cfs)
4. Need to adjust hydrology for downstream reaches

**B. SPLIT FLOW ANALYSIS AT CAP**

1. Methodology for flow divergence
2. Overtopping of CAP and I-17
3. Limits of study for Union Hills watershed
4. Cross-Section alignment changes

**C. OTHER**



**MONTGOMERY WATSON**

**MEETING MINUTES**

<b>Project:</b>	Skunk Creek Floodplain Delineation	<b>Date:</b>	September 23, 1996
		<b>Time:</b>	10:00 a.m.
		<b>Place:</b>	Montgomery Watson
<b>Subject:</b>	Skunk Creek DTM Meeting	<b>Reference:</b>	1213.0070

<b>Attendees:</b>	<b>Affiliation:</b>	<b>Phone:</b>
Rudy Stricklan	Mapping Automation	829-3090
Ellis Hyde	Kenney Aerial Mapping	258-6471
Gary Finnie	Kenney Aerial Mapping	258-6471
Laurie Miller	Montgomery Watson	954-6781
Cortney Brand	Montgomery Watson	954-6781

**Discussion:**

The purpose of this meeting was to discuss the status of digital mapping for the Skunk Floodplain Delineation project. The issues to be resolved included: (1) Mapping Automation's scope of work, (2) status of the DTM for Del Webb's portion of Skunk Creek, and (3) limitations of submitting a continuous DTM to the Flood Control District of Maricopa County (District). As discussed in a previous meeting of July 31, 1996, the discrepancies in mapping that exist between the development work being done for Del Webb by Castro-Fleet-Fisher (CFF) and the floodplain delineation study being done for the District by Montgomery Watson involve differences in levels of accuracy and contours at the margins of the two studies. Additionally, most of Skunk Creek which lies within the Del Webb property was not recently mapped. Mapping in this reach was derived by digitizing contours from existing mapping which is approximately ten years old.

The following is a summary of the various discussions.

**Scope of Work - Mapping Automation**

Rudy stated that Mapping Automation (MA) does not normally produce check plots from ARC-Info. MA typically submits the digital data base directly to the client, which in this case is the District. As a result, this task may be omitted and Montgomery Watson would not be able to certify that the check plots faithfully represent the data and maps in the report and/or work maps. Laurie will discuss this issue with the District.

**Del Webb DTM**

Gary explained that Kenney was able to "trim" data at the Del Webb boundaries and blend the contours with Montgomery Watson's without affecting any of the cross sections in the District's study. However, Kenney does not have a DTM for the Del Webb study reach. Gary said that in

order for Kenney to develop a DTM for Del Webb's portion, he would need to acquire CFF's TIN model. However, Gary warned that data accuracy would be lost within Del Webb's portion and at the meeting points with Montgomery Watson's study reach. Further, a TIN model probably has not been developed.

Rudy explained that data conversion could be performed by MA for the continuous DTM; however, this would exceed MA's original scope of work. Alternatively, CFF could perform data conversion for Del Webb's portion, and this file could be incorporated into Montgomery Watson's data file at a later date. The problem with this approach is that the data submitted by CFF for Del Webb's portion must be in the same format (i.e., mass points and breaklines) as the data submitted by MA for the District's study. Both Rudy and Gary said this would be a difficult task. Gary suggested that he could give Montgomery Watson's contour data to CFF for its use if Montgomery Watson signed a release form. Laurie will discuss these issues with the District before proceeding.

### Continuous DTM

Although not stated in its contract with the District, Montgomery Watson agreed to submit a continuous DTM of the entire reach of Skunk Creek upstream of the CAP Aqueduct if possible. However, it appears that a DTM does not exist for Del Webb's portion. After some discussion, it was determined that two options are available to create a continuous DTM. First, CFF could create a TIN and perform HIS data conversion. However, the data must be in the form of mass points and breaklines. Kenney and MA agreed that mass points could be obtained, but not breaklines. Additionally, the TIN model would be of reduced quality, would be very large, and its usefulness to the District would be limited. Second, Kenney and MA could perform the work, but this would require a change order because the effort is significant. Additionally, limitations in the quality and usefulness remain as in the first option.

Gary gave Rudy the DTM data for Montgomery Watson's study reach, but MA will not begin data conversion until Laurie resolves the continuous DTM issue with the District. MA and Kenney agree to review data content and sign off when data conversion is complete.

The preceding minutes were prepared by Cortney Brand and are his interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise him in writing or verbally of any discrepancies and/or omissions.

MONTGOMERY WATSON

  
Cortney C. Brand

September 24, 1996

Date Prepared

\_\_\_\_\_  
(Dates Revised)

c: Attendees  
Fred Duren  
1213.0070.3.3



**MONTGOMERY WATSON**

**MEETING MINUTES**

<b>Project:</b>	Skunk Creek Floodplain Delineation Study	<b>Date:</b>	July 31, 1996
		<b>Time:</b>	9:00 a.m.
		<b>Place:</b>	Flood Control District
<b>Subject:</b>	Mapping Problem Resolution	<b>Job No. :</b>	1213.0070

<b>Attendees:</b>	<b>Affiliation:</b>	<b>Phone:</b>
Pedro Calza	Flood Control District	506-1501
Hasan Mushtaq	Flood Control District	506-1501
Dan Freese	Del Webb Corporation	808-8074
Len Erie	Erie & Associates	954-6399
Bob Castro	Castro-Fleet-Fisher	264-3335
Susan Houston	Castro-Fleet-Fisher	264-3335
Laurie Miller	Montgomery Watson	954-6781
Fred Duren	Montgomery Watson	954-6781

**Discussion:**

The purpose of the meeting was to resolve discrepancies in mapping that exist between the LOMR work being done for Del Webb by Erie & Associates and Castro-Fleet-Fisher and the floodplain delineation study being done for the Flood Control District by Montgomery Watson. The discrepancies are differences in levels of accuracy and contours at the margins of the two studies, and a different horizontal datum used in the two studies. These discrepancies have prevented the development of a continuous DTM for the entire reach of Skunk Creek upstream of the CAP Aqueduct, incorporating DTM's prepared in the two studies. A letter from Kenney Aerial Mapping was distributed by Bob Castro.

After discussion, the following problem resolutions were defined.

1. Mapping Coordination

Del Webb will authorize its consultants to blend the contours at the upstream and downstream margins of its study reach with those from the Flood Control District study so that there are no discrepancies in contours at the margins. The blending will be accomplished outside the limits of the Flood Control District study in such a way that none of the cross sections in the Flood Control District study will be affected. Del Webb will also authorize its consultants to convert the horizontal control of the DTM for its study to state plane coordinates to be consistent with that used in the Flood Control District study. Del Webb will further authorize its consultants to extend the limits of its HEC-2 model to meet those of the Flood Control District study.

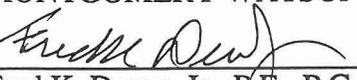
## 2. Continuous DTM

Montgomery Watson will incorporate the Del Webb DTM as notified with the DTM prepared for the Flood Control District's floodplain delineation project to provide a continuous DTM for the District. The District will not hold Montgomery Watson responsible for resolving any questions on the Del Webb DTM. Pedro requested that Del Webb provide any resolutions requested in its DTM resulting from the District's review.

The meeting ended at about 10:00 a.m.

The preceding minutes were prepared by Fred Duren of Montgomery Watson and are his interpretations/understandings of the issues discussed therein. Meeting attendees are requested to advise the author in writing or verbally of any discrepancies and/or omissions.

MONTGOMERY WATSON

  
Fred K. Duren, Jr., P.E., P.G.

August 2, 1996  
Date Prepared

(Dates Revised)

Attachment

c: Attendees  
file

# Kenney Aerial Mapping Inc.

PHOTOGRAMMETRIC SERVICES



180 W. St. Elmo, Phoenix, Arizona 85007  
Phone: (602) 258-0471 Fax: (602) 346-1877

3805 W. Spring Mountain Rd., Suite 100, Las Vegas, NV 89102  
Phone: (702) 398-7574 Fax: (702) 573-4185

PHOTOGRAMMETRIC SERVICES SINCE 1963

Peter A. Dyrain, JR. PRESIDENT

Ellis O. Hyde, PRESIDENT  
July 17, 1996

Mr. Pedro Calva  
Maricopa County Flood Control District  
2801 West Durango  
Phoenix, Arizona 85009

Dear Mr. Calva:

Rob Castro asked me to write concerning the difference in contours on the Skunk Creek Projects being submitted by Castro Fleet Fisher and Montgomery Watson.

Both jobs were done using Digital Terrain Modeling methods, which starts with collecting breaklines wherever there is a change in slope. These breaklines are then supplemented with Mass Points at various intervals depending on the final map scale. The collected data is then run through a computer program and a triangulated surface is created from which the contours are interpolated. This results in contours that accurately depict the ground.

In areas of very little slope, the placement of Mass Points and the way the stereo model is leveled in our instrument can greatly change the resulting contours. If a Mass Point is inserted with an elevation of 1870.1 instead of 1869.9 it can shift a contour many feet horizontally and still be well within mapping standards for vertical accuracy. This slight difference in reading the ground is compounded by the fact that the projects were flown at two different photo scales. Although, the project by Castro Fleet Fisher was flown for a higher accuracy level than required by F.E.M.A. for flood plain delineation projects, both projects meet National Mapping Accuracy Specifications.

The only way to make the contours match perfectly would be to strip away the breaklines of the Montgomery Watson project, combine the data of both and re-run the contours, which would result in different contours on both projects.

I hope this letter outlines the differences between the two projects. If you have any further questions, please do not hesitate to call the office.

Sincerely,  
Kenney Aerial Mapping, Inc.

*Gary A. Finnie*  
Gary A. Finnie  
Project Manager

GAF:jec

**MONTGOMERY WATSON****MEETING MINUTES**

---

**Project:** Skunk Creek Floodplain  
Delineation Study FCD 95-16

**Date:** April 22, 1996

**Time:** 9:00 p.m.

**Place:** FCDMC

**Subject:** Project Coordination Meeting

**Reference:** 1213.0050

---

**Attendees:**

Pedro Calza  
Hasan Mushtaq  
Fred Duren  
Laurie Miller  
Paul Hoskin

**Affiliation:**

FCDMC  
FCDMC  
Montgomery Watson  
Montgomery Watson  
HEC

**Discussion:**

A coordination meeting was held to discuss ongoing activities on the Skunk Creek Floodplain Delineation Study. A summary of the meeting is presented below by agenda item. A copy of the agenda is attached.

**PURPOSE OF MEETING**

Fred stated that the primary purpose of the meeting was to reach decisions on: (1) whether to use new hydrology developed by Montgomery Watson under this contract or to use the adopted discharges in the effective Flood Insurance Study (FIS); and (2) determine the scope of the Phase II work, or floodplain delineations. Additionally, the project status would be discussed.

**OVERVIEW OF PROJECT STATUS**

Laurie reported on the status of the project by task since the last coordination meeting, as follows.

**Task 1 - Coordination**

Laurie and Hasan have coordinated as needed, primarily on the hydrologic and topographic mapping comparison elements. Several informal meetings have taken place.

**Task 2 - Data Collection**

A data collection report, Technical Memorandum No 2, was submitted on April 18, 1996, which completes the data collection task.

### Task 3 - Topographic Mapping

The topographic mapping task is nearly complete. The only remaining task is providing digitized cross sections, which will be performed after cross sections are located and the District approves them.

### Task 4 - Ground Surveying

The ground survey task is complete. The final survey report has been submitted to Montgomery Watson by Collins-Pina Engineers. Laurie asked if the District would prefer to receive the survey report and other miscellaneous deliverables now or at the end of the project. Hasan asked that Montgomery Watson hold such submittals until the end.

### Task 5 - Hydrology

The hydrologic analysis is complete. The draft report was submitted to the District for review on April 4, 1997. Hasan noted that Afshin Ahouraiyan has reviewed the report and is prepared to discuss his comments.

### Task 6 - Hydraulic Analysis of Test Reaches

The hydraulic analysis of test reaches has not been completed due to the uncertainty of whether the adopted or newly developed discharges will be used and whether HEC-2 or HEC-RAS will be used for hydraulic modeling.

Paul presented the results of running a portion of the existing HEC-2 model data (that upon which the adopted floodplain is based) at two cross sections using new mapping (attached). The water surface elevation changed at both locations with minimal changes to the floodplain width. It was pointed out that, even though the floodplain width does not change significantly, the location of the floodplain may due to shifts in channel alignment.

## REVIEW OF HYDROLOGIC RESULTS

Montgomery Watson provided a summary of results presented in its draft hydrology report. The District noted that Afshin Ahouraiyan has completed the review and is preparing a summary of comments. It was agreed that Laurie will set up a separate meeting with Hasan to discuss the District's comments. Montgomery Watson made the following comments on the hydrologic results:

1. Discharges from the new analysis are approximately 25% lower than adopted discharges at the CAP aqueduct (26,700 cfs versus 35,000 cfs)
2. In the upper portion of the watershed, new peak discharges closely match adopted discharges.
3. The adopted discharges show a significant increase in flow (i.e., 3,600 cfs) between Carefree Highway and the CAP Aqueduct. This would not be expected because the corresponding area contributing to runoff is minimal and should not result in such an increase. Further, attenuation of flow would be expected in a long, narrow subarea. Attenuation of flow occurred in the new hydrologic model, but not in the effective study.
4. A depth-area reduction factor of 1.0 was used in the Cline and Rodger Creek studies performed previously by others, which is not in accordance with current practices for subwatersheds of similar size.

## DISCUSSION OF TOPOGRAPHIC MAPPING COMPARISON

Laurie presented the topographic mapping comparison, which was summarized in Technical Memorandum No. 1. It was determined that significant differences in topography occurred throughout the study reach. The District asked why the new thalweg was not plotted all the way to the CAP Aqueduct on Figure 1 of the report. Laurie will investigate and contact Hasan.

## DECISION ON STUDY DIRECTION

Based on observations made during discussion of the hydrologic results, the District directed Montgomery Watson to use the new discharges developed for this study. Pedro will provide written authorization to proceed. The District also directed Montgomery Watson to proceed with Phase II, floodplain delineations, for the entire study reach.

The status of the Del Webb LOMR study for Skunk Creek was discussed. The District had not received the study for review, but had been told by Len Erie that it would be submitted within approximately one week. Pedro will contact Sam Calgon with Del Webb and Len Erie to check the status of the study and will inform Montgomery Watson.

The use of HEC-RAS versus HEC-2 computer models was discussed. It was decided that HEC-RAS would be used, but only if it had been used to develop delineations for the Del Webb portion of Skunk Creek. In order to match water surface elevations between the two studies, the same model would have to be used for both. Pedro will ask Len Erie what was used for the Del Webb portion and inform Montgomery Watson.

The District noted that MCDOT has developed design plans for the new Carefree Highway bridge. The District would like the new bridge analyzed in the HEC-2 model but does not wish to have it included in the floodplain delineation study. Hasan will provide the design plans for the new bridge.

## PROJECT SCHEDULE

Laurie distributed an updated schedule (attached) and noted that the project has been delayed due to unforeseen difficulties for the District in modifying the existing Cline and Rodger Creek hydrology models to conform to current District hydrologic procedures. Pedro stated that the District now requires a change order for modifications to the project schedule. It was agreed that any change order needs for time extension would be re-evaluated at the end of July 1996.

Laurie further noted that HIS data conversion occurs after the floodplain delineations are completed and approval by FEMA is obtained. This time requirement cannot be estimated, but would extend well beyond the contract duration, as noted on the project schedule. Pedro suggested Montgomery Watson initiate HIS data conversion on the topographic mapping portion of the study. This information would not be modified as a result of FEMA's review, so could be performed and reviewed by the District in advance of FEMA approval.

## OTHER

The District requested that Montgomery Watson submit a revised billing estimate for the fourth quarter of FY 95/96 to reflect the schedule delay.

**ACTION ITEMS****Montgomery Watson will:**

- Hold the final survey report and other miscellaneous deliverables until the study nears completion
- Meet with the District to discuss its review comments on the hydrology report
- Commence floodplain delineation tasks for the entire study reach using new discharges developed for this study
- Check the profile data in Figure 1 of Technical Memorandum No. 1
- Submit a revised billing estimate for the fourth quarter of FY 95/96
- Re-evaluate time extension needs at the end of July 1996
- Initiate HIS data conversion of topographic mapping

**The District will:**

- Provide written authorization to proceed with Phase II
- Contact Len Erie to determine the status of the LOMR and which hydraulic model (HEC-2 or HEC-RAS was used). Information will be provided to Montgomery Watson.
- Provide MCDOT design plans for the new Carefree Highway bridge

The preceding minutes were prepared by Laurie Miller and are her interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise her in writing or verbally of any discrepancies and/or omissions.

  
Laurie T. Miller, P.E.

5/23/96  
Date

Attachments

**PROGRESS MEETING NO. 2 AGENDA**  
**Flood Control District of Maricopa County**  
**SKUNK CREEK FLOODPLAIN DELINEATION STUDY**

April 22, 1996

**A. PURPOSE OF MEETING**

1. Project Status
2. Decision on Study Hydrology
3. Decision on Extent of Phase II Floodplain Delineations

**B. OVERVIEW OF PROJECT STATUS**

1. Coordination
2. Data Collection
3. Topographic Mapping
4. Field Survey
5. Hydrology
6. Existing Hydraulic Model Review
7. Decision on Study Direction

**C. REVIEW OF HYDROLOGIC RESULTS**

1. Overview of Results of Hydrologic Analysis
2. Comparison with Adopted Discharges
3. Decision Required: Adopted vs. New Peak Discharges

**D. DISCUSSION OF TOPOGRAPHIC MAPPING COMPARISON**

1. Overview of Technical Memorandum No. 1
2. Conclusion

**E. DECISION ON STUDY DIRECTION**

1. Criteria for Determining Study Direction
  - a. Hydrology
  - b. Topographic Mapping Comparison
  - c. Use of HEC-RAS vs. HEC-2
  - d. Other
2. Decision Required: Finalize Phase II Scope of Work

**F. PROJECT SCHEDULE**

1. Revised Schedule

**G. OTHER**

**Skunk Creek Floodplain Delineation**  
**Comparison of Computed Water Surface Elevations**

**Cross-Section 23.72**

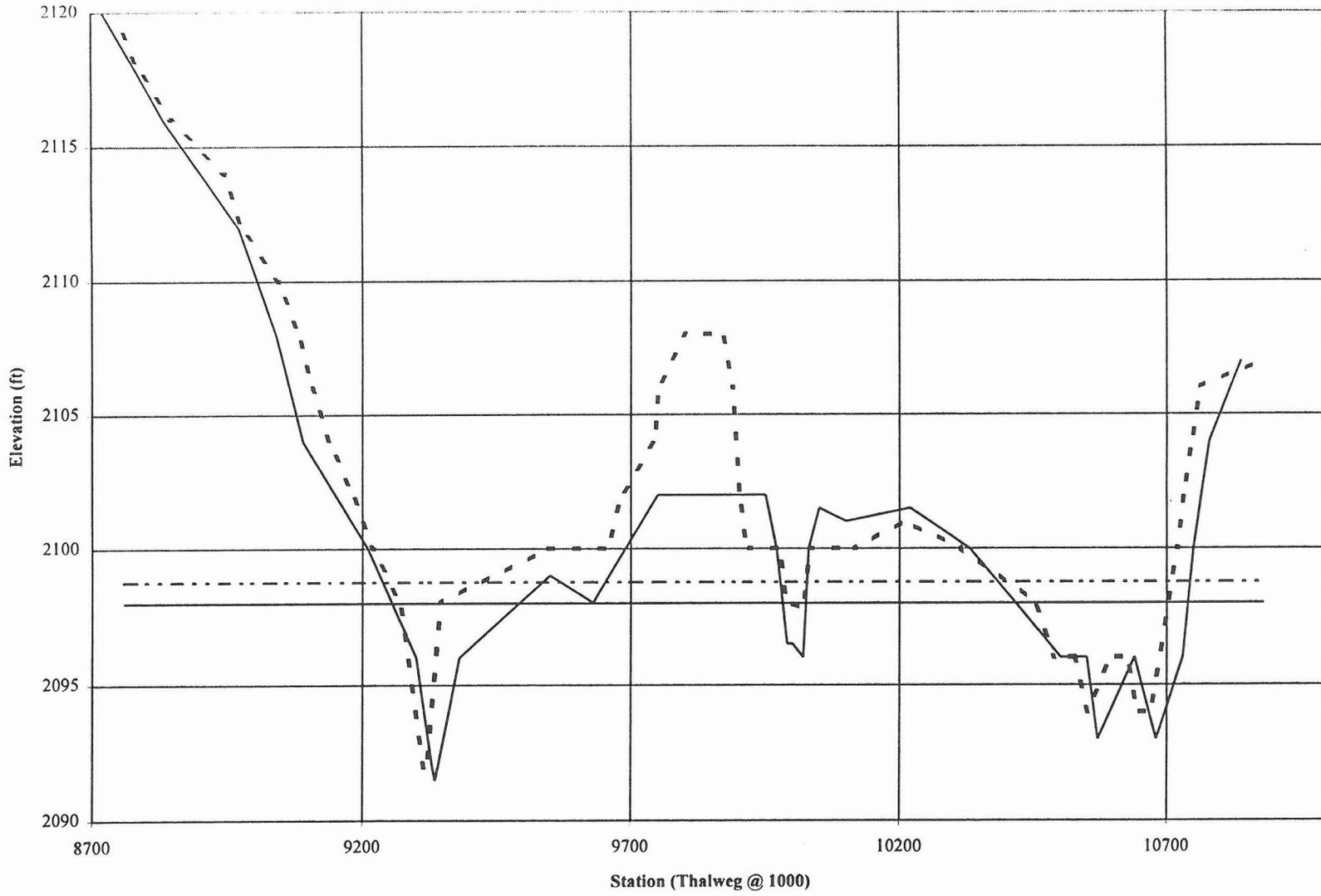
	<b><u>100-Year Floodway</u></b>	
<b>Prior</b>	2018.57	2018.89
<b>Current</b>	2017.04	2017.32
<b>Difference</b>	1.53	1.57

**Cross-Section 25.48**

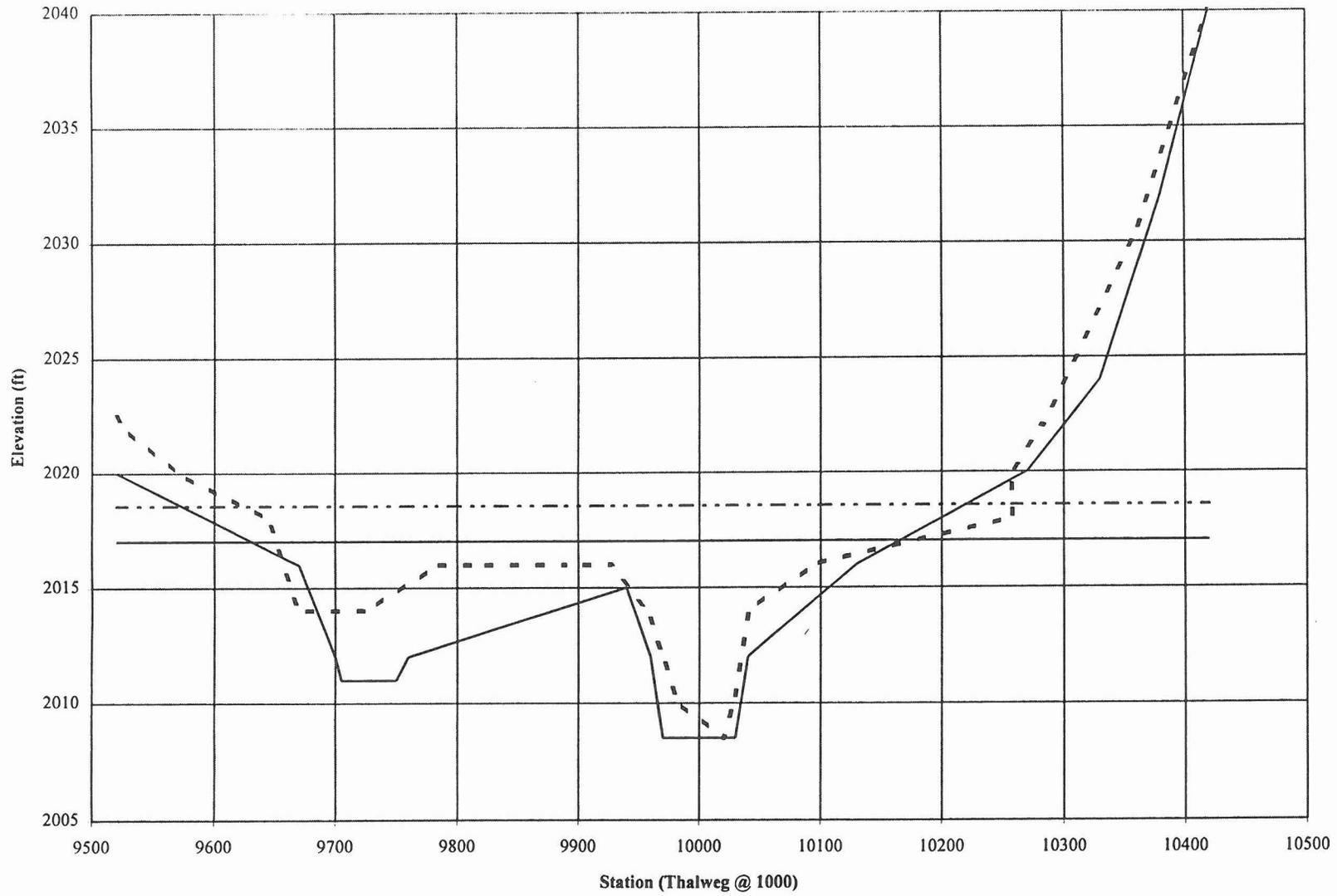
	<b><u>100-Year Floodway</u></b>	
<b>Prior</b>	2098.75	2099.28
<b>Current</b>	2097.98	2098.9
<b>Difference</b>	0.77	0.38

Note: Water Surface Elevations computed using HEC-2 and identical upstream and downstream cross-sections.

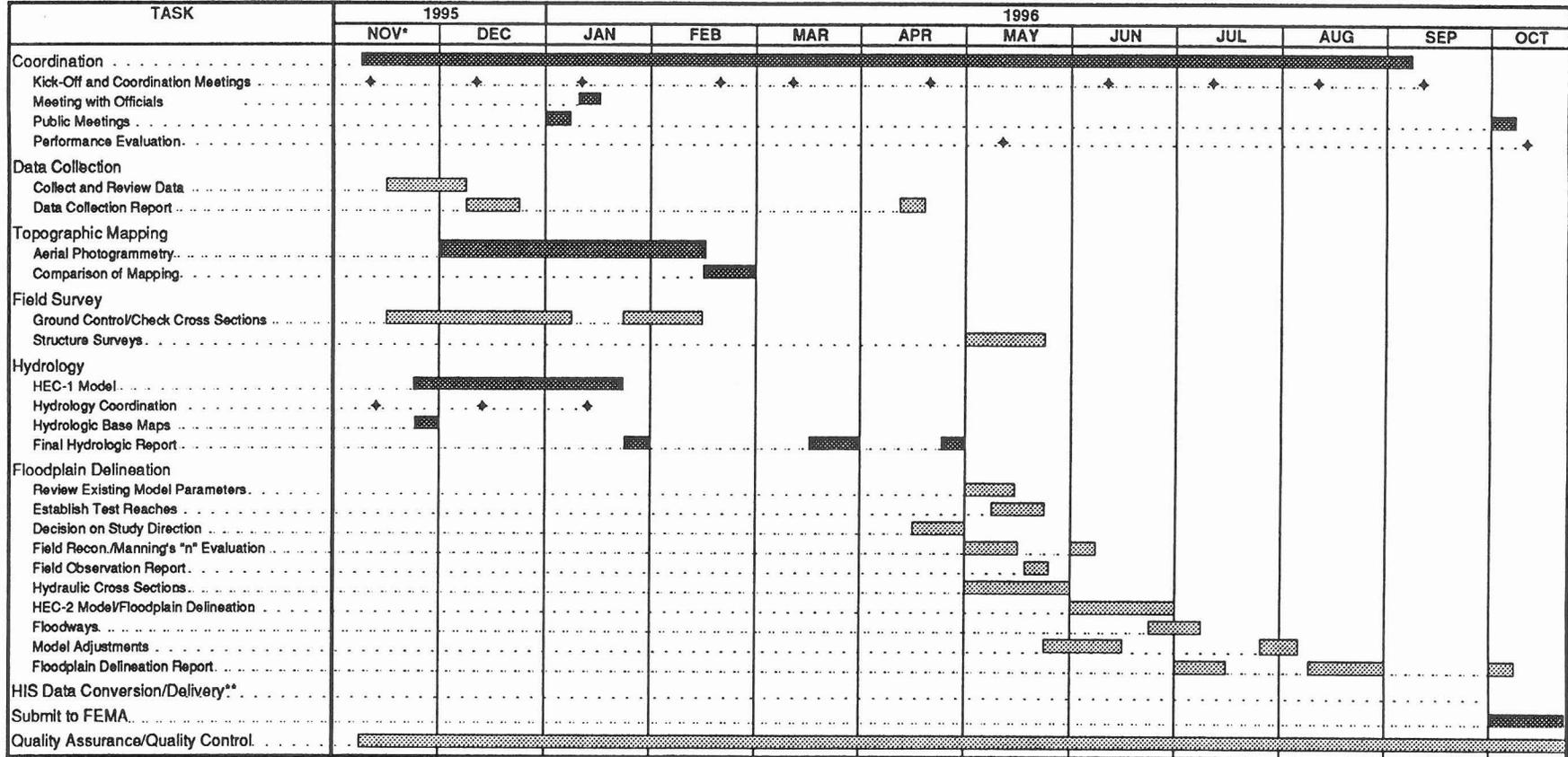
CL 25.48  
CROSS SECTION CE (Sta 23.72)



CROSS SECTION CE (Sta 23.72)



**PROJECT SCHEDULE**  
**SKUNK CREEK FLOODPLAIN DELINEATION PROJECT**  
**FCD 95-16**  
**Revised 4/22/96**



\*Assumed Notice-to-Proceed 11-9-95.

\*\* Completion assumed 3 months following FEMA approval.

**MONTGOMERY WATSON****MEETING MINUTES**

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**Project:** Skunk Creek Floodplain  
Delineation Study FCD 95-16

**Date:** February 27, 1996

**Time:** 2:00 p.m.

**Subject:** Hydrology and Review Meeting  
and Topographic Mapping  
Comparison

**Place:** Montgomery Watson

**Reference:** 1213.0050

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**Attendees:**

Hasan Mushtaq  
Laurie Miller

**Affiliation:**

FCDMC  
Montgomery Watson

**Discussion:**

A hydrology review meeting and discussion of topographic mapping were held at office of Montgomery Watson on the Skunk Creek Floodplain Delineation Study (FCD 95-16). The discussion from the meeting is summarized below.

**DISTRICT HYDROLOGY REVIEW COMMENTS**

Hasan reiterated the District's main review comments discussed on February 23, 1996. Two additional items were discussed. First, Hasan provided the final HEC-1 hydrology models for Cline and Rodger Creek. These models are to be inserted into the Skunk Creek model "as-is". Second, Hasan reviewed the flow diagram for the Skunk Creek model and had no comments.

**TOPOGRAPHIC MAPPING**

Laurie presented a technical memorandum which summarizes the comparison of prior and current topographic mapping. Overall, significant differences were found by comparing both the prior and current thalweg and by comparing selected cross sections.

Hasan noted that the differences in cross-sectional area among the cross sections evaluated varied widely. He suggested additional cross sections could be analyzed to identify trends on the differences found. Laurie responded that several factors do not lend themselves to such an analysis:

1. The number of cross sections suitable for comparison is limited because there are few landmarks on which to duplicate the location of the original cross sections.
2. The fact that differences exist in the profiles of the thalwegs throughout the reach support the conclusion that elevation differences in the channel are not localized.

3. The cross sections which were evaluated were selected to represent the range of discrepancies, which in part explains why the net change among cross sections varies widely.

Laurie noted that comparison of topographic mapping is one of several criteria which will be used to evaluate the need for new floodplain delineation. It was agreed that the District will review the technical memorandum and discuss it further after the hydrologic modeling is finalized. Then the two criteria can be evaluated together in identifying the future study direction.

The preceding minutes were prepared by Laurie Miller and are her interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise her in writing or verbally of any discrepancies and/or omissions.

  
Laurie T. Miller, P.E.

2/29/96  
Date



**MONTGOMERY WATSON**

**MEETING MINUTES**

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**Project:** Skunk Creek Floodplain  
Delineation Study FCD 95-16

**Date:** February 23, 1996

**Time:** 3:00 p.m.

**Place:** FCDMC

**Subject:** Hydrology Review Meeting

**Reference:** 1213.0050

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**Attendees:**

Hasan Mushtaq  
Laurie Miller

**Affiliation:**

FCDMC  
Montgomery Watson

**Discussion:**

A hydrology review meeting was held at the District offices on the Skunk Creek Floodplain Delineation Study (FCD 95-16). The discussion from the meeting is summarized below.

**DISTRICT REVIEW COMMENTS**

Hasan presented a brief overview of the District's review of Montgomery Watson's hydrologic write-up and HEC-1 model ofr Skunk Creek. Detailed discussions are summarized below.

**Kn Parameter**

Several Kn values were incorrect, possibly as a result of not tabbing through all fields when a change is made. The District had no objections to any of the other hydrologic parameter estimations.

**Storm Duration**

The 24-hour storm duration should be used instead of the 6-hour storm. Laurie noted that the District had given Montgomery Watson the HEC-1 input data files for the 6-hour storm for Cline and Rodger Creeks, but the change in storm duration can be easily made.

**DDMS Files**

The DDMS files need to be submitted as one watershed, not in separate files for the Union Hills area or Cline and Rodger Creeks.

Tables D and E of the hydrologic write-up are difficult to follow. Hasan suggested that the information be outlined within the table to separate the subbasins or that the table be modified to show three subbasins per page.

### Soil Classification for Tonto National Forest

Hasan summarized his efforts to collect soils data from the Forest Service to be used in areas within the Tonto National Forest which are not covered by the current soils survey. He determined that no data were available for the unmapped areas within the Skunk Creek study area.

Hasan thought that the soil classifications for areas within the Tonto National Forest had been estimated by assuming the same percentages of soils exist on forest land as adjacent mapped areas. Laurie clarified that soil types were actually estimated by extrapolating soil types from adjacent mapped areas and extending the information based on topographic features. These extrapolated areas were then measured to estimate weighted loss rates.

Hasan agreed that this approach is the most reasonable given that soils data are not available from the Forest Service. Laurie will modify the explanation in the hydrologic report to make the description of methodology more clear.

### HEC-1 Model

The KK blocks should be defined consistently, e.g., the concentration points should be identified consistently throughout the model.

The HC records should be completely defined to identify the upstream contributing areas.

The warning messages in the output file seem to be concentrated on the routing of "CLINER". This reach should be checked and attempts should be made to reduce or eliminate the warning message.

Hasan had not yet reviewed the model diagram, but would do so within the next couple of days.

### MODIFIED HEC-1 MODELS FOR RODGER AND CLINE CREEKS

Hasan presented the Rodger and Cline Creek hydrologic models which he modified to conform with current District guidelines. He first collected soils and land use data from the District's HIS database, and re-created the "KK" blocks using DDMS. Comments have been added to the input file which summarizes his methodology. Except for the "KK" blocks, no other changes were made to the routing parameters.

The revised run for Rodger Creek came very close, within 5 cfs of the original model. However, that for Cline Creek was more than 1,400 cfs higher than the original model, although the same approach was used. Hasan noted that the outflow from individual subbasins in the revised model are approximately 1.5 times higher than the original subbasin outflows. However, routed flows are much closer between the two versions of the model.

Hasan noted that he would like to analyze the Cline Creek model further in order to bring the results closer to the original model; therefore, the Cline Creek model is likely to change. Laurie noted that Montgomery Watson could not finalize the hydrology until both Rodger and Cline were finalized to avoid two separate revisions and because calibration cannot proceed with interim data. It was agreed that Montgomery Watson would not proceed with work on the hydrology until the Rodger and Cline Creek models are finalized. Hasan estimated that his work would be complete on February 27, 1996.

District review of the Cline and Rodger Creek portions of the study were discussed. Hasan said that these portions of the study would not be modified by District review of Montgomery Watson's hydrology, but would be accepted "as is".

Laurie noted that the information provided by the District would be included without modification in an appendix to the hydrology report so that it is clear no further changes were made to the models and to facilitate District review. Hasan will provide a write-up to be included in the appendix which describes the modifications to the two models.

### Hydrologic Parameter Methodology for Cline and Rodger Creeks

Hasan commented on several aspects of the Cline and Rodger Creek models.

**Precipitation.** Each data point on the "PC" records in the original Cline and Rodger Creek models was multiplied by the total rainfall depth instead of the more common method of leaving the data as a ratio of 1.

**Soils Data.** Hasan assumed a soil type of loam from the data provided from the Forest Service (soil types 103 and 126), and consulted the District's hydrology manual for parameter estimation.

**Land Use.** A land use of "open" was assumed rather than "desert" because the vegetation on the watershed appeared more dense than is typical of the desert classification.

### MISCELLANEOUS

Hasan asked that his review comments be returned with the submittal of the hydrology report.

Laurie will verify with Kenney Aerial Mapping, Inc., that permission has been granted by Del Webb to allow us to incorporate its mapping for the proposed Desert Hills development.

### ACTION ITEMS

- The District will review the HEC-1 model diagram for Skunk Creek
- The District will provide final versions of HEC-1 models for Cline and Rodger Creeks
- Montgomery Watson will modify the hydrologic write-up and HEC-1 model for Skunk Creek per the District's review comments, upon receipt of the final Cline and Rodger Creek models
- The District will provide a description of methodologies used to modify the Cline and Rodger Creek models, to be inserted into an appendix to the hydrology report
- The District will review the HEC-1 model diagram for Skunk Creek
- Montgomery Watson will verify with Kenney Aerial Mapping, Inc., that mapping for the Desert Hills area is available for insertion into the Skunk Creek DTM

The preceding minutes were prepared by Laurie Miller and are her interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise her in writing or verbally of any discrepancies and/or omissions.

  
Laurie T. Miller, P.E.

2/29/96  
Date

**MONTGOMERY WATSON****MEETING MINUTES**

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**Project:** Skunk Creek Floodplain  
Delineation Study FCD 95-16**Date:** January 23, 1996**Time:** 10:00 a.m.**Place:** FCDMC**Subject:** Progress Meeting No. 1**Reference:** 1213.0050

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**Attendees:**Pedro Calza  
Hasan Mushtaq  
Fred Duren  
Laurie Miller  
Chip Paulson  
Paul Hoskin**Affiliation:**FCDMC  
FCDMC  
Montgomery Watson  
Montgomery Watson  
Montgomery Watson  
HEC**Discussion:**

A progress meeting was held on the Skunk Creek Floodplain Delineation Study (FCD 95-16). The discussion is summarized below by agenda item. The meeting agenda is attached.

**PROGRESS OVERVIEW**

Laurie Miller presented a brief overview of the work performed by major task since the last meeting. Detailed discussions are summarized below.

**ONGOING/UPCOMING ACTIVITIES**

A number of tasks have been completed or are in progress, as described herein.

**Task 1 - Coordination**

Public notification of the study and public meeting was made and appeared twice in three newspapers (two local and one major). Affidavits have been submitted to the District.

The first of two public meetings was held on January 3, 1996. It was well-attended, with about 30 or more residents attending. One attendee, who had contacted the District several times by telephone, was concerned because a survey lath was placed by Collins-Pina Consulting Engineers, Inc. (CPE), on her property. She again expressed her concerns at the public meeting. Laurie informed her that the surveyor had attempted to place all ground control within public rights-of-way and likely had placed the lath on a section line which had not yet been dedicated a street right-of-way.

Hasan stated that he had received a call recently from someone in the existing designated floodway who had not received the letter the District had sent out to residents in the area. The District

concluded that the County's assessment data was not up to date or contained an error which omitted the affected homeowner.

The need for scheduling a meeting with local officials was discussed. It was concluded that it would probably not be necessary to schedule a meeting. Hasan will contact the City of Phoenix and Maricopa County to verify. Hasan will also obtain the design plans for improving the Skunk Creek crossing of Desert Hills Drive.

Montgomery Watson reported that it is in the process of finalizing subcontracts with Kenney Aerial Mapping, Inc. (Kenney), CPE, and Hydrologic Engineering Consultants (HEC).

Responsibilities were discussed of preparing presentation materials for the second of two public meetings. It was agreed that the format will be to open with a presentation and continue with an open-house format. The District will prepare presentation boards, but will need "clean" CAD files from Montgomery Watson which contain the new topography, digitized existing floodplain delineations, and hand-drawn proposed delineations. Montgomery Watson will prepare any slides which may be needed for the presentation portion of the meeting.

### **Data Collection**

Most, but not all, documents pertinent to the project have been collected. A list of data needs was distributed (attached). It was estimated that the data collection report would be completed approximately two weeks after receipt of the information discussed below.

**Adopted Discharges.** Montgomery Watson asked for adopted discharges above the CAP Aqueduct. Hasan reported that the design discharge used by the Maricopa County Department of Transportation (MCDOT) for the New River Road bridge is 7,200 cfs. He will collect any other adopted discharges.

**Record/Design Drawings.** The District will collect available record/design drawings for New River Road bridge, Carefree Highway bridge, and any dip road crossings of Skunk Creek. Hasan will request these from Ron Phalen.

**Soils Data.** Montgomery Watson requested soils data for areas within the Tonto National Forest. Hasan will provide data within the next day or two.

**Revised Hydrologic Models.** Revised hydrologic models for Rodger and Cline Creeks were requested. The District is working on modifications to these models.

**Del Webb Topographic Mapping.** Kenney will need permission from Del Webb to incorporate the aerial mapping it performed on the proposed Desert Hills Development. Hasan will ask Pedro to contact Del Webb; Laurie will contact Kenney to keep them informed of the proposed plan.

**Del Webb Floodplain Delineations.** The District was informed by Del Webb that it plans to delay floodplain delineation of Skunk Creek within the proposed Desert Hills development. Del Webb has re-assessed its priorities and will not begin delineation until February. This delay could adversely affect the Skunk Creek delineations because it was planned to match the Del Webb water surface elevations in the Skunk Creek model.

### **Topographic Mapping**

A complete set of topographic maps are scheduled to be delivered to Montgomery Watson within approximately one week. The southern half will be delivered before the end of the week. The

District asked that the vertical control be verified (i.e., that NGVD and USGS control are used, not ADOT or MCDOT control).

### Field Survey

Field survey tasks are essentially complete, except for field verification of cross sections and receipt of the surveyor's report. Montgomery Watson will select cross sections once the mapping is received, and these will be field verified.

### Hydrology

As part of the coordination meeting, a discussion was held on the District's review of hydrologic parameters submitted previously by Montgomery Watson and on the results of the draft HEC-1 model.

**Hydrologic Parameters.** Chip presented an overview of the methodology used to develop hydrologic parameters and results of the initial HEC-1 model. Some of the details included:

- Data from adjacent subareas were extrapolated and soil types were calculated digitally for areas within the Tonto National Forest.
- The S-graph was used for the unit hydrograph, using Phoenix Mountain or Phoenix Valley, depending on the terrain.
- Lag was calculated using the Corps' formula.
- Loss rates were estimated using the Green Ampt Method from the District's DDMS software.
- Channel routing was performed by the Muskingum method.

Montgomery Watson will provide a description of methodologies used to develop the hydrologic model, which will become part of the hydrology report. The District also asked that data input files be submitted as well.

**Hydrologic Model.** Results from the preliminary HEC-1 model, which includes the unmodified Cline and Rodger Creeks models, indicate that peak flows are considerably lower than the adopted flood discharges. Paul provided information on the flood frequency analysis (attached) and confirmed that the adopted discharges are high compared to the flood frequency analysis. Hasan stated that he will meet with Pedro and other District staff to reopen discussions on the need to modify the existing hydrology. If the modifications cause the difference in peak flows to increase, then the exercise may be counterproductive.

It was noted that no effort was made in Montgomery Watson's HEC-1 model to center the design storm over various locations of the watershed. This will not be performed until the revised Rodger and Cline Creek models are received or a decision is made not to modify them. Hasan said that the Cline and Rodger Creek models did not include depth-area reduction factors (DARF).

There was a discussion on the use of "JR" verses "JD" records in the HEC-1 model developed by Montgomery Watson. Because the total precipitation depth was slightly higher in the upper area of the watershed than in the lower area, "JR" records were used. Hasan recommended that an average depth be assumed over the watershed and the "JD" record be used. Also, it was noted that the wrong storm pattern was used for the Cline and Rodger Creek watersheds in the current draft model.

Montgomery Watson agreed to revise the HEC-1 model to include the use of the "JD" record and average total precipitation, and correct the storm pattern for the entire watershed. The District will complete its review of model parameters by January 26, 1996, and complete its review of the hydrology model by February 2, 1996. A decision on revision by the District of the Rodger and Cline Creek models will also be made by February 2.

### Existing Hydraulic Model Review

Review of the existing HEC-2 model was briefly discussed. A detailed approach was provided in the attached agenda. It was noted that this task cannot commence until the topographic maps are received and cannot be completed until the hydrology is finalized.

### Determine Study Direction

It was reiterated that the extent of new floodplain delineations, if required, will be determined from the results of mapping, hydrologic, and hydraulic comparisons, and other factors not yet identified. Once the extent of new delineations is determined, the scope of work for Phase II of the project will be finalized. Methods to be used in checking the topography include field-checking selected cross sections, checking elevations on the Carefree Highway, checking the MCDOT survey data, and checking the subcritical and supercritical points in the original HEC-2 model.

### PROJECT SCHEDULE

Montgomery Watson reported that the topographic mapping is approximately one week behind schedule. Completion of the Data Collection task is also behind schedule, and will not be finalized until the requested data are received. However, this is not a critical task from a scheduling standpoint.

### OTHER

Montgomery Watson noted that, as requested by the District, future invoices will not include a statement of interest accrual for unpaid invoices. However, the December 1995 invoice had been mailed just before receiving the District's request. All future invoices beginning with January 1996 will not include a statement of interest accrual.

### ACTION ITEMS

Montgomery Watson is responsible for the following action items:

- Contact Kenney regarding inclusion in the DTM of the Del Webb portion of the Skunk Creek mapping
- Submit a description of methodologies used to develop hydrologic parameters
- Submit Revised HEC-1 model
- Submit data input files

The District is responsible for the following action items:

- Assess the necessity of a meeting with public officials
- Provide adopted flood discharges above the CAP Aqueduct
- Provide available record/design drawings for crossings of Skunk Creek, including New River Road, Carefree Highway, Desert Hills Drive, and other dip crossings
- Provide soils data for areas within the Tonto National Forest

- Provide revised Cline and Rodger Creek HEC-1 models, or notification that they will remain unchanged
- Contact Del Webb to request permission for Kenney to incorporate mapping of proposed Desert Hills development
- Provide final review comments to the hydrologic parameters and HEC-1 model

The preceding minutes were prepared by Laurie Miller and are her interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise her in writing or verbally of any discrepancies and/or omissions.

#### Attachments

**PROGRESS MEETING NO. 1 AGENDA**  
**Flood Control District of Maricopa County**  
**SKUNK CREEK FLOODPLAIN DELINEATION STUDY**

**January 23, 1996**

**A. PROGRESS OVERVIEW**

1. Coordination
2. Data Collection
3. Topographic Mapping
4. Field Survey
5. Hydrology
6. Existing Hydraulic Model Review
7. HIS

**B. ONGOING/UPCOMING ACTIVITIES**

1. Coordination
  - a. Schedule Meeting with Local Officials
2. Data Collection
  - a. Verify Availability of Remaining Data
  - b. Complete Data Collection Report
3. Topographic Mapping
  - a. Receipt of Topographic Bluelines
  - b. Test Reach evaluation (see 6. c.)
4. Field Survey
  - a. Check Cross Sections
5. Hydrology
  - a. Discussion of Hydrologic Parameters and Model
  - a. Incorporation of Rodger and Cline Creek Models
  - b. Comparison of Hydrologic Results
  - c. Complete Hydrologic Report
6. Existing Hydraulic Model Review
  - a. Identify Test Reaches (2 test reaches)
  - b. Identify areas of significant manmade changes (ie. bridge construction)
  - c. Compare HEC-2 Cross-Sections with new topography (10 cross-sections in tabular form)
  - d. Conduct field review of test reaches
  - e. Review Model Parameters (discharges, 'n' values, channel & overbank lengths, encroachments, ineffective flow areas, bridges & dip crossings and cross-section orientation)
  - f. Run existing HEC-2 with revised discharges and evaluate results with comparison of computed WSEL and Topwidth (computed and plotted on topography)
  - g. Prepare existing Model Evaluation Report

7. Discussion of Study Direction
  - a. Evaluate Mapping, Hydrologic, and Other Factors
  - b. Finalize Phase II Scope of Work

**C. PROJECT SCHEDULE**

1. Status

**D. OTHER**

## List of Data Collection Requirements

1. Previous Flood Hazard and Hydrology Reports
2. Historical Flooding Information
3. Record Drawings for Existing Structures, if any
4. Design Drawings for New River Road Bridge
5. Revised Hydrologic Models for Cline and Roger Creeks
6. New Topographic Mapping for Del Webb Development
7. Floodplain Delineations for Del Webb Development

**SKUNK CREEK FLOOD-FREQUENCY ANALYSIS**

**Description** Skunk Creek Near Phoenix, AZ - USGS No. 09513860  
Gauging Station Records for period 1960-1994

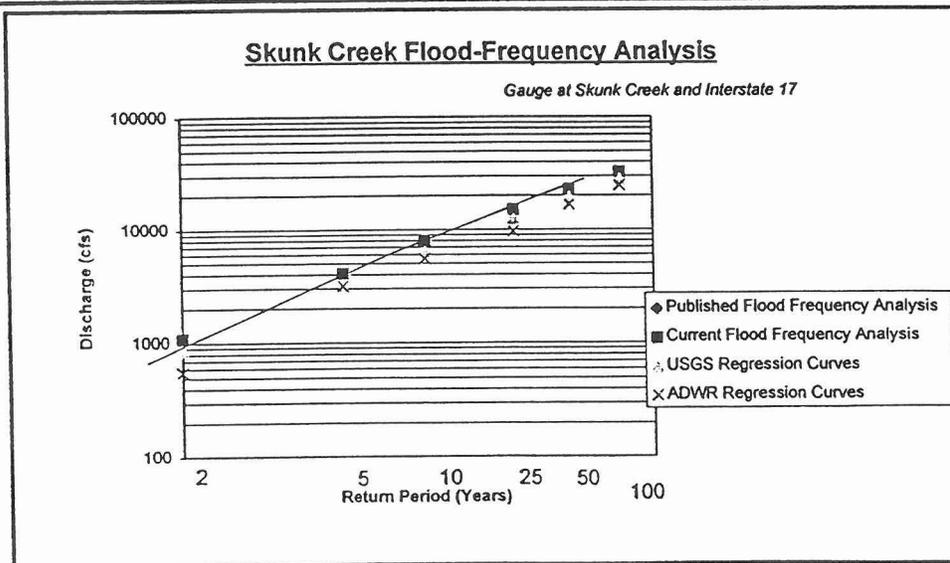
**Location:** Lat 33°43'50", Long 112°07'09" in SE 1/4 Sec.35, T.5 N., R.2E., Maricopa County  
Located on the right bank dike of Skunk Creek flood-control channel, 300 ft east of Interstate 17, 3 miles north of Adobe  
Prior to December 29, 1984, the gauge was located 300 feet downstream.

Water Year	Date	Annual Peak Discharge (cfs)	Water Year	Date	Annual Peak Discharge (cfs)
1960	12/25/59	9400	1978	3/1/78	3590
1961	n/a	0	1979	1/18/79	600
1962	n/a	175	1980	2/20/80	1210
1963	n/a	480	1981	7/16/81	311
1964	8/1/64	11500	1982	10/2/81	281
1965	2/7/65	400	1983	11/30/82	6170
1966	8/18/66	700	1984	9/26/84	565
1967	9/2/67	950	1985	1/26/85	1320
1968	12/19/67	5900	1986	7/22/86	906
1969	n/a	0	1987	10/10/86	3440
1970	9/5/70	9650	1988	11/1/87	2250
1971	8/21/71	4770	1989	1/4/89	111
1972	7/17/72	2380	1990	8/12/90	8160
1973	10/6/72	4700	1991	8/11/91	1250
1974	7/21/74	300	1992	8/23/92	7020
1975	10/29/74	240	1993	1/8/93	4990
1976	7/28/76	13	1994	n/a	0
1977	1/3/77	70			

Note: A zero value indicates that no measurable flow was recorded during that year.

**Comparison of Results**

Return period (years)	Discharge (cfs)					
	2	5	10	25	50	100
Probability Function	0.00	0.84	1.28	1.75	2.05	2.33
Published Flood Frequency Analysis	967	3,570	6,910	13,700	21,200	31,000
Current Flood Frequency Analysis	1,090	4,069	7,776	15,050	22,683	32,455
USGS Regression Curves	873	3,211	6,236	12,313	19,129	27,953
ADWR Regression Curves	562	3,122	5,464	9,559	16,560	24,423



Skunk Creek  
Flood Frequency Analysis

Period of Record 1960-1994  
N = 35 Years

Water Year	Q (cfs)	Rank (m)	Log10 Q (X)	(X-X) <sup>2</sup>	(X-X) <sup>3</sup>	(100m/n+1)
1964	11500	1	4.0607	0.8660	0.8059	3
1970	9650	2	3.9845	0.7301	0.6238	6
1960	9400	3	3.9731	0.7107	0.5992	8
1990	8160	4	3.9117	0.6109	0.4775	11
1992	7020	5	3.8463	0.5130	0.3675	14
1983	6170	6	3.7903	0.4359	0.2878	17
1968	5900	7	3.7709	0.4106	0.2631	19
1993	4990	8	3.6981	0.3226	0.1833	22
1971	4770	9	3.6785	0.3008	0.1650	25
1973	4700	10	3.6721	0.2938	0.1592	28
1978	3590	11	3.5551	0.1806	0.0768	31
1987	3440	12	3.5366	0.1652	0.0672	33
1972	2380	13	3.3766	0.0608	0.0150	36
1988	2250	14	3.3522	0.0493	0.0110	39
1985	1320	15	3.1206	0.0001	0.0000	42
1991	1250	16	3.0969	0.0011	0.0000	44
1980	1210	17	3.0828	0.0022	-0.0001	47
1967	950	18	2.9777	0.0232	-0.0035	50
1986	906	19	2.9571	0.0299	-0.0052	53
1966	700	20	2.8451	0.0812	-0.0231	56
1979	600	21	2.7782	0.1239	-0.0436	58
1984	565	22	2.7520	0.1429	-0.0540	61
1963	480	23	2.6812	0.2015	-0.0904	64
1965	400	24	2.6021	0.2788	-0.1472	67
1981	311	25	2.4928	0.4062	-0.2589	69
1974	300	26	2.4771	0.4264	-0.2784	72
1982	281	27	2.4487	0.4643	-0.3163	75
1975	240	28	2.3802	0.5623	-0.4217	78
1962	175	29	2.2430	0.7869	-0.6980	81
1989	111	30	2.0453	1.1767	-1.2764	83
1977	70	31	1.8451	1.6512	-2.1218	86
						99
<b>TOTAL</b>			97.0326	12.0090	-1.6367	

Note: Years 1961, 1969, 1976 and 1994 deleted from analysis due to no flow record.

$\bar{X} = 3.1301$  (N=31)  
 $S = 0.632694$   
 $G = -0.230265$

Perform test for high and low outliers due to large negative skew and in particular the 1976 and 1977 discharges

$XH = X + KNS$

For a sample size of 35, the value of KN = 2.628

$XH = 4.792804$

$XL = X - KNS$

$XL = 1.467366$

Conclusion: Eliminate the low 1976 value from consideration.

Skunk Creek  
Flood Frequency Analysis

<i>P</i>	<i>KG(-0.2)</i>	<i>KG(-0.3)</i>	<i>KG(-0.23027)</i>	<i>Log10 Q</i>	<i>Q(cfs)</i>	<i>Published Q*</i>	<i>Conditional Adjusted P</i>	<i>Conditional Adj. Log10Q</i>	<i>Conditional Adjusted Q</i>
0.98	-2.1594	-2.2108	-2.1749	1.7540	57		0.8680		
0.9	-1.3011	-1.3094	-1.3036	2.3053	202		0.7971		
0.7	-0.4993	-0.4860	-0.4953	2.8167	656		0.6200	2.5858	385
0.5	0.0333	0.0499	0.0383	3.1543	1,427	967	0.4429	3.0454	1,110
0.3	0.5476	0.5584	0.5508	3.4786	3,010		0.2657	3.4158	2,605
0.2	0.8499	0.8529	0.8508	3.6684	4,660	3,570	0.1771	3.6194	4,163
0.1	1.2582	1.2452	1.2543	3.9237	8,388	6,910	0.0886	3.8907	7,775
0.04	1.6800	1.6433	1.6689	4.1860	15,345	13,700	0.0354	4.1634	14,568
0.02	1.9450	1.8896	1.9282	4.3501	22,390	21,200	0.0177	4.3289	21,325
0.01	2.1784	2.1039	2.1559	4.4941	31,195	31,000	0.0089	4.4755	29,888
0.002	2.6367	2.5174	2.6006	4.7755	59,631		0.0018	4.7664	58,398

Since there is a truncated record for the period due to no flow records, the procedure described in Appendix 5 of "Guidelines For Determining Flood Flow Frequency" is applied.

\* Published in USGS Summary for period 1960-1989

Estimated Probability that annual peak will exceed the truncation level,  $P = N/n$

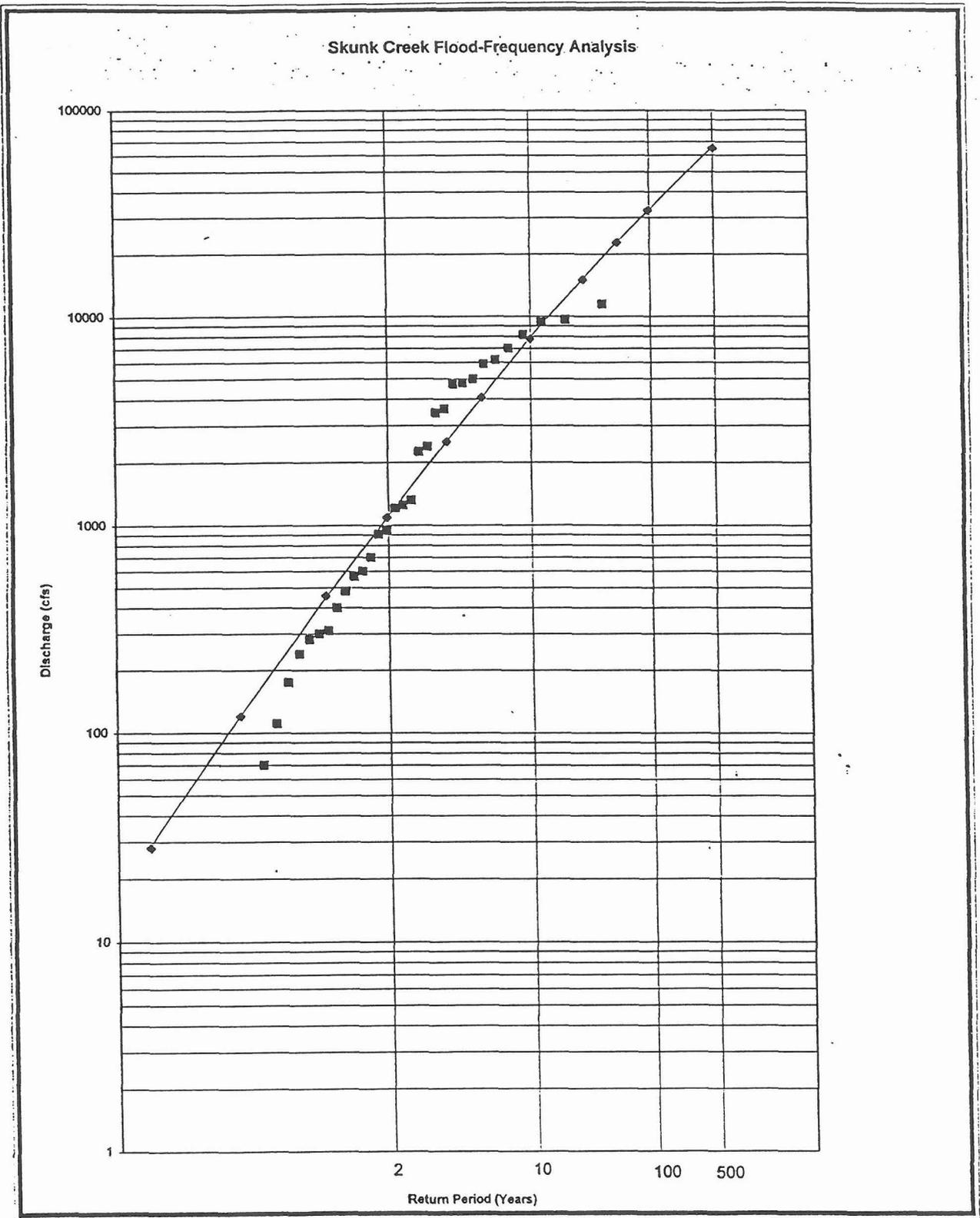
	<u>Computed Values</u>	<u>Published Values*</u>
$P =$	0.8857 (31/35)	
$P_{0.5} =$	1,110 cfs	967 cfs
$P_{0.1} =$	7,775 cfs	6,910 cfs
$P_{0.01} =$	29,888 cfs	31,000 cfs

<u>Synthetic Values</u>	<i>P</i>	<u>KG(-0.3)</u>	<u>KG(-0.4)</u>	<u>KG(-0.34)</u>
$G_s =$	0.5	0.0499	0.0665	0.0568
$S_s =$	0.01	2.1039	2.0293	2.0729
$X_s =$				
$A =$				
$B =$				
$MSEG =$				
$G_w =$	-0.27	0.00	-0.16	

<i>P</i>	<u>KG(-0.2)</u>	<u>KG(-0.3)</u>	<u>KG(-0.28)</u>	<u>Log10 Q</u>	<u>Revised Q(cfs)</u>	<u>Published Q*</u>
0.98	-2.1594	-2.2108	-2.1974	1.4464	28	
0.9	-1.3011	-1.3094	-1.3072	2.0779	120	
0.7	-0.4993	-0.4860	-0.4895	2.6579	455	
0.5	0.0333	0.0499	0.0456	3.0374	1,090	967
0.3	0.5476	0.5584	0.5556	3.3992	2,507	
0.2	0.8499	0.8529	0.8521	3.6095	4,069	3,570
0.1	1.2582	1.2452	1.2486	3.8908	7,776	6,910
0.04	1.6800	1.6433	1.6529	4.1775	15,050	13,700
0.02	1.9450	1.8896	1.9040	4.3557	22,683	21,200
0.01	2.1784	2.1039	2.1234	4.5113	32,455	31,000
0.002	2.6367	2.5174	2.5485	4.8129	64,992	

Skunk Creek  
Flood Frequency Analysis



Skunk Creek  
Flood Frequency Analysis

Period of Record 1960-1989

N = 30

Water Year	Q (cfs)	Rank (m)	Log10 Q (X)	(X-X) <sup>2</sup>	(X-X) <sup>3</sup>	(100m/n+1)
1964	11500	1	4.0607	1.0118	1.0178	3
1970	9650	2	3.9845	0.8644	0.8037	6
1960	9400	3	3.9731	0.8433	0.7745	10
1983	6170	4	3.7903	0.5409	0.3979	13
1968	5900	5	3.7709	0.5127	0.3671	16
1971	4770	6	3.6785	0.3890	0.2426	19
1973	4700	7	3.6721	0.3811	0.2352	23
1978	3590	8	3.5551	0.2503	0.1252	26
1987	3440	9	3.5366	0.2321	0.1118	29
1972	2380	10	3.3766	0.1035	0.0333	32
1988	2250	11	3.3522	0.0884	0.0263	35
1985	1320	12	3.1206	0.0043	0.0003	39
1980	1210	13	3.0828	0.0008	0.0000	42
1967	950	14	2.9777	0.0059	-0.0005	45
1986	906	15	2.9571	0.0095	-0.0009	48
1966	700	16	2.8451	0.0440	-0.0092	52
1979	600	17	2.7782	0.0765	-0.0212	55
1984	565	18	2.7520	0.0917	-0.0277	58
1963	480	19	2.6812	0.1395	-0.0521	61
1965	400	20	2.6021	0.2050	-0.0928	65
1981	311	21	2.4928	0.3159	-0.1775	68
1974	300	22	2.4771	0.3337	-0.1928	71
1982	281	23	2.4487	0.3673	-0.2226	74
1975	240	24	2.3802	0.4551	-0.3070	77
1962	175	25	2.2430	0.6590	-0.5349	81
1989	111	26	2.0453	1.0190	-1.0287	84
1977	70	27	1.8451	1.4634	-1.7703	87
<b>TOTAL</b>			82.4796	10.4083	-0.3026	

Note: Years 1961, 1969, and 1976 deleted from analysis due to no or low flow record.

$\bar{X}$  = 3.0548 (n=27)  
 S = 0.632709  
 G = -0.049619

Skunk Creek  
Flood Frequency Analysis

<i>P</i>	<i>KG(-0.0)</i>	<i>KG(-0.1)</i>	<i>KG(-0.04962)</i>	<i>Log10 Q</i>	<i>Q(cfs)</i>	<i>Published Q*</i>	<i>Conditional Adjusted P</i>	<i>Conditional Adj. Log10Q</i>	<i>Conditional Adjusted Q</i>
0.98	-2.0538	-2.1070	-2.0802	1.7387	55		0.8820		
0.9	-1.2816	-1.2918	-1.2866	2.2407	174		0.8100		
0.7	-0.5244	-0.5121	-0.5183	2.7269	533		0.6300	2.5378	345
0.5	0.0000	0.0166	0.0082	3.0600	1,148	967	0.4500	2.9675	928
0.3	0.5244	0.5362	0.5303	3.3903	2,456		0.2700	3.3353	2,164
0.2	0.8416	0.8461	0.8438	3.5887	3,879	3,570	0.1800	3.5446	3,504
0.1	1.2816	1.2704	1.2760	3.8621	7,280	6,910	0.0900	3.8318	6,788
0.04	1.7507	1.7158	1.7334	4.1515	14,175	13,700	0.0360	4.1301	13,492
0.02	2.0538	1.9997	2.0269	4.3373	21,740	21,200	0.0180	4.3166	20,731
0.01	2.3264	2.2526	2.2897	4.5035	31,882	31,000	0.0090	4.4851	30,554
0.002	2.8782	2.7571	2.8181	4.8378	68,837		0.0018	4.8285	67,380

Since there is a truncated record for the period due to no flow records, the procedure described in Appendix 5 of "Guidelines For Determining Flood Flow Frequency" is applied.

\* Published in USGS Summary for period 1960-1989

Estimated Probability that annual peak will exceed the truncation level,  $P = N/n$

<i>P =</i>	<i>Computed Values</i>	<i>Published Values*</i>
<i>P =</i>	0.9000 (27/30)	
<i>P0.5 =</i>	928 cfs	967 cfs
<i>P0.1 =</i>	6,788 cfs	6,910 cfs
<i>P0.01 =</i>	30,554 cfs	31,000 cfs

<i>Synthetic Values</i>	<i>P</i>	<i>KG(-0.1)</i>	<i>KG(-0.2)</i>	<i>KG(-0.14)</i>
<i>Gs =</i>	0.5	0.0166	0.0333	0.0235
<i>Ss =</i>	0.01	2.2526	2.1784	2.2217
<i>Xs =</i>				
<i>A =</i>				
<i>B =</i>				
<i>MSEG =</i>				
<i>Gw =</i>				

<i>P</i>	<i>KG(-0.1)</i>	<i>KG(-0.2)</i>	<i>KG(-0.16)</i>	<i>Log10 Q</i>	<i>Revised Q(cfs)</i>	<i>Published Q*</i>
0.98	-2.1070	-2.1594	-2.1256	1.4838	30	
0.9	-1.2918	-1.3011	-1.2951	2.0571	114	
0.7	-0.5121	-0.4993	-0.5075	2.6008	399	
0.5	0.0166	0.0333	0.0225	2.9668	926	967
0.3	0.5362	0.5476	0.5403	3.3242	2,110	
0.2	0.8461	0.8499	0.8474	3.5363	3,438	3,570
0.1	1.2704	1.2582	1.2661	3.8253	6,688	6,910
0.04	1.7158	1.6800	1.7031	4.1270	13,397	13,700
0.02	1.9997	1.9450	1.9803	4.3184	20,815	21,200
0.01	2.2526	2.1784	2.2262	4.4882	30,772	31,000
0.002	2.7571	2.6367	2.7143	4.8251	66,851	

**Regional Regression Equations - USGS Roeske Method**

The following estimates are in accordance with the report entitled "Methods for Estimating the Magnitude and Frequency of Floods In Arizona." developed by R.H. Roeske at the U.S.G.S.

From Figure 1, the Skunk Creek Watershed lies within the Central Mountain Area

$Q2 = 5.66 A^{.673} E^{-0.605} p^{1.03}$   
 $Q5 = 31.6 A^{.650} E^{-0.868} p^{0.987}$   
 $Q10 = 74.7 A^{.638} E^{-1.00} p^{0.971}$   
 $Q25 = 186 A^{.626} E^{-1.14} p^{0.933}$   
 $Q50 = 329 A^{.617} E^{-1.22} p^{0.915}$   
 $Q100 = 553 A^{.610} E^{-1.3} p^{0.915}$   
 $Q500 = 1,530 A^{.595} E^{-1.45} p^{0.886}$

TOTAL OF ALL SUB-BASINS (A)	64.028 Square Miles
AVERAGE WATERSHED ELEVATION (E)	2.21 feetx1000
AVERAGE ANNUAL PRECIPITATION (p)	14 inches

Q2 =	873 cfs
Q5 =	3,211 cfs
Q10 =	6,236 cfs
Q25 =	12,313 cfs
Q50 =	19,129 cfs
Q100 =	27,953 cfs
Q500 =	59,773 cfs

**Regional Regression Equations - ADWR Method**

The following estimates are based upon procedures established in the ADWR Draft publication entitled "State Standard for Estimating Peak Discharges on Ungaged Rural Watersheds"

According to Figure 1 the Skunk Creek watershed lies within Region 12

TOTAL OF ALL SUB-BASINS (A)	64 Square Miles
AVERAGE WATERSHED ELEVATION (E)	2.21 feetx1000
AVERAGE ANNUAL PRECIPITATION (p)	14 inches

$Q2 = 41.1A^{0.629}$   
 $Q5 = 238 A^{0.687} E^{-0.358}$   
 $Q10 = 479 A^{0.661} E^{-0.398}$   
 $Q25 = 942 A^{0.63} E^{-0.383}$   
 $Q50 = 10^{(7.36-4.17 A^{-0.08})} E^{-0.440}$   
 $Q100 = 10^{(6.55-3.17 A^{-0.11})} E^{-0.454}$

Q2 =	562 cfs
Q5 =	3,122 cfs
Q10 =	5,464 cfs
Q25 =	9,559 cfs
Q50 =	16,560 cfs
Q100 =	24,423 cfs

Skunk Creek  
Flood Frequency Analysis

Summary of Drainage Sub-Basins

<u>Sub-basin Name</u>	<u>Drainage Area(mi^2)</u>						
S-1	2.08	U-1	2.53	C-1	1.26	R-1	1.56
S-2	1.174	U-2	1.596	C-2	2.15	R-2	1.98
S-3	1.03	U-3	0.843	C-3	1.25	R-3	1.59
S-4	0.97	U-4	2.795	C-4	2.55		
S-5	1.85	U-5	3.251	C-5	3.38		
S-6	0.936	U-6	0.704	C-6	2.25		
S-7	0.681	U-7	1.467	C-7	1.18		
S-8	1.121			C-8	1.42		
S-9	1.021			C-9	0.53		
S-10	1.801						
S-11	0.92						
S-12	0.91						
S-13	1.271						
S-14	0.833						
S-15	0.987						
S-16	1.318						
S-17	1.033						
S-18	1.713						
S-19	0.772						
S-20	1.273						
S-21	2.221						
S-22	1.467						
S-23	1.72						
S-24	0.64						
<b>TOTALS</b>	<b>29.742</b>		<b>13.186</b>		<b>15.97</b>		<b>5.13</b>

Average Basin Elevation Estimation

<u>Union Hills Node Pt.</u>	<u>Rodger Node Pt.</u>	<u>Cline Node Pt.</u>	<u>U. Skunk Node Pt.</u>	<u>L.Skunk Node Pt.</u>
2206	2447	2570	1920	2018
2410	2600	2447	1967	1856
1899	2550	2206	2040	1868
1650	2139	2210	2940	1786
1546	1994	2227	2242	1812
1581	1920	2410	2083	1821
1573		2600	2180	1729
1620		2810	2298	1927
1681		3160	2281	1812
1740		2576	2160	1629
1970		2639	2218	1586
1731		2670	2360	1495
1646		3040	2471	
1633		3080	3709	
1710		4540	2680	
1790			2380	
			2309	
			2702	
			2560	
<b>Average</b>	<b>1774</b>	<b>2275</b>	<b>2746</b>	<b>2371</b>

Average of All Watersheds                      2207 feet



**MONTGOMERY WATSON**

**MEETING MINUTES**

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**Project:** Skunk Creek Floodplain  
Delineation Study FCD 95-16

**Date:** November 9, 1995

**Time:** 9:30 a.m.

**Place:** FCDMC

**Subject:** Kick-off Meeting

**Reference:** 1213.0050

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**Attendees:**

Pedro Calza  
Hasan Mushtaq  
Fred Duren  
Laurie Miller  
Chip Paulson  
Paul Hoskin

**Affiliation:**

FCDMC  
FCDMC  
Montgomery Watson  
Montgomery Watson  
Montgomery Watson  
HEC

**Discussion:**

A kick-off meeting was held to initiate the Skunk Creek Floodplain Delineation Study (FCD 95-16). The discussion is summarized below by agenda item. The meeting agenda is attached.

**INTRODUCTION**

Fred Duren introduced the project team. He is the project manager and Laurie Miller will act as project engineer. All technical contact should go through Laurie.

Chip Paulson will focus on the hydrologic portion of the project, but will also be involved in the floodplain delineations as well. Paul Hoskin will assist Montgomery Watson in portions of the hydrologic and hydraulic elements of the project.

Kenney Aerial Mapping, Inc., will perform the aerial photography and Collins-Piña (CPE) will perform the ground survey tasks

Hasan Mushtaq will manage the project for the District. All submittals should be directed to him, except billings. Invoices should be sent directly to Lovetta Henry, with a copy to Hasan.

**PROJECT OVERVIEW**

Laurie presented an overview of the project, including a statement of goals. It was stated that the project goal is to prepare new topographic mapping, perform a hydrology study, and prepare new floodplain delineations for a portion of Skunk Creek from the CAP Aqueduct to the community of New River. Major elements of the project were discussed, as summarized below.

### Initial Activities

Public notification and obtaining any necessary Rights of Entry were discussed. The District's public relations staff will be responsible for public coordination and will schedule and notify the public of the initial public meeting. The District will provide a sample public notice and Montgomery Watson will arrange to have the notice published in a local and a widely-published paper. Jim Phipps can assist in identifying local newspapers.

Montgomery Watson will obtain locations of proposed panel points from CPE and forward them to the District. The District will then provide a list of homeowners who may be affected by surveying of the panel points, and a sample letter of notification for Montgomery Watson to distribute to the affected homeowners.

The first of two field trips is scheduled at the conclusion of the kickoff meeting. Hasan, Laurie, Chip, and Paul will attend. Of particular interest will be the CAP Aqueduct overchutes, the 7th Avenue crossing, and the New River Road bridge crossing which is currently under construction. At the second field trip, the District will invite Dave Creighton with the Arizona Department of Water Resources to attend. The District stated that ADWR will not be asked to review the hydrology and hydraulics prepared for this project.

The first quarterly estimation of project billings was presented to the District and covers the period ending December 31, 1995 (attached).

Montgomery Watson reported that it is in the process of finalizing subcontracts with Kenney Aerial Mapping, CPE, and HEC.

### Data Collection

A number of documents pertinent to the project have been collected. Laurie will fax a list of documents obtained to Hasan to avoid duplication of effort. A partial list of data needs was distributed (attached). The District will provide the following information, some of which were included on the list:

- verification of plans for the modification of the Carefree Highway bridge
- digital soils and land use data
- soils data previously collected in the Tonto National Forest
- channel transmission loss data
- new topographic mapping from Del Webb
- report on the modifications to the loss rate parameters for Cline and Rodger Creek watersheds
- HEC-2 model (disk and hard copy, if available) of existing study
- CAD standards

In addition to the above, Hasan will provide preliminary models of the modified Cline and Rodger Creeks watersheds right away and the final modified models by February 1, 1996. The calibration methodology will be provided by January 1, 1996.

### Topographic Mapping

Montgomery Watson reiterated that the limits of new mapping extend from the CAP Aqueduct to existing cross-section CN, which is upstream of the New River Road bridge crossing. The new mapping excludes approximately 2.3 miles of new mapping being prepared by Del Webb for a new development.

The District asked Montgomery Watson verify that the downstream limit of the new mapping meets or overlaps the mapping done for the Coe & Van Loo Study. Also, the District would like a continuous digital terrain model (DTM) and suggested that Kenney Aerial be responsible for combining the two models since they did the mapping for the Del Webb portion.

### **Hydrologic Study**

The District directed that the same calibration procedures be used for the hydrologic model as that for Cline and Rodger Creeks. Hasan cautioned that the results will change because the uniform loss rate method was used in the original models and the Green & Ampt method is used currently.

The District reiterated that one of our objectives in the hydrology study is to calibrate new peak discharges to the currently adopted discharges, within the limits of the District's approved modeling parameters and procedures.

The District will provide the soil survey information for the study area, except for the Tonto National Forest area.

The District stated that Russ Cruff performed a regional discharge study that could be used to cross-check peak flows developed in the study. Hasan will check on this.

Montgomery Watson requested any information the District has on channel transmission losses.

### **Determine Study Direction**

It was agreed that the extent of new floodplain delineations, if required, will be determined from the results of mapping, hydrologic, and hydraulic comparisons, and other factors not yet identified. Once the extent of new delineations is determined, the scope of work for Phase II of the project will be finalized.

### **Floodplain Delineations**

The District has a hard copy of the existing HEC-2 model. The model may be available on disk, but would have been run using an older version of HEC-2. Hasan will run the model using the latest version of HEC-2 to determine if there are any changes to the results.

There was discussion on the use of HEC-RAS vs. HEC-2 for the floodplain delineation tasks. The District will allow the use of either program for this project.

### **Data Conversion**

The District now has CAD standards and will provide a copy. The standards include layer names and order.

The District cautioned against "dangling nodes" in the digital data conversion task. All features must close, or "snap" so that there are no open polygons.

Individual HIS products can be delivered whenever complete; it is not necessary to wait until the end of the project to deliver all HIS products at one time.

## **PROJECT MANAGEMENT**

Montgomery Watson submitted the following items for the District's review and approval:

- sample monthly progress report (attached)
- sample invoice (attached)
- quarterly billing report (attached)

The District approved the format of the monthly progress report. The sample invoice also appeared to be acceptable, but will be verified with the District's billing department.

The District requested that coordination meetings be scheduled on Tuesday, Wednesday, or Thursday mornings, if possible.

## **PROJECT SCHEDULE**

A revised project schedule was distributed, which is based on an assumed written Notice to Proceed of November 9, 1995 (attached). As of the meeting, written notice had not been received.

## **DELIVERABLES**

A proposed list of deliverables and estimated due dates was distributed (attached).

## **ACTION ITEMS**

- The District will provide a sample public notice.
- Montgomery Watson will have the notice published in the papers identified by Jim Phipps.
- Montgomery Watson will obtain locations of proposed panel points and forward them to the District.
- The District will provide a list of homeowners and sample notification letter.
- Montgomery Watson to fax to the District a list of documents obtained.
- The District will provide preliminary models of the modified Cline and Rodger Creeks watersheds.
- The District will provide the regional discharge study for cross-check of flows, if available.
- The District will provide SCS soil survey information for the watershed area outside of the Tonto National Forest, and will obtain soil parameters from Michael Baker for those areas inside the Tonto National Forest.
- The District will provide its CAD standards for use by Montgomery Watson.

The preceding minutes were prepared by Laurie Miller and are her interpretation/understanding of the issues discussed therein. Meeting attendees are asked to advise her in writing or verbally of any discrepancies and/or omissions.

Attachments

## KICK-OFF MEETING AGENDA

### Flood Control District of Maricopa County SKUNK CREEK FLOODPLAIN DELINEATION STUDY

November 9, 1995

#### A. INTRODUCTION

1. Attendees
2. Project Team Responsibilities

#### B. PROJECT OVERVIEW

1. Goal: Prepare topographic mapping, perform a hydrology study, and prepare floodplain delineations for a portion of Skunk Creek from the CAP Aqueduct to the community of New River
2. Initial Activities
  - a. Public Notification
  - b. Obtain Rights of Entry
  - c. Field Trip
  - d. Quarterly Estimation of Projected Billing
  - e. Revised Project Schedule
  - f. Finalize Subcontracts
3. Data Collection  
(partial list attached)
4. Topographic Mapping
  - a. Limits of Mapping
  - b. Comparison of Existing and New Mapping
5. Hydrologic Study
  - a. Rainfall Excess Calculations
  - b. Comparison of Hydrologic Results
6. Determine Study Direction
  - a. Evaluate Mapping, Hydrologic, and Other Factors
  - b. Finalize Phase II Scope of Work
7. Floodplain Delineations
  - a. Cross-section Selection
  - b. HEC-2 Model Development
  - c. Comparison of Floodplains
8. Data Conversion

#### C. PROJECT MANAGEMENT

1. Monthly Progress Report Format
2. Billing Format

**D. PROJECT SCHEDULE**

1. Coordination Meetings
2. Milestone Dates
3. Public Meetings

**E. DELIVERABLES**

1. List Attached with Approximate Delivery Dates

**F. OTHER**

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
SKUNK CREEK FLOODPLAIN DELINEATION STUDY  
FCD 95-16

QUARTERLY PROJECTED BILLING REPORT NO. 1

SECOND FISCAL QUARTER (Oct. - Dec. 1995)

Task 1 - Coordination	15%
Task 2 - Data Collection	85%
Task 3 - Topographic Mapping	20%
Task 4 - Field Survey	55%
Task 5 - Hydrology	45%
Task 6 - Existing Hydraulic Model Review	0%
Task 7 - Decision Study Direction	0%
Task 8 - Floodplain Delineation	0%
Task 9 - HIS Data	0%
Task 10 - Deliverables	0%
Task 11 - Quality Assurance/Quality Control	20%
Other Direct Costs	20%
<b>Second Fiscal Quarter Projected Billing</b>	<b>\$ 46,000</b>

### **Partial List of Data Collection Requirements**

1. Previous Flood Hazard and Hydrology Reports
2. Historical Flooding Information
3. Record Drawings for Existing Structures, if any
4. Design Drawings for New River Road Bridge
5. Hydrologic Models for Cline and Roger Creeks
6. Floodplain Delineations for Del Webb Development
7. Current Hydrologic/Hydraulic Models, if available
8. Streamgage Data at I-17 Crossing
9. Other

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
SKUNK CREEK FLOODPLAIN DELINEATION STUDY  
FCD 95-16**

**MONTHLY PROGRESS REPORT  
\_\_\_\_\_ 1995**

1. **Work Accomplished During the Month of \_\_\_\_\_.**

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2. **Work Completed by Task**

<b>Task</b>	<b>% Complete This Month</b>	<b>% Complete to Date</b>
1. Coordination		
2. Data Collection		
3. Topographic Mapping		
4. Field Survey		
5. Hydrology		
6. Existing Hydraulic Model Review		
7. Decision on Study Direction		
8. Floodplain Delineation		
9. HIS Data		
10. Deliverables		
11. Quality Control		



Flood Control District  
of Maricopa County  
2801 West Durango  
Phoenix, AZ 85009

Attention: Accounts Payable

Date: \_\_\_\_\_, 1995

Invoice No.: AZxxxx

Contract No.: CxxxxE001/002

Job No.: 1213.00xxxx

FOR PROFESSIONAL SERVICES RENDERED DURING PERIOD OF 09-NOV-1995 THRU  
25-NOV-1995

To perform a Skunk Creek Wash Floodplain Delineation Study, in accordance with our Contract No.  
FCD 95-16, dated September 29, 1995.

**Phase I**

xx% of Fixed Lump Sum of	\$ 147,000	\$ xx.00
Less xx% Previously Invoiced		<u>xx.00</u>
Total Phase I		\$ xx.00

**Phase II**

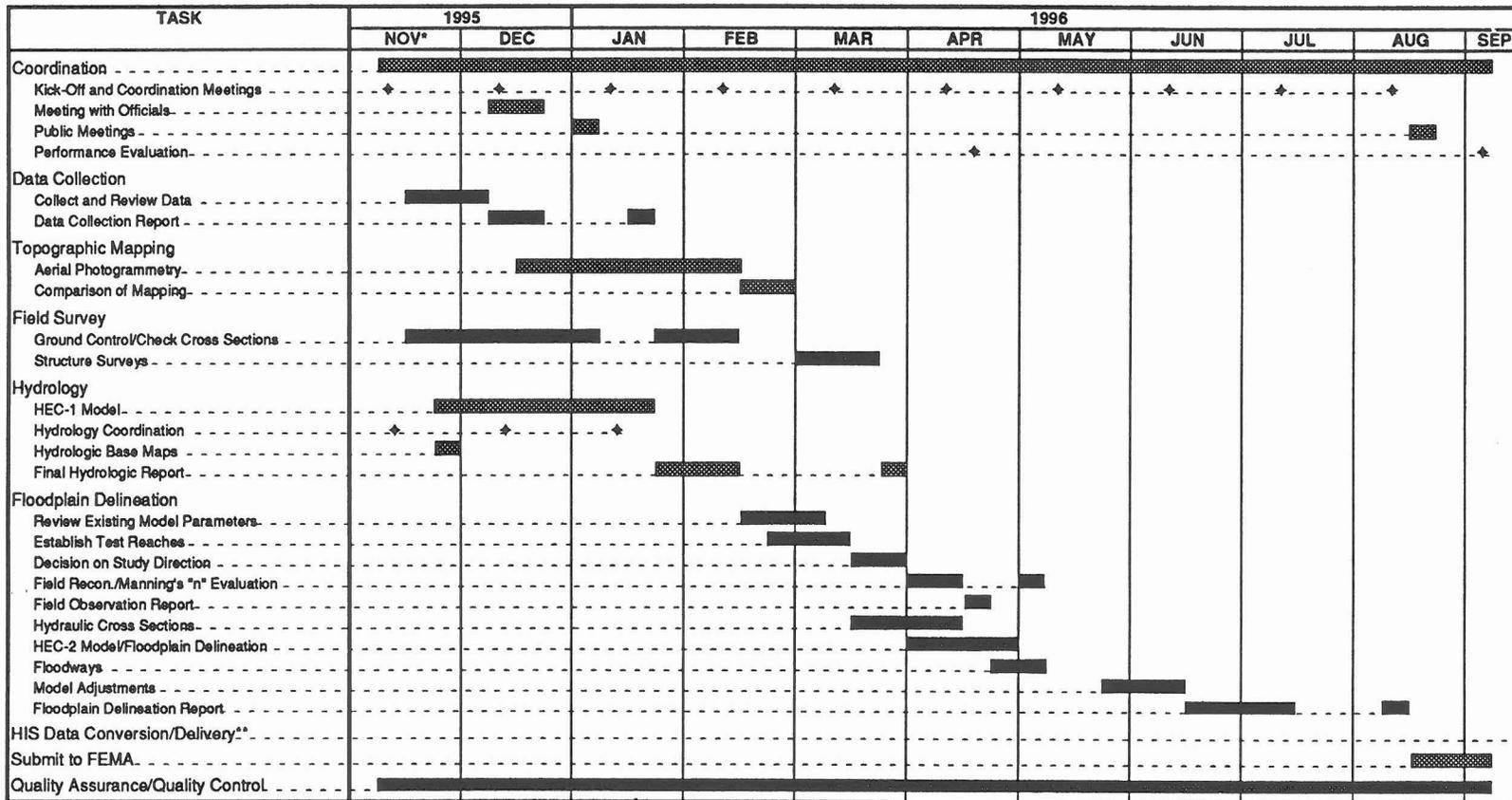
xx% of Fixed Lump Sum of	\$ 62,900	\$ xx.00
Less xx% Previously Invoiced		<u>xx.00</u>
Total Phase II		\$ xx.00

Total All Phases	\$ xx.00
10% Retention	(\$ xx.00)
Total Amount This Invoice	\$ xx.00

Total Contract Amount	\$ 209,900.00
Total Amount Billed to Date	\$ xx.00
Less Amount Previously Paid	\$ xx.00
Total Amount Due	\$ xx.00

Please Note: This is an invoice for professional services and is due payable by 9-DEC-1995. A charge of 18.00% per year will be added to past due accounts.

**PROJECT SCHEDULE**  
**SKUNK CREEK FLOODPLAIN DELINEATION PROJECT**  
**FCD 95-16**  
**Revised 11/9/95**



\*Assumed Notice-to-Proceed 11-9-95.  
 \*\* Completion assumed 3 months following FEMA approval.

**Skunk Creek Floodplain Delineation Study  
List of Deliverables**

<u>Deliverable</u>	<u>Estimated Delivery Date</u>
1. Quarterly Projected Billings	Quarterly
2. Monthly Project Reports	Monthly
3. Affidavits of Public Notification	11-30-95
4. List of Property Owners Notified	11-30-95
5. Meeting Minutes	N/A
6. Data Collection Report	1-19-96
7. Topographic Base Maps	2-15-96
8. Report of Topographic Mapping Comparison	2-29-96
9. Sub-Basin Delineation Maps	11-30-95
10. Hydrologic Parameter Estimation	12-15-95
11. Hydrologic Report	3-30-96
12. Summary of Hydraulic Model Review	2-29-96
13. Field Reconnaissance Report	4-19-96
14. Hydraulics Report	8-16-96
15. Technical Data Notebook	8-16-96
16. FEMA Forms	8-16-96
17. Digital Terrain Model	8-16-96
18. Survey Notes	8-16-96
19. Floodplain Delineation Panels	8-16-96
20. Final Approved Deliverables	*

\*Assumed 3 months following FEMA approval.

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## Appendix C

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**MONTGOMERY WATSON**

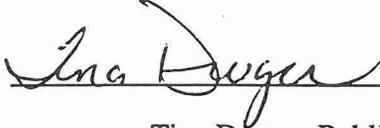
# AFFIDAVIT OF PUBLICATION

## COPY OF NOTICE

ANNOUNCEMENT OF  
FLOOD HAZARD  
STUDY AND  
PUBLIC MEETING

State of Arizona }  
County of Maricopa } ss.

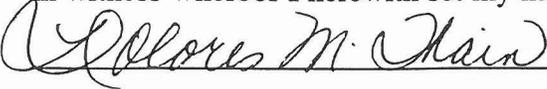
I, **Tina Dwyer** being duly sworn, depose and say that I am Publisher of the Foothills Sentinel, a weekly newspaper of general circulation and published every Wednesday at Cave Creek, Maricopa County, Arizona, and that the notice attached hereto, was published in said newspaper for Two consecutive weeks, the first publication having been made on 12/13/95 and the last on 12/20/95. That said notice was published in the regular and entire issue of every number of the paper during the period and times of publication, and that the same was published in the newspaper proper and not supplement.

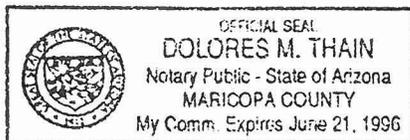
  
Tina Dwyer, Publisher

State of Arizona }  
County of Maricopa } ss.

This instrument was acknowledged before me this 8<sup>th</sup> day of January, 19 96, by TINA DWYER.

In witness whereof I herewith set my hand and official seal.

, Notary Public.



**400 Legal Notices**

MARCH 12, 1996

REFERENDUM ON ORDINANCE 94-16;  
PROPOSITION 100

NOTICE is hereby given that the Town of Carefree will hold a Special Election on Tuesday, March 12, 1996 to refer Ordinance 94-16, rezoning the northwest corner of Cave Creek Road and Carefree Highway from residential to commercial zoning, to vote of the registered voters of Carefree. The ballot will refer to this matter as Proposition 100. The sole polling place will be the Town Hall, 100 Easy Street in Carefree.

**PROPOSITION 100**

A "yes" vote shall have the effect of causing Ordinance 94-16 to be adopted, thereby authorizing the change of the zoning designation from R1-35 Single Family Residential to C-2 Commercial on parcel number 211-47-6B.

A "no" vote shall have the effect of preventing Ordinance No. 94-16 from being adopted, thereby preventing a change of zoning designation on parcel 211-47-6B from R1-35 Single Family Residential to C-2 Commercial.

**PUBLICITY PAMPHLET**

A publicity pamphlet will be printed and mailed to all carefree voters and will contain: the full text of Ordinance 94-16, a sample ballot, and arguments submitted for and against Proposition 100. (Ordinance 94-16).

ARGUMENTS IN SUPPORT OF OR OPPOSITION TO PROPOSITION 100 MUST BE FILED WITH TOWN CLERK DIANE THREADGILL, BY 5:00 P.M. ON MONDAY, JANUARY 15, 1996 AND MUST MEET THE FOLLOWING REQUIREMENTS FOR ACCEPTANCE AND INCLUSION IN THE PUBLICITY PAMPHLET:

1. THEY MUST RELATE TO THE PROPOSITION REFERRED BY REFERENDUM
2. THEY MUST IDENTIFY THE PROPOSITION TO WHICH THEY REFER AND INDICATE WHETHER THE ARGUMENT IS IN SUPPORT OF OR OPPOSITION TO THE PROPOSITION.
3. THEY MAY NOT EXCEED THREE HUNDRED (300) WORDS IN LENGTH.
4. THEY MUST BE SIGNED BY THE PERSON OR PERSONS WHO SUBMIT THEM. ALL PERSONS SIGNING DOCUMENTS SHALL INDICATE THEIR RESIDENCE OR POST OFFICE BOX.
5. NO PERSON OR ORGANIZATION SHALL SUBMIT MORE THAN ONE ARGUMENT.
6. EACH ARGUMENT SHALL BE ACCOMPANIED BY

**400 Legal Notices**

A DEPOSIT IN THE AMOUNT OF \$250 TO OFFSET PROPORTIONAL COSTS OF PRINTINGS. THIS REQUIREMENT SHALL NOT BE WAIVED ON ANY ACCOUNT.

Published Foothills Sentinel: 12-20, 12-27, 95.

**Public Notice**

**ANNOUNCEMENT OF FLOOD HAZARD STUDY AND PUBLIC MEETING**

The Flood Control District of Maricopa County, under authority of the National Flood Insurance Act of 1968 (P.L. 90-448), as amended, and the Flood Disaster Protection Act of 1973 (P.L. 93-234), is funding a detailed study of flood hazard areas in The Skunk Creek Wash Area, from the CAP Canal to approximately New River Road. The study is being performed for the Flood Control District by Montgomery Watson.

The purpose of this study is to examine and evaluate flood hazard in areas which are developed or are likely to be developed, and to determine flood elevations for those areas. These flood elevations will be used by Maricopa County to carry out floodplain management and by the Federal Emergency Management Agency to determine flood insurance rates under the National Flood Insurance Program.

This announcement is intended to notify all interested persons of the commencement of this study so that they may have an opportunity to bring any relevant facts and technical data concerning local flood hazards to the attention of the Flood Control District for consideration in the course of this study. Such information should be addressed to Mr. Hasan Mushtaq, Flood Control District of Maricopa County, 2801 W. Durango Street, Phoenix Arizona 85009, telephone (602) 506-1501, fax (602) 506-4601.

A public meeting will be held from 4:30 to 7:00 pm on January 3, 1996, in the library of Desert Mountain Middle School, 35959 N. 7th Ave. Representatives of the Flood Control District of Maricopa County and Montgomery Watson will be present to inform the public of the purpose and scope of the study.

Published Foothills Sentinel: 12-13, 12-20, 95.

**Public Notice**

**APPLIANCE EXPRESS, INC.  
ARTICLES OF INCORPORATION**

We, the undersigned, for the purpose of forming a corporation under and by virtue of the laws of the State of Arizona, do hereby adopt the following article of incorporation:

**400 Legal Notices**

1. NAME. The name of the corporation is Appliance Express, Inc.
2. KNOWN PLACE OF BUSINESS. The known place of business and mailing address of the corporation shall be 2158 W. Tonto Lane, Phoenix, AZ 85027.
3. PURPOSE. The purpose of which the corporation is organized is the transaction of any or all lawful business for which corporate may be incorporated under the laws of the State of Arizona as they may be amended from time to time.
4. INITIAL BUSINESS. Appliance Repair and sales.
5. STATUTORY AGENT. The name and address of the Initial Statutory Agent, a bona fide resident of Arizona for three years is: Steve Slipek, 2158 W. Tonto Lane, Phoenix, AZ 85027.
6. BOARD OF DIRECTORS. The initial Board of Directors shall consist of two (2) Directors. (Only one director is required.) The person(s) who are to serve as Directors until the first annual meetings of shareholders or until their successors are elected and qualified are:  
  
Steve Slipek, 2158 W. Tonto Lane,  
Phoenix, AZ 85027.  
Brenda Slipek, 2158 W. Tonto Lane,  
Phoenix, AZ 85027.
7. INCORPORATORS. The names and address of the incorporators are:  
  
Jeff Schwartz, 1324 W. Michigan,  
Phoenix, AZ 85023.  
Steve Slipek, 2158 W. Tonto Lane,  
Phoenix, AZ 85027.
8. INDEMNIFICATION OF OFFICERS, DIRECTOR, EMPLOYEES, AND AGENTS. Subject to the further provision hereof, this corporation shall indemnify any person who incurs expenses by reason such person acting as an officer, director, employee, or agent of this corporation. This indemnification shall be mandatory in all circumstances in which indemnification is permitted by law.
9. EXEMPTION OF PRIVATE PROPERTY. The private property of the incorporators, directors, officers, and members of this corporation shall be forever exempt from its corporate debts, obligations, and liabilities.
10. AUTHORIZED CAPITAL. The aggregate number of shares which the corporation shall have the authority to issue is one million (1,000,000) shares of One Dollar (\$1.00) par value common stock.

Jeffrey A. Schwartz Steve Slipek

Dated: 10-3-95.

I, Steve Slipek, having been designated to act as statutory agent, hereby consent to act in that capacity until removed or resignation is submitted in accordance with Arizona Revised Statutes.

Steve Slipek, 10-3-95.

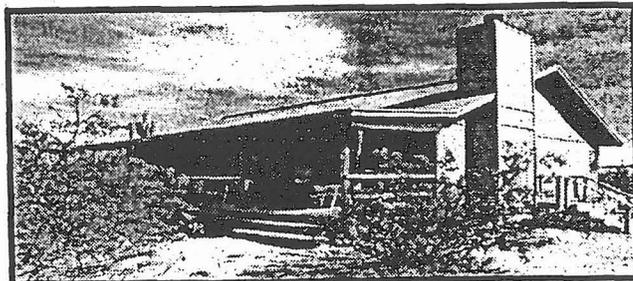
Published Foothills Sentinel: 12-13, 12-20, 12-27, 95.

**total home conc**



**Agatha Lipowicz  
Featured Realtor**

Does quiet country living & room to spread out on appeal to you? Call Agatha. Professional service you can count on - in Desert Hills & New River!



**Super New River Location Surrounded By Mountains!**  
Energy efficient 2 bedroom/2 bath ranch on 2.5 acres in a beautiful location just north of Circle Mountain Rd. 1355sf, open floor plan, island kitchen, custom oak cabinets, fireplace.

**FREE  
Classified  
Ads**

- Any item or items for sale \$99 or less
- All Lost and Found ads
- Buy 3, get 1 FREE  
Run your ad 3 times and we'll run it a 4th time free of charge.

The Arizona Republic/The Phoenix Gazette

INVOICE NO. 95532  
**ANNOUNCEMENT OF FLOOD HAZARD STUDY AND PUBLIC MEETING**  
 The Flood Control District of Maricopa County, under authority of the National Flood Insurance Act of 1968 (P.L. 90-448), as amended, and the Flood Disaster Protection Act of 1973 (P.L. 93-234), is funding a detailed study of flood hazard areas in The Skunk Creek Wash Area, north of CAP canal. The study is being performed for the Flood Control District by Montgomery Watson.

The purpose of this study is to examine and evaluate flood hazard in areas which are developed or which are likely to be developed, and to determine flood elevations for those areas. These flood elevations will be used by Maricopa County to carry out floodplain management and by the Federal Emergency Management Agency to determine flood insurance rates under the National Flood Insurance Program.

This announcement is intended to notify all interested persons of the commencement of this study so that they may have an opportunity to bring any relevant facts and technical data concerning local flood hazards to the attention of the Flood Control District for consideration in the course of this study. Such information should be addressed to Mr. Hasan Mushtaq, Flood Control District of Maricopa County, 2801 N. Durango Street, Phoenix, Arizona 85009, telephone (602) 506-1501, fax (602) 506-4801. A public meeting will be held from 4:30 to 7:00 p.m. on January 3, 1996, in the library of Desert Mountain Middle School, 35959 N. 7th Ave. Representatives of the Flood Control District of Maricopa County and Montgomery Watson will be present to inform the public of the purpose and scope of the study.

Published: Arizona Republic/Phoenix Gazette, December 14, 28, 1995.

STATE OF ARIZONA }  
 COUNTY OF MARICOPA } SS.

TOM BIANCO, being first duly sworn, upon oath deposes and says: That he is the legal advertising manager of the Arizona Business Gazette, a newspaper of general circulation in the county of Maricopa, State of Arizona, published at Phoenix, Arizona, by Phoenix Newspapers Inc., which also publishes The Arizona Republic and The Phoenix Gazette, and that the copy hereto attached is a true copy of the advertisement published in the said paper on the dates as indicated.

The Arizona Republic  
 The Phoenix Gazette

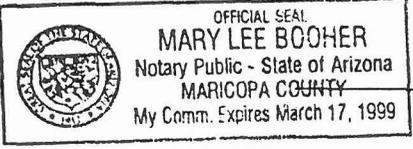
DECEMBER 14, 28, 1995

*Tom Bianco*

Sworn to before me this

28TH day of

DECEMBER A.D. 19 95



*Mary Lee Booher*

Notary Public



MONTGOMERY WATSON

November 30, 1995

Mr. Jack A. Colaric  
8526 E. Hazelwood St.  
Scottsdale, AZ 85251

**Re : Right of Entry for Surveying Purposes**

Dear Property Owner :

The Flood Control District of Maricopa County has contracted with Montgomery Watson to perform a flood delineation study for the Skunk Creek Wash area. The project boundary extends from the CAP Aqueduct to the New River mountains to the north. The purpose of this study is to determine flood-related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcels of land within the limits of the study area.

The intent of this letter is to notify you of the commencement of surveying activities in support of the above-mentioned study. In order to perform these surveys, it may be necessary to enter your property. This activity should not result in any inconvenience or damage to the property. If you have any objections to the entry onto your property, would you notify Mr. Hasan Mushtaq of the Flood Control District at 506-1501. Otherwise, it will be assumed that you consent to the entry onto your property.

The re-study and resulting maps will be used for floodplain management purposes and submitted to the Federal Emergency Management Agency for flood insurance information and revisions of Flood Insurance Rate Maps. This study should be available to the public in approximately 18 months.

The Flood Control District and its representatives appreciate your help in assuring the accuracy of this study by allowing access to your property for the surveyors and by providing any information you may have regarding past flooding or related problems.

If you have any questions regarding this study or the right of entry, please contact Mr. Hasan Mushtaq of the Flood Control District or Ms. Laurie Miller of Montgomery Watson.

Mr. Hasan Mushtaq, Hydrologist, Flood Control District, (602) 506-1501.  
Ms. Laurie Miller, Supervising Engineer, Montgomery Watson, (602) 954-6781.

Very truly yours,

Fred K. Duren, Jr., P.E., P.G.  
Project Manager

c: Hasan Mushtaq  
1213.0050.3.1.6



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

BOARD OF DIRECTORS  
Betsy Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

**News Release**  
**Public Meeting Announcement**  
**Skunk Creek Floodplain Delineation Study**

The Flood Control District of Maricopa County invites interested people to attend a public open house presenting floodplain delineation information on:

January 3, 1996  
Wednesday  
4:30 - 7:00 pm

Desert Mountain Middle School (Media Center)  
35959 N. 7th Avenue  
7th Ave. so of Cloud Rd, approx. 1/2 mile north of  
Carefree Highway, (Desert Hills area)

Maps of the creek and study area will be displayed. Representatives from the Flood Control District and the engineering consulting firms will be available to discuss the study process and answer questions.

Floodplain delineation involves developing detailed topographic maps to determine where water goes, while incorporating the results of studying rainfall patterns to determine typical and peak amounts of runoff. Along with extensive surveying and aerial mapping, drainage factors such as slope, vegetation, soil composition and land use are analyzed and included. The studies will be used to better manage the floodplain to reduce or prevent flood damage and maintain the integrity of the floodplains. Some areas may be designated for further analysis.

Additional information about the project or meeting may be obtained by contacting:

**Sandy Walchuk, Public Involvement Coordinator, or**  
**Hasan Mushtaq, Project Manager, at the Flood Control District, 506-1501**

A sign language interpreter will be made available upon request with 72 hours' notice. Alternative format materials or FM or Infra-Red Listening Devices are also available upon request with 72 hours' notice. Additional reasonable accommodations will be made available to the extent possible within the time frame of the request. Please contact David A. Brozovsky, Flood Control District ADA Coordinator, at 506-1501, if any of these services are required.

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## Appendix D

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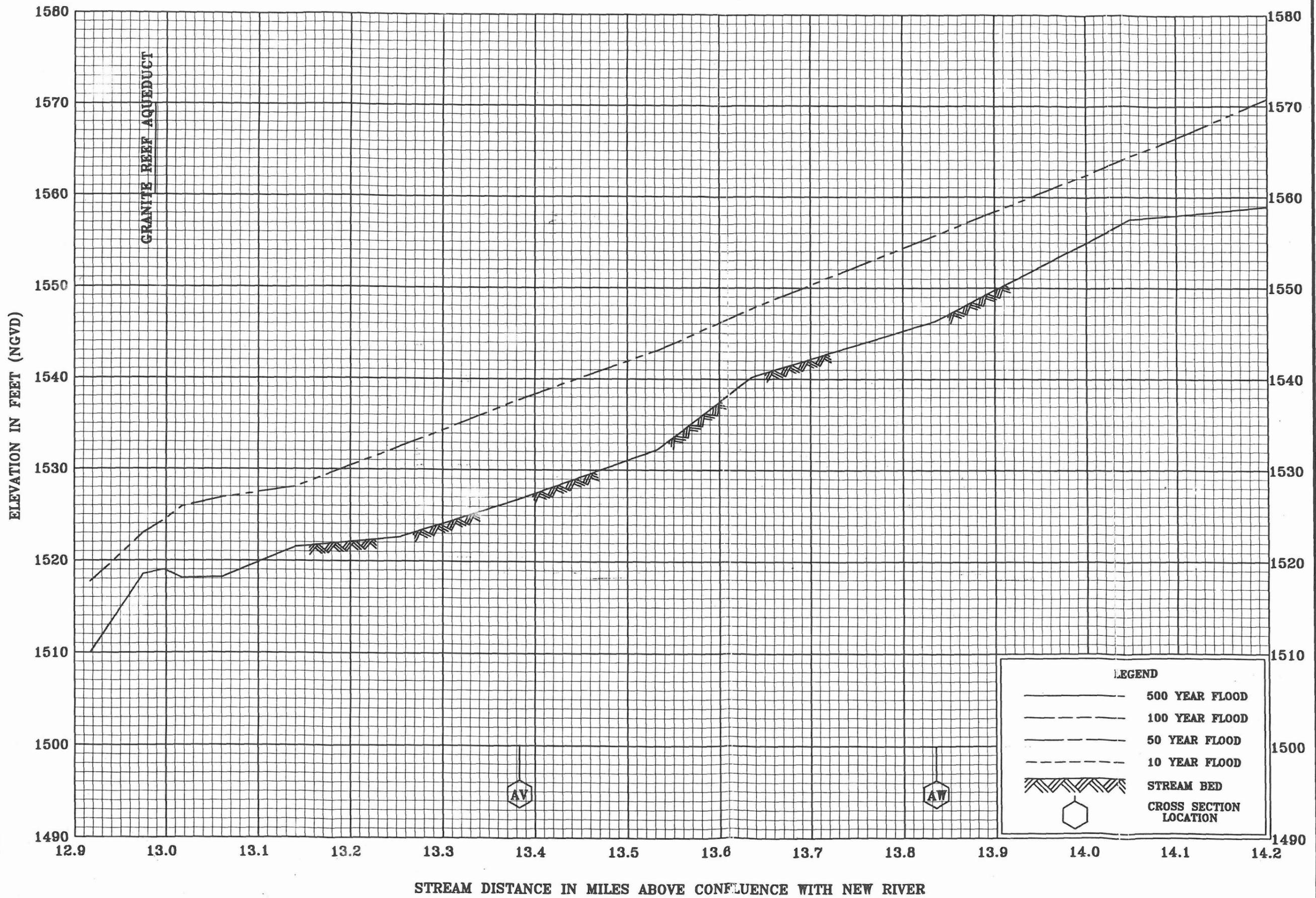
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## Appendix E

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MONTGOMERY WATSON



FEDERAL EMERGENCY MANAGEMENT AGENCY  
 MARICOPA COUNTY, AZ  
 AND INCORPORATED AREAS

FLOOD PROFILES  
 SKUNK CREEK  
 REFLECT LOWR

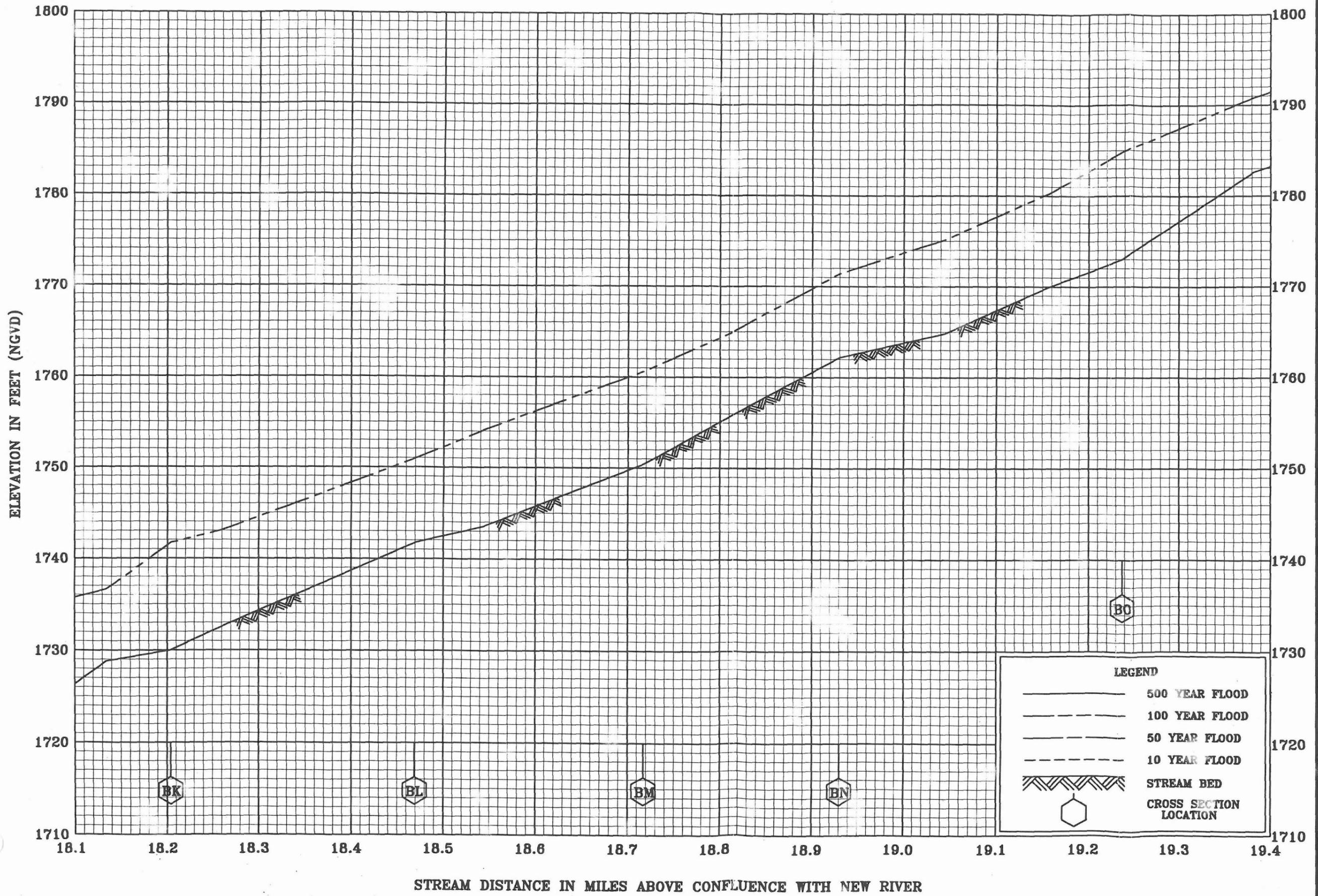
DATED SEP 23 1998

315P









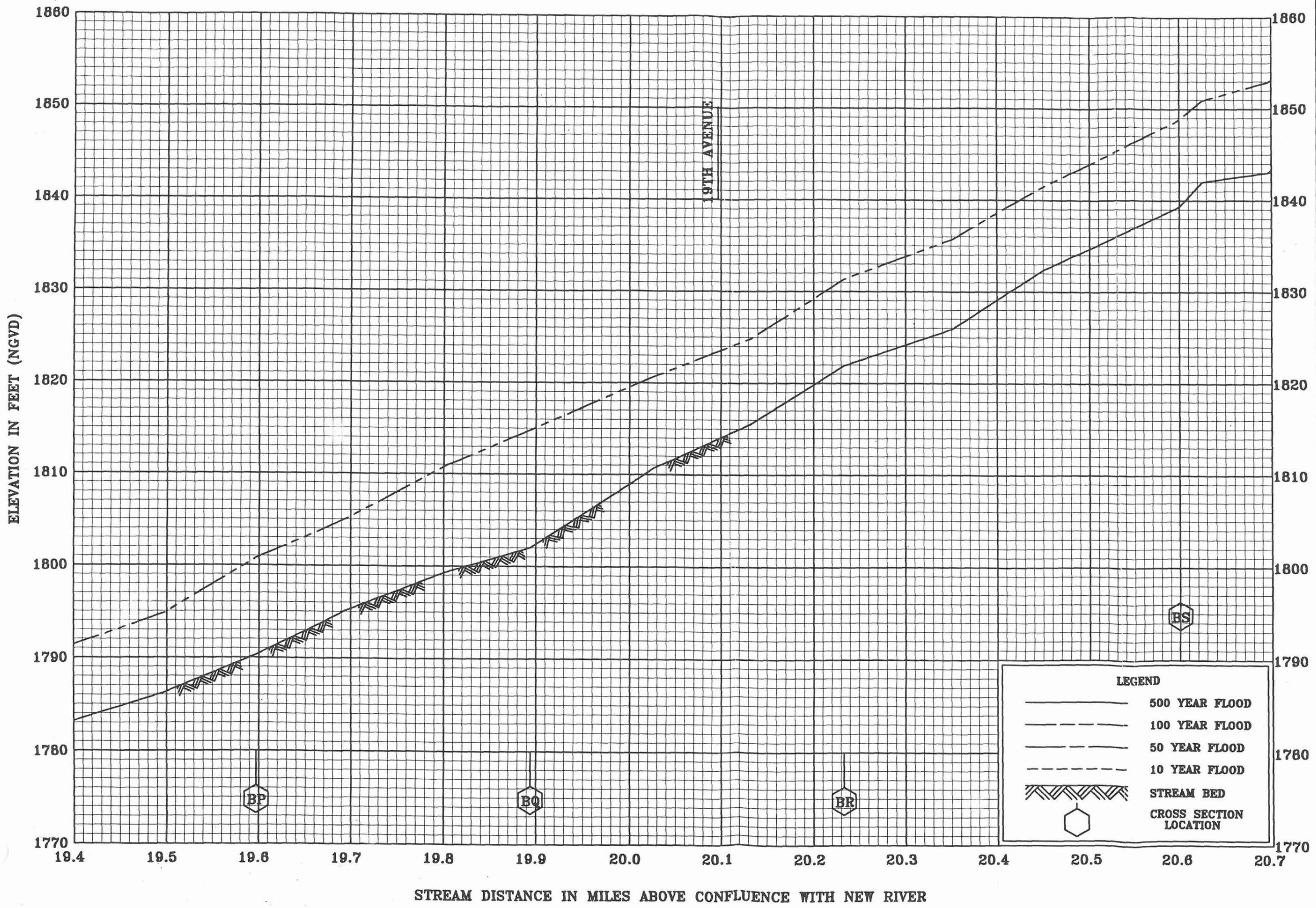
FEDERAL EMERGENCY MANAGEMENT AGENCY  
 MARICOPA COUNTY, AZ  
 AND INCORPORATED AREAS

REVISION TO  
 FLOOD PROFILES  
 SKUNK CREEK  
 REVISION TO

DATE: SEP 23 1998

319P

SEP 23 1998



FLOOD PROFILES

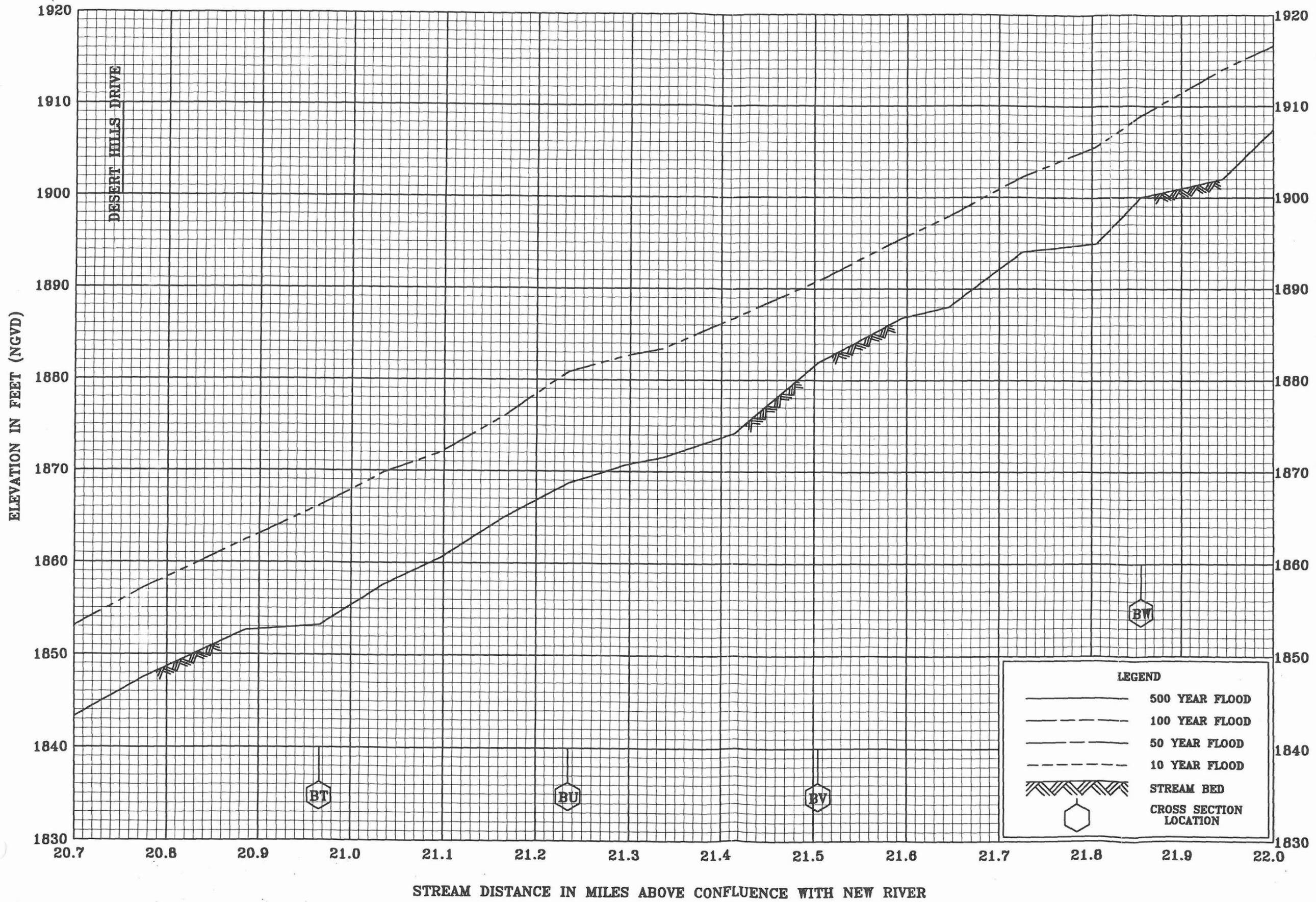
SKUNK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

AND INCORPORATED AREAS

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FLOOD PROFILES

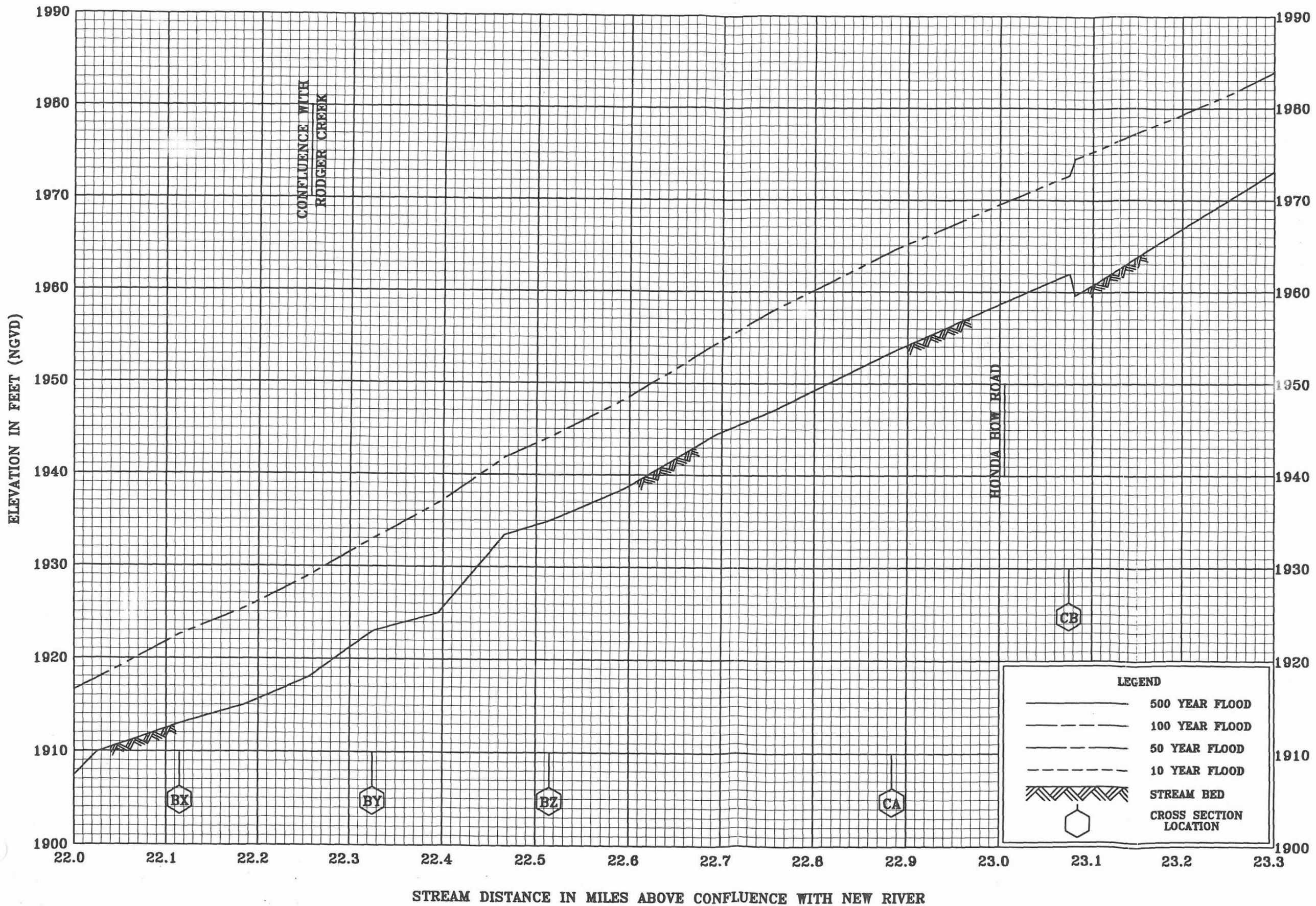
SKUNK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ  
AND INCORPORATED AREAS

321P

REVIEWED TO  
REVIEWED TO  
DATED SEP 23 1998



STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH NEW RIVER

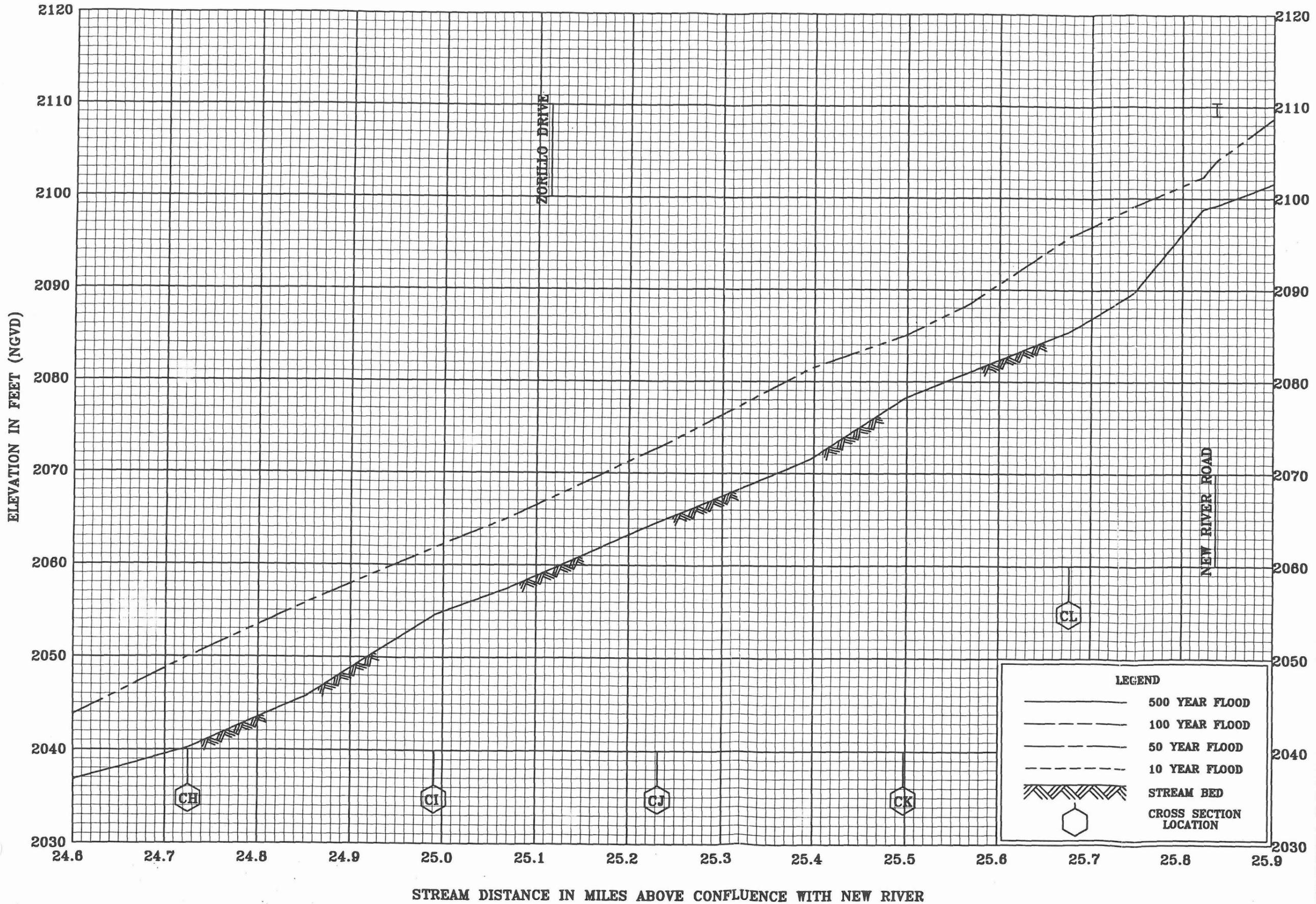
FEDERAL EMERGENCY MANAGEMENT AGENCY  
 MARICOPA COUNTY, AZ  
 AND INCORPORATED AREAS

FLOOD PROFILES  
 SKUNK CREEK

322P

DATE: SEP 23 1998



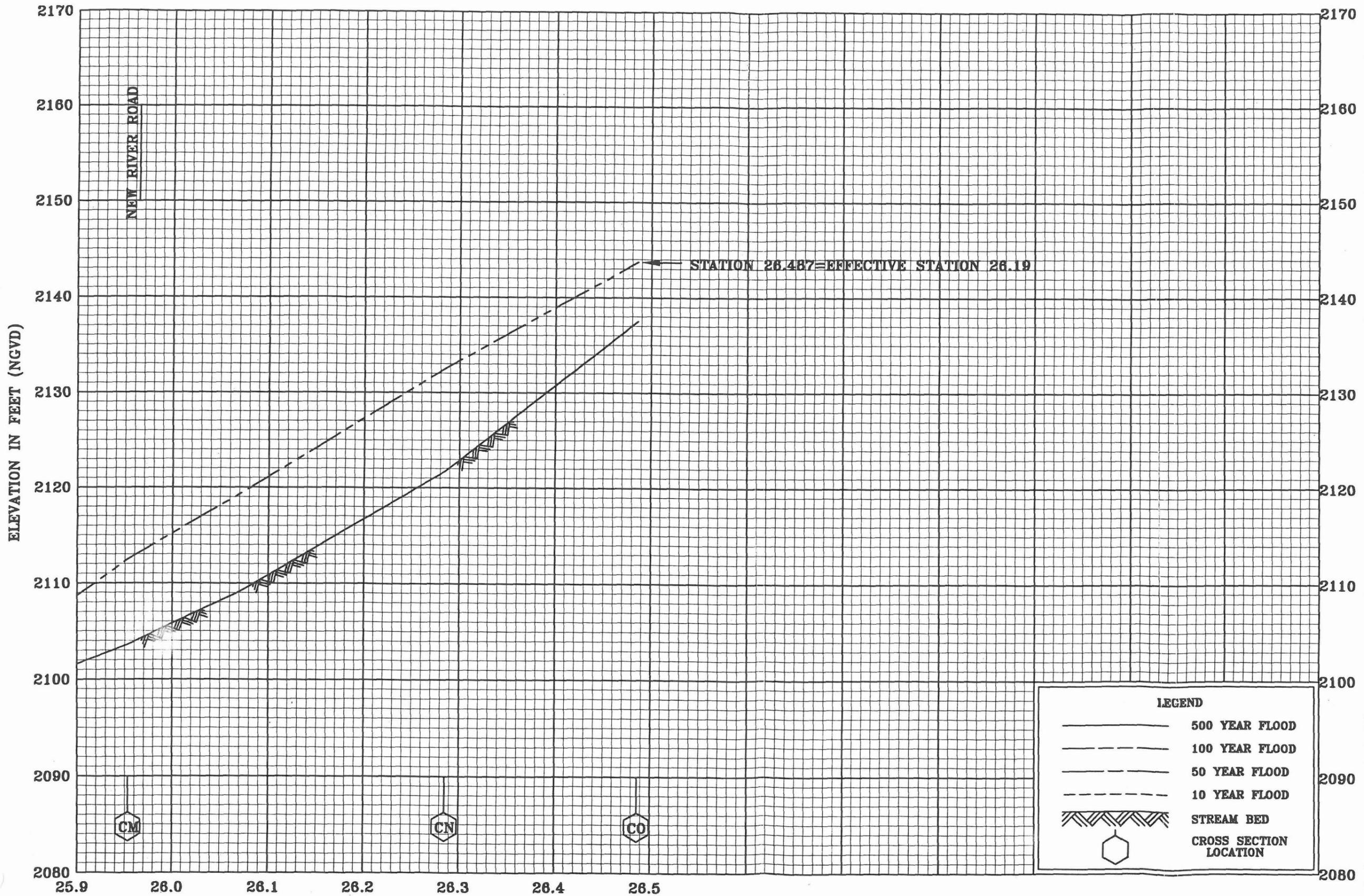


FEDERAL EMERGENCY MANAGEMENT AGENCY  
 MARICOPA COUNTY, AZ  
 AND INCORPORATED AREAS

FLOOD PROFILES  
 SKUNK CREEK

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SEP 23 1989



STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH NEW RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY  
 MARICOPA COUNTY, AZ  
 AND INCORPORATED AREAS

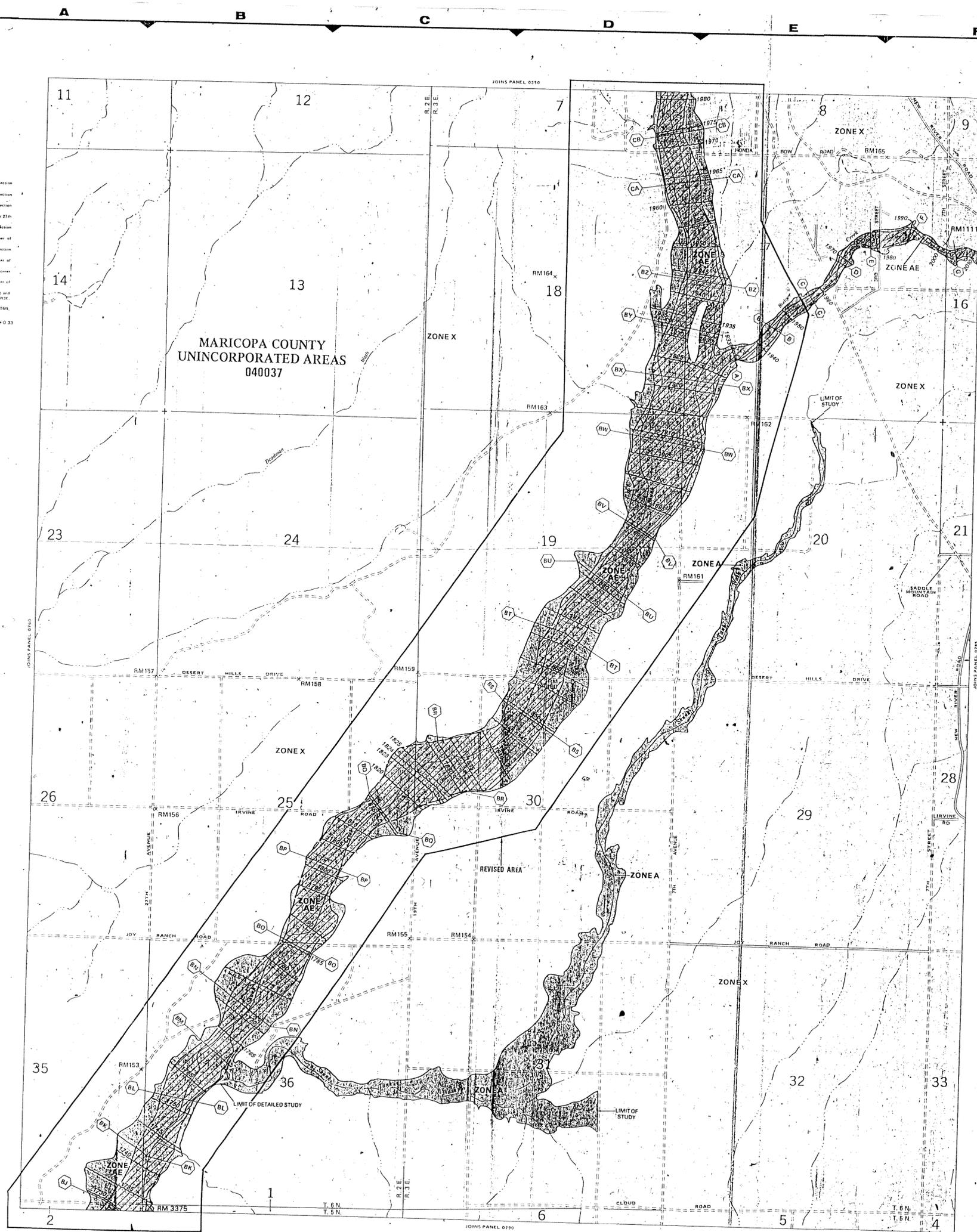
FLOOD PROFILES

SKUNK CREEK

325P

REVISED TO  
 REVISION TO  
 DATED SEP 23 1998





REFERENCE MARK	ELEVATION (FT. MSLVD)	DESCRIPTION OF LOCATION
RM153	1758.88	Government Land Office brass cap at east quarter corner of Section 25, T6N, R3E.
RM154	1795.40	Government Land Office brass cap at west quarter corner of Section 31, T6N, R3E.
RM155	1813.95	Government Land Office brass cap at northeast corner of Section 31, T6N, R3E.
RM156	1807.61	Top rock quarried yellow at southeast corner of intersection 27th Avenue and Irvine Road.
RM157	1817.44	Government Land Office brass cap at northwest corner of Section 25, T6N, R3E.
RM158	1841.83	Government Land Office brass cap at north quarter corner of Section 25, T6N, R3E.
RM159	1857.45	Government Land Office brass cap at northwest corner of Section 25, T6N, R3E.
RM160	1856.42	Government Land Office brass cap at north quarter corner of Section 20, T6N, R3E.
RM161	1830.57	Concrete 7th Avenue road east near the east quarter corner of Section 19, T6N, R3E.
RM162	1933.25	Concrete intersection 0.25 mile east of the northeast corner of Section 25, T6N, R3E.
RM163	1822.38	Top rock quarried yellow south of fork in road. Road east and northeast near the north quarter corner of Section 19, T6N, R3E.
RM164	1900.42	Concrete intersection near corner of Section 18, T6N, R3E.
RM165	1979.29	Concrete intersection near northeast corner of Section 17, T6N, R3E.
RM 1111	1993.65	5'-8" (bar set in concrete 25.5 feet west of concrete D 33 mile south of Honda Bow Road on 7th Street.
RM1111	1711.44	

MARICOPA COUNTY  
UNINCORPORATED AREAS  
040037

### LEGEND

**SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD**

- ZONE A** No base flood elevations determined.
- ZONE AH** Base flood elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE AO** Flood depths of 3 to 5 feet (usually shear flow on sloping terrain); average depths determined. For areas of unusual fan flooding, velocities also determined.
- ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
- ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

**FLOODWAY AREAS IN ZONE AE**

- OTHER FLOOD AREAS**
- ZONE X** Area of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with discharge areas less than 1 square mile and areas protected by levees from 100-year flood.
- OTHER AREAS**
- ZONE X** Areas determined to be outside 500-year flood plan.
- ZONE D** Area in which flood hazards are undetermined.

**UNDEVELOPED COASTAL BARRIERS**

- Identified 1981
- Identified 1993
- Proposed Areas

\*Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

Floodplain Boundary  
Floodway Boundary  
Zone D Boundary

**BOUNDARY DIVIDING SPECIAL FLOOD HAZARD AREAS AND BOUNDARY DIVIDING AREA OF INTEREST: COASTAL BASE FLOOD ELEVATIONS WITHIN SPECIAL FLOOD HAZARD ZONES**

573 Base Flood Elevation Line, Elevation in Feet  
D Cross Section Line  
TEL 9871 Base Flood Elevation in Feet Where Uniform Within Zone  
RM 7x Elevation Reference Mark  
+M1.5 River Mile

\*Referenced to the National Geodetic Vertical Datum of 1929.

### NOTES

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all geographic features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on FEMA and for any information on floodway determinations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, AH, A99, AO, A99, V, VE, and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1:200 scale.

Coastal base flood elevations apply only to landward of 0 (0 MSLVD), and include the effects of wave action. These elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 2 of the Flood Insurance Study Report.

For adjoining panels, see separately printed Map Index.

**MAP DEPOSITORY**  
Refer to Repository Listing on Index Map

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:**  
APRIL 15, 1988

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:**  
DECEMBER 3, 1993

Map revised September 30, 1995 to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to change zone designations, to add and update roads and road names, to reflect updated topographic information, to incorporate previously issued letters of map revision, and to incorporate previously issued letters of map amendment.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET  
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM FLOOD INSURANCE RATE MAP**

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 780 OF 4350

CONTAINS:

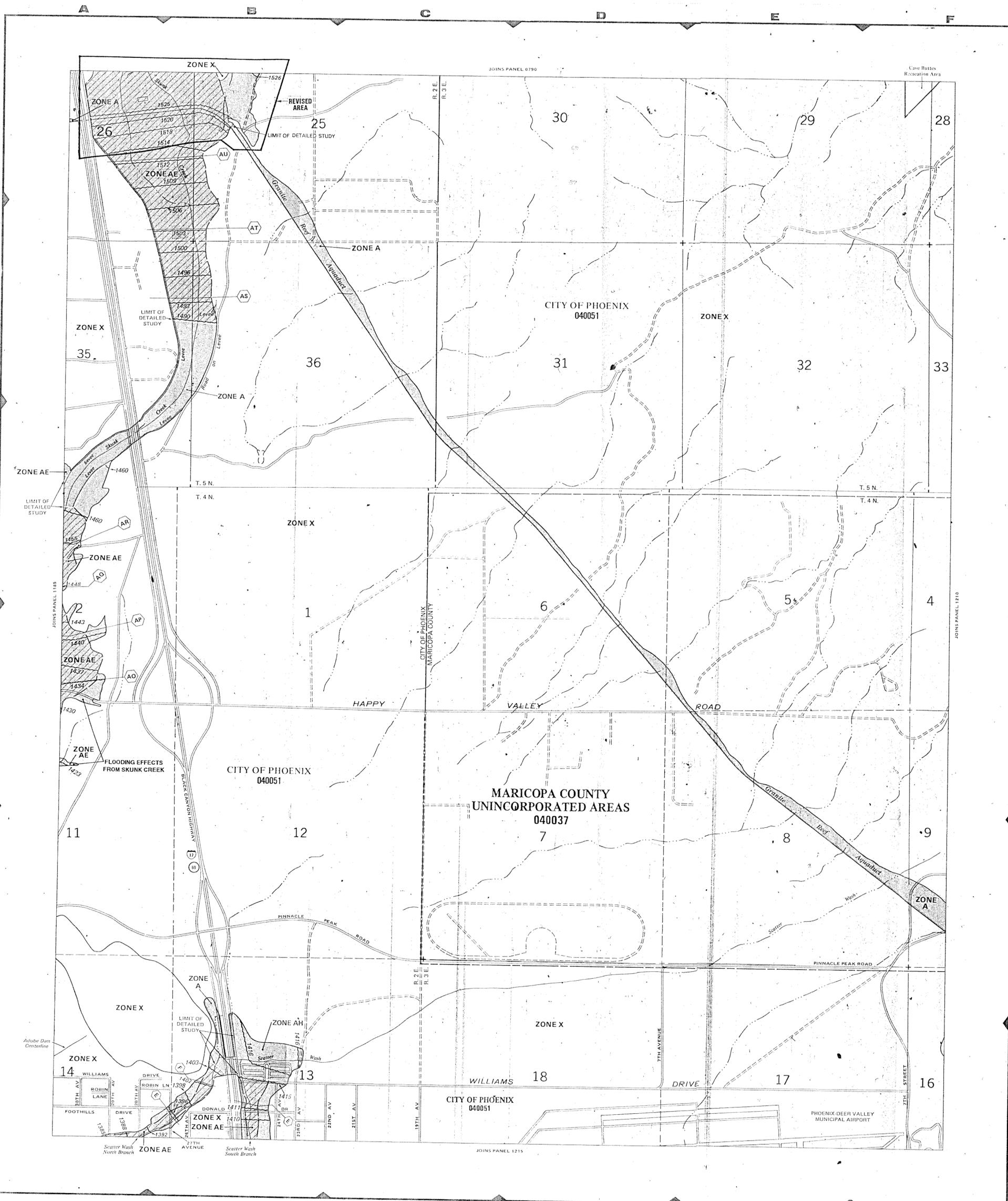
COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0780	7

REVISED TO EFFECT LOMR

MAP NUMBER 04013C0780 F

MAP REVISED: SEPTEMBER 30, 1995

Federal Emergency Management Agency



### LEGEND

**SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD**

- ZONE A** No base flood elevations determined.
- ZONE AE** Base flood elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE AO** Flood depths of 3 to 1 feet (usually sheet flow on sloping terrain); average depths determined; for areas of annual fan flooding; velocities also determined.
- ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
- ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

**FLOODWAY AREAS IN ZONE AE**

**OTHER FLOOD AREAS**

- ZONE X** Areas of 500-year flood, areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from 100-year flood.
- OTHER AREAS** Areas determined to be outside 500-year floodplain.
- ZONE D** Areas in which flood hazards are undetermined.

**UNDEVELOPED COASTAL BARRIERS:**

- Identified 1983
- Identified 1990
- Otherwise Protected Areas

\*Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

Floodplain Boundary  
 Floodway Boundary  
 Zone D Boundary  
 Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 Base Flood Elevation Line; Elevation in Feet\*  
 D Cross Section Line  
 (E.L. 987) Base Flood Elevation in Feet Where Uniform Within Zone\*  
 RM 7x Elevation Reference Mark  
 M1.5 River Mile

\*Referenced to the National Geodetic Vertical Datum of 1929.

### NOTES

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on SFHAs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown as 1/20 inch.

Coastal base flood elevations apply only landward of 0.0 NADVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 6 of the Flood Insurance Study Report.

For adjoining panels, see separately printed Map Index.

**MAP REPOSITORY**  
 Refer to Repository Listing on Index Map

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:**  
 APRIL 15, 1988

**EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:**  
 Map revised December 3, 1993 to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to change zone designations, to update map format, to add roads and road names, to reflect updated topographic information, and to incorporate previously issued letters of map revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM FLOOD INSURANCE RATE MAP**

**MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS**

PANEL 1205 OF 4350

**CONTAINS**

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	1205	E
PHOENIX, CITY OF	040051	1205	E

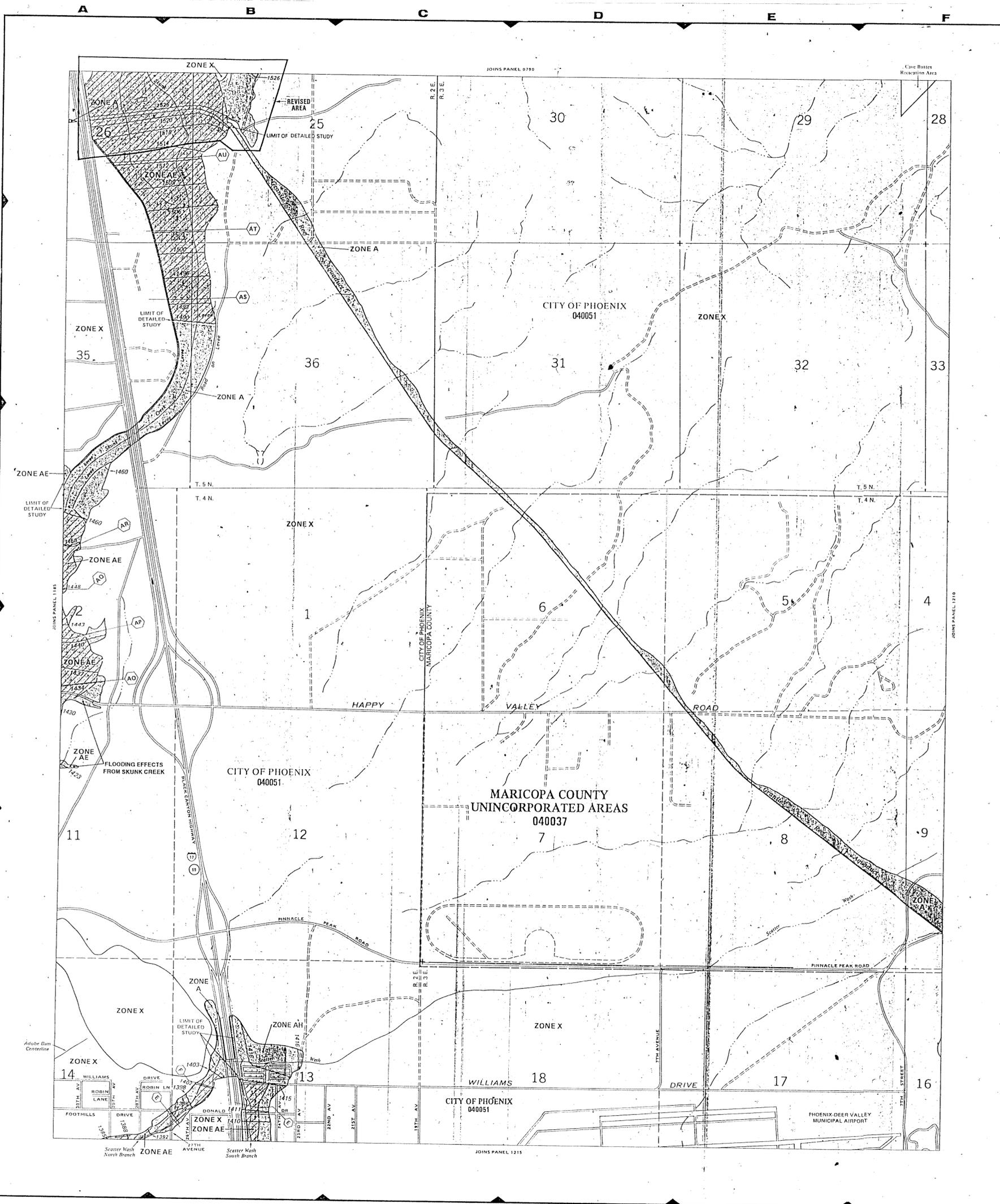
**REVISED TO REFLECT LOWER FLOOD ELEVATIONS**

SEP 23 1988

**MAP NUMBER**  
04013C1205 E

**MAP REVISED:**  
DECEMBER 3, 1993

Federal Emergency Management Agency



### LEGEND

**SPECIAL FLOOD HAZARD AREAS INUNDATE BY 100-YEAR FLOOD**

- ZONE A** No base flood elevations determined.
- ZONE AE** Base flood elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually where flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
- ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
- ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

**FLOODWAY AREAS IN ZONE AE**

**OTHER FLOOD AREAS**

- ZONE X** Areas of 100-year flood, areas of 100-year flood with average depth of less than 1 foot and drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.
- OTHER AREAS** Areas determined to be outside 100-year floodplain.
- ZONE D** Areas in which flood hazards are undetermined.

**UNDEVELOPED COASTAL BARRIERS**

- Identified 1981
- Identified 1990
- Otherwise Planned Area

Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

- Floodplain Boundary
- Floodway Boundary
- Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundaries Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

- 513 Base Flood Elevation Line; Elevation in Feet
- (D) Cross Section Line
- (EL 987) Base Flood Elevation in Feet Where Uniform Within Zone\*
- RM 7x Elevation Reference Mark
- M.S. River Mile

\*Referenced to the National Geodetic Vertical Datum of 1929.

### NOTES

The maps for use in administering the National Flood Insurance Program do not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community maps repository should be consulted for more detailed data on BEs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and X.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 100' width.

Coastal base flood elevations apply only landward of 0.0 NVD, and include the effects of wave action; these elevations may also differ significantly from Special Flood Hazard Areas developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 600 of the Flood Insurance Study Report.

For adjoining panels, see separately printed Map Index.

**MAP REPOSITORY**  
Refer to Repository Listing on Index Map.

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:**  
APRIL 15, 1988

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:**  
Map revised December 3, 1993 to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to change zone designations, to update map format, to add back and new names, to reflect updated topographic information, and to incorporate previously issued letters of map revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM**  
**FLOOD INSURANCE RATE MAP**

**MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS**

**PANEL 1205 OF 4350**

CONTAINS	COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	1205	E	
PHOENIX, CITY OF	040051	1205	E	

**SENT TO**  
**LECT LOAN**

SEP 23 1998

**MAP NUMBER**  
04013C1205 E

**MAP REVISED:**  
DECEMBER 3, 1993

Federal Emergency Management Agency

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## Appendix F

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**MONTGOMERY WATSON**



# Federal Emergency Management Agency

Washington, D.C. 20472

FLOOD CONTROL DISTRICT RECEIVED	
SEP 28 1998	
CHEV	
PIO	
ADAM	
FINAN	
J & M	
ELOR	
REMARKS	SM

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:  
Case No.: 97-09-1120P

The Honorable Skip Rimsza  
Mayor, City of Phoenix  
200 West Washington Street, 11th Floor  
Phoenix, Arizona 85003-1611

Community: City of Phoenix, Arizona  
Community No.: 040051  
FIRM Panels Affected: 04013C0770 D,  
0780 F, 0790 E,  
and 1205 E

FBFM Panel Affected: 04013C0770  
Effective Date of **SEP 23 1998**  
This Revision:

102-I-A-C

Dear Mayor Rimsza:

This responds to a request that the Federal Emergency Management Agency (FEMA) revise the effective Flood Insurance Rate Map (FIRM), Flood Boundary and Floodway Map (FBFM), and Flood Insurance Study (FIS) report for Maricopa County, Arizona and Incorporated Areas (the effective FIRM, FBFM, and FIS report for your community), in accordance with Part 65 of the National Flood Insurance Program (NFIP) regulations. In a letter dated August 5, 1997, Mr. Hasan Mushtaq, P.E., Engineering Division, Flood Control District of Maricopa County, requested that FEMA revise the FIRM, FBFM, and FIS report to show the effects of a restudy of Skunk Creek from approximately 370 feet downstream of Granite Reef Aqueduct to approximately 2,750 feet upstream of New River Road based on revised hydrology, updated topographic information, and construction of new bridges at Carefree Highway and New River Road.

All data required to complete our review of this request were submitted with letters from Mr. Mushtaq and Mr. Tim Murphy, also with the Flood Control District of Maricopa County.

We have completed our review of the submitted data and the flood data shown on the effective FIRM, FBFM, and FIS report. We have revised the FIRM, FBFM, and FIS report to modify the elevations, floodplain and floodway boundary delineations, and zone designations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) along Skunk Creek from approximately 370 feet downstream of Granite Reef Aqueduct to just downstream of Carefree Highway. As a result of the revision, we have converted effective FIRM Panel 04013C0770 D to the Map Initiatives Format. In the Map Initiatives Format, all base flood elevations (BFEs), cross sections, and floodplain and floodway boundary delineations are shown on the FIRM. The flood insurance zone designations were changed to reflect the Map Initiatives Format. Special Flood Hazard Areas (SFHAs), areas that would be inundated by the base flood, previously shown as numbered Zone A were changed to Zone AE, those shown as Zone B were changed to Zone X (shaded), and those shown as Zone C were changed to Zone X (unshaded).

As a result of the modifications, the BFEs for Skunk Creek increased, the width of the SFHA increased in some areas and decreased in other areas, and the width of the regulatory floodway increased in some

areas and decreased in other areas. The modifications are shown on the enclosed annotated copies of FIRM Panel(s) 04013C0770 D dated April 15, 1988, 04013C0780 F and 04013C0790 E, both dated September 30, 1995, and 04013C1205 E dated December 3, 1993; Profile Panel(s) 315P through 318P; and affected portions of the Summary of Discharges Table and Floodway Data Table. This Letter of Map Revision (LOMR) hereby revises the above-referenced panel(s) of the effective FIRM and the affected portions of the FIS report dated September 30, 1995.

Because this revision request also affects the unincorporated areas of Maricopa County, a separate LOMR for that community was issued on the same date as this LOMR.

The modifications are effective as of the date shown above. The map panel(s) as listed above and as modified by this letter will be used for all flood insurance policies and renewals issued for your community.

The following table is a partial listing of existing and modified BFEs:

Location	Existing BFE (feet)*	Modified BFE (feet)*
Approximately 50 feet upstream of Granite Reef Aqueduct	1,521	1,524
Just downstream of Carefree Highway	1,677	1,679

\*Referenced to the National Geodetic Vertical Datum, rounded to the nearest whole foot

Public notification of the proposed modified BFEs will be given in the *Arizona Republic* on or about October 23 and October 30, 1998. A copy of this notification is enclosed. In addition, a notice of changes will be published in the *Federal Register*. Within 90 days of the second publication in the *Arizona Republic*, a citizen may request that FEMA reconsider the determination made by this LOMR. Any request for reconsideration must be based on scientific or technical data. All interested parties are on notice that, until the 90-day period elapses, the determination to modify the BFEs presented in this LOMR may itself be modified.

Because this LOMR will not be printed and distributed to primary users, such as local insurance agents and mortgage lenders, your community will serve as a repository for these new data. We encourage you to disseminate the information reflected by this LOMR throughout the community, so that interested persons, such as property owners, local insurance agents, and mortgage lenders, may benefit from the information. We also encourage you to prepare a related article for publication in your community's local newspaper. This article should describe the assistance that officials of your community will give to interested persons by providing these data and interpreting the NFIP maps.

We are processing a revised FIRM and FIS report for Maricopa County; therefore, we will not physically revise and republish the FIRM and FIS report for your community to incorporate the modifications made by this LOMR at this time. Revised preliminary copies of the FIRM and FIS report were submitted to your community for review on May 29, 1998. We will incorporate the modifications made by this LOMR into the FIRM and FIS report before they become effective.

The floodway is provided to your community as a tool to regulate floodplain development. Therefore, the floodway modifications described in this LOMR, while acceptable to FEMA, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

This LOMR is based on minimum floodplain management criteria established under the NFIP. Your community is responsible for approving all floodplain development, and for ensuring all necessary permits required by Federal or State law have been received. State, county, and community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction in the SFHA. If the State, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

This determination has been made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and is in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed minimum NFIP criteria. These criteria are the minimum and do not supersede any State or local requirements of a more stringent nature. This includes adoption of the effective FIRM to which the regulations apply and the modifications described in this LOMR. Our records show that your community has met this requirement.

FEMA makes flood insurance available in participating communities; in addition, we encourage communities to develop their own loss reduction and prevention programs. Our Project Impact initiative, developed by FEMA Director James Lee Witt, seeks to focus the energy of businesses, citizens, and communities in the United States on the importance of reducing their susceptibility to the impact of all natural disasters, including floods, hurricanes, severe storms, earthquakes, and wildfires. Natural hazard mitigation is most effective when it is planned for and implemented at the local level, by the entities who are most knowledgeable of local conditions and whose economic stability and safety are at stake. For your information, we are enclosing a Project Impact Fact Sheet. For additional information on Project Impact, please visit our Web site at [www.fema.gov](http://www.fema.gov).

A Consultation Coordination Officer (CCO) has been designated to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Dorothy M. Lacey  
Director, Mitigation Division  
Federal Emergency Management Agency, Region IX  
The Presidio of San Francisco, Building 105  
San Francisco, California 94129-1250  
(415) 923-7177

If you have any questions regarding floodplain management regulations for your community or the NFIP in general, please contact the CCO for your community at the telephone number cited above. If you have any technical questions regarding this LOMR, please contact Mr. Mike Grimm of our staff in Washington, DC, either by telephone at (202) 646-2878 or by facsimile at (202) 646-4596.

Sincerely,



for Mike Grimm, Project Engineer  
Hazards Study Branch  
Mitigation Directorate

For: Matthew B. Miller, P.E., Chief  
Hazards Study Branch  
Mitigation Directorate

Enclosure(s)

cc: The Honorable Janice K. Brewer  
Chairman, Maricopa County  
Board of Supervisors

Mr. Raymond U. Acuña, P.E.  
Floodplain Manager  
City of Phoenix Street Transportation Department

Mr. Hasan Mushtaq, P.E. ✓  
Engineering Division  
Flood Control District of Maricopa County

Mr. Daniel Weinstein, P.E.  
Montgomery-Watson



# Federal Emergency Management Agency

Washington, D.C. 20472

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:  
Case No.: 97-09-1120P

The Honorable Janice K. Brewer  
Chairman, Maricopa County  
Board of Supervisors  
301 Jefferson Street  
Phoenix, Arizona 85003

Community: Maricopa County, Arizona  
Community No.: 040037  
FIRM Panels Affected: 04013C0390 E,  
0770 D, 0780 F,  
and 0790 E

FBFM Panel Affected: 04013C0770  
Effective Date of **SEP 23 1998**  
This Revision:

102-I-A-C

Dear Ms. Brewer:

This responds to a request that the Federal Emergency Management Agency (FEMA) revise the effective Flood Insurance Rate Map (FIRM), Flood Boundary and Floodway Map (FBFM), and Flood Insurance Study (FIS) report for Maricopa County, Arizona and Incorporated Areas (the effective FIRM, FBFM, and FIS report for your community), in accordance with Part 65 of the National Flood Insurance Program (NFIP) regulations. In a letter dated August 5, 1997, Mr. Hasan Mushtaq, P.E., Engineering Division, Flood Control District of Maricopa County, requested that FEMA revise the FIRM, FBFM, and FIS report to show the effects of a restudy of Skunk Creek from approximately 370 feet downstream of Granite Reef Aqueduct to approximately 2,750 feet upstream of New River Road based on revised hydrology, updated topographic information, and construction of new bridges at Carefree Highway and New River Road.

All data required to complete our review of this request were submitted with letters from Mr. Mushtaq and Mr. Tim Murphy, also with the Flood Control District of Maricopa County.

We have completed our review of the submitted data and the flood data shown on the effective FIRM, FBFM, and FIS report. We have revised the FIRM, FBFM, and FIS report to modify the elevations, floodplain and floodway boundary delineations, and zone designations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) along Skunk Creek from just downstream of Carefree Highway to approximately 2,750 feet upstream of New River Road. As a result of the revision, we have converted effective FIRM Panel 04013C0770 D to the Map Initiatives Format. In the Map Initiatives Format, all base flood elevations (BFEs), cross sections, and floodplain and floodway boundary delineations are shown on the FIRM. The flood insurance zone designations were changed to reflect the Map Initiatives Format. Special Flood Hazard Areas (SFHAs), areas that would be inundated by the base flood, previously shown as numbered Zone A were changed to Zone AE, those shown as Zone B were changed to Zone X (shaded), and those shown as Zone C were changed to Zone X (unshaded).

As a result of the modifications, the BFEs for Skunk Creek increased, the width of the SFHA increased in some areas and decreased in other areas, and the width of the regulatory floodway increased in some

areas and decreased in other areas. The modifications are shown on the enclosed annotated copies of FIRM Panel(s) 04013C0390 E, dated December 3, 1993; 04013C0770 D, dated April 15, 1988; and 04013C0780 F and 04013C0790 E, both dated September 30, 1995; Profile Panel(s) 318P through 325P; and affected portions of the Summary of Discharges Table and Floodway Data Table. Profile Panel 1040P has been added to show BFEs along Skunk Creek East Split Flow upstream of New River Road. In addition, the channel distances shown in the Floodway Data Table for cross sections upstream of Cross Section CN have been revised to reflect an increase in overall channel length. This Letter of Map Revision (LOMR) hereby revises the above-referenced panel(s) of the effective FIRM and the affected portions of the FIS report dated September 30, 1995.

Because this revision request also affects the City of Phoenix, a separate LOMR for that community was issued on the same date as this LOMR.

The modifications are effective as of the date shown above. The map panel(s) as listed above and as modified by this letter will be used for all flood insurance policies and renewals issued for your community.

The following table is a partial listing of existing and modified BFEs:

Location	Existing BFE (feet)*	Modified BFE (feet)*
Just downstream of Carefree Highway	1,677	1,679
Just upstream of New River Road	2,110	2,113

\*Referenced to the National Geodetic Vertical Datum, rounded to the nearest whole foot

Public notification of the proposed modified BFEs will be given in the *Arizona Republic* on or about October 23 and October 30, 1998. A copy of this notification is enclosed. In addition, a notice of changes will be published in the *Federal Register*. Within 90 days of the second publication in the *Arizona Republic*, a citizen may request that FEMA reconsider the determination made by this LOMR. Any request for reconsideration must be based on scientific or technical data. All interested parties are on notice that, until the 90-day period elapses, the determination to modify the BFEs presented in this LOMR may itself be modified.

Because this LOMR will not be printed and distributed to primary users, such as local insurance agents and mortgage lenders, your community will serve as a repository for these new data. We encourage you to disseminate the information reflected by this LOMR throughout the community, so that interested persons, such as property owners, local insurance agents, and mortgage lenders, may benefit from the information. We also encourage you to prepare a related article for publication in your community's local newspaper. This article should describe the assistance that officials of your community will give to interested persons by providing these data and interpreting the NFIP maps.

We are processing a revised FIRM and FIS report for Maricopa County; therefore, we will not physically revise and republish the FIRM and FIS report for your community to incorporate the modifications made by this LOMR at this time. Preliminary copies of the FIRM and FIS report were submitted to your community for review on December 23, 1997. We will incorporate the modifications made by this LOMR into the FIRM and FIS report before they become effective.

The floodway is provided to your community as a tool to regulate floodplain development. Therefore, the floodway modifications described in this LOMR, while acceptable to FEMA, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

This LOMR is based on minimum floodplain management criteria established under the NFIP. Your community is responsible for approving all floodplain development, and for ensuring all necessary permits required by Federal or State law have been received. State, county, and community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction in the SFHA. If the State, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

This determination has been made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and is in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed minimum NFIP criteria. These criteria are the minimum and do not supersede any State or local requirements of a more stringent nature. This includes adoption of the effective FIRM to which the regulations apply and the modifications described in this LOMR. Our records show that your community has met this requirement.

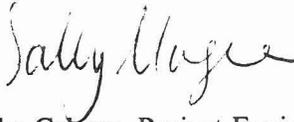
FEMA makes flood insurance available in participating communities; in addition, we encourage communities to develop their own loss reduction and prevention programs. Our Project Impact initiative, developed by FEMA Director James Lee Witt, seeks to focus the energy of businesses, citizens, and communities in the United States on the importance of reducing their susceptibility to the impact of all natural disasters, including floods, hurricanes, severe storms, earthquakes, and wildfires. Natural hazard mitigation is most effective when it is planned for and implemented at the local level, by the entities who are most knowledgeable of local conditions and whose economic stability and safety are at stake. For your information, we are enclosing a Project Impact Fact Sheet. For additional information on Project Impact, please visit our Web site at [www.fema.gov](http://www.fema.gov).

A Consultation Coordination Officer (CCO) has been designated to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Dorothy M. Lacey  
Director, Mitigation Division  
Federal Emergency Management Agency, Region IX  
The Presidio of San Francisco, Building 105  
San Francisco, California 94129-1250  
(415) 923-7177

If you have any questions regarding floodplain management regulations for your community or the NFIP in general, please contact the CCO for your community at the telephone number cited above. If you have any technical questions regarding this LOMR, please contact Mr. Mike Grimm of our staff in Washington, DC, either by telephone at (202) 646-2878 or by facsimile at (202) 646-4596.

Sincerely,



Mike Grimm, Project Engineer  
Hazards Study Branch  
Mitigation Directorate

For: Matthew B. Miller, P.E., Chief  
Hazards Study Branch  
Mitigation Directorate

Enclosure(s)

cc: The Honorable Skip Rimsza  
Mayor, City of Phoenix

Mr. Raymond U. Acuña, P.E.  
Floodplain Manager  
City of Phoenix Street Transportation Department

Mr. Hasan Mushtaq, P.E. ✓  
Engineering Division  
Flood Control District of Maricopa County

Mr. Daniel Weinstein, P.E.  
Montgomery-Watson

CHANGES ARE MADE IN DETERMINATIONS OF BASE FLOOD ELEVATIONS FOR THE CITY OF PHOENIX AND THE UNINCORPORATED AREAS OF MARICOPA COUNTY, ARIZONA, UNDER THE NATIONAL FLOOD INSURANCE PROGRAM

On September 30, 1995, the Federal Emergency Management Agency identified Special Flood Hazard Areas (SFHAs) in the City of Phoenix and the unincorporated areas of Maricopa County, Arizona, through issuance of a Flood Insurance Rate Map (FIRM). The Mitigation Directorate has determined that modification of the elevations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) for certain locations in these communities is appropriate. The modified base flood elevations (BFEs) revise the FIRM for these communities.

The changes are being made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65.

A hydraulic analysis was performed to incorporate a restudy of Skunk Creek from approximately 370 feet downstream of Granite Reef Aqueduct to approximately 2,750 feet upstream of New River Road based on revised hydrology, updated topographic information, and construction of new bridges at Carefree Highway and New River Road and has resulted in a revised delineation of the regulatory floodway, increases and decreases in SFHA width, and increased BFEs. The table below indicates existing and modified BFEs for selected locations along the affected lengths of the flooding source(s) cited above.

Location	Existing BFE (feet)*	Modified BFE (feet)*
<sup>1</sup> Approximately 50 feet upstream of Granite Reef Aqueduct	1,521	1,524
<sup>1,2</sup> Just downstream of Carefree Highway	1,677	1,679
<sup>2</sup> Just upstream of New River Road	2,110	2,113

<sup>1</sup> City of Phoenix

<sup>2</sup> Unincorporated areas of Maricopa County

\*National Geodetic Vertical Datum, rounded to nearest whole foot

Under the above-mentioned Acts of 1968 and 1973, the Mitigation Directorate must develop criteria for floodplain management. To participate in the National Flood Insurance Program (NFIP), the community must use the modified BFEs to administer the floodplain management measures of the NFIP. These modified BFEs will also be used to calculate the appropriate flood insurance premium rates for new buildings and their contents and for the second layer of insurance on existing buildings and contents.

Upon the second publication of notice of these changes in this newspaper, any person has 90 days in which he or she can request, through the Chief Executive Officer of the community, that the Mitigation Directorate reconsider the determination. Any request for reconsideration must be based on knowledge of changed conditions or new scientific or technical data. All interested parties are on notice that until the 90-day period elapses, the Mitigation Directorate's determination to modify the BFEs may itself be changed.

Any person having knowledge or wishing to comment on these changes should immediately notify:

The Honorable Skip Rimsza  
Mayor, City of Phoenix  
200 West Washington Street, 11th Floor  
Phoenix, Arizona 85003-1611

OR

The Honorable Janice K. Brewer  
Chairman, Maricopa County Board of Supervisors  
301 Jefferson Street  
Phoenix, Arizona 85003

---

Table 3. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs)			
		10-Year	50-Year	100-Year	500-Year
<b>Skunk Creek</b>					
At New River Road	8.04	-- <sup>1</sup>	-- <sup>1</sup>	7,800	-- <sup>1</sup>
At confluence with Cline Creek	15.76	-- <sup>1</sup>	-- <sup>1</sup>	11,800	-- <sup>1</sup>
At confluence with Rodger Creek	32.67	-- <sup>1</sup>	-- <sup>1</sup>	24,400	-- <sup>1</sup>
At Carefree Highway	40.11	-- <sup>1</sup>	-- <sup>1</sup>	27,300	-- <sup>1</sup>
At Granite Reef Aqueduct	63.49	-- <sup>1</sup>	-- <sup>1</sup>	26,700	-- <sup>1</sup>
At Inflow of Adobe Dam	89.6	15,000	29,000	39,000	85,000
At Outflow of Adobe Dam	0.0	1,370	1,650	1,730	2,000
Above confluence with Scatter Wash	0.9	1,600	2,200	2,600	4,600
Below confluence with Scatter Wash (At 59th Avenue)	0.4	2,000	5,500	8,400	22,000
At confluence with Arizona Canal	19.9	2,200	6,700	11,000	33,000
<b>Buchanan Wash</b>					
800 feet downstream of Central Arizona Project Canal	9.17	1,065	1,253	1,308	1,407
At confluence with Skunk Creek	11.29	1,422	2,005	2,304	3,067
<b>Scatter Wash</b>					
At Mouth	8.5	580	3,500	6,100	17,000
Above Black Canyon Highway (State Highway 17)	6.3	540	3,200	5,700	16,000
<b>Salt River</b>					
At Granite Reef Dam	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	245,000	-- <sup>2</sup>
At Gilbert Road	12,593.0	100,000	170,000	230,000	345,000
At Country Club Drive	-- <sup>2</sup>	-- <sup>2</sup>	-- <sup>2</sup>	225,000	-- <sup>2</sup>
At Tempe Bridge	12,783.0	93,000	160,000	215,000	330,000
At Central Avenue	12,831.0	91,000	155,000	200,000	325,000
At 67th Avenue	12,931.0	90,000	150,000	190,000	315,000
Above confluence with Gila River	12,962.0	85,000	145,000	185,000	310,000
<b>East Fork Cave Creek</b>					
At confluence with Cave Creek	14.4	2,300	6,400	9,000	19,000
Below 7th Avenue Extended	13.8	2,300	6,300	8,900	18,000
Below 7th Street	12.4	2,200	5,900	8,400	17,000
Above 7th Street	10.0	1,900	5,300	7,500	15,200
At Bell Road	3.4	1,100	2,900	4,200	8,200
Below Cave Creek Road	3.0	1,000	2,800	3,900	7,900
At Utopia Road	1.8	800	2,100	3,000	5,800
At Beardsley Road	1.0	600	1,500	2,100	4,300

<sup>1</sup>Data Not Computed

<sup>2</sup>Data Not Available

RECEIVED  
 REFLECT DOWN  
 DATED SEP 23 1998

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Skunk Creek (Cont'd)								
AV	13.38	932	3,659	6.4	1,537.7	1,537.7	1,538.5	0.8
AW	13.84	1,524	3,993	5.8	1,555.7	1,555.7	1,556.3	0.6
AX	14.28	950	2,810	8.3	1,574.0	1,574.0	1,574.8	0.8
AY	14.72	356	2,081	11.2	1,591.1	1,591.1	1,591.2	0.1
AZ	15.04	418	2,352	9.9	1,602.4	1,602.4	1,602.5	0.1
BA	15.39	374	2,264	10.3	1,616.9	1,616.9	1,617.0	0.1
BB	15.73	639	3,750	6.2	1,630.0	1,630.0	1,631.0	1.0
BC	16.05	300	2,140	10.9	1,643.8	1,643.8	1,644.8	1.0
BD	16.25	282	1,666	14.0	1,651.8	1,651.8	1,652.3	0.5
BE	16.66	650	2,992	7.8	1,668.2	1,668.2	1,668.4	0.2
BF	16.94	641	2,211	12.3	1,684.2	1,684.2	1,684.5	0.3
BG	17.16	953	2,912	9.4	1,694.4	1,694.4	1,694.9	0.5
BH	17.37	765	3,086	8.8	1,704.7	1,704.7	1,705.5	0.8
BI	17.63	757	3,353	8.1	1,717.2	1,717.2	1,717.7	0.5
BJ	17.93	750	3,439	7.9	1,729.8	1,729.8	1,730.3	0.5
BK	18.21	700	2,938	9.4	1,741.7	1,741.7	1,741.7	0.0
BL	18.47	643	2,780	10.0	1,750.9	1,750.9	1,751.0	0.1
BM	18.72	745	2,612	10.5	1,760.6	1,760.6	1,760.7	0.1
BN	18.93	841,	3,403	8.0	1,771.3	1,771.3	1,771.8	0.5
BO	19.24	635	2,449	11.1	1,784.8	1,784.8	1,784.8	0.0
BP	19.60	746	3,467	7.9	1,800.8	1,800.8	1,800.8	0.0
BQ	19.90	683	3,193	8.5	1,814.8	1,814.8	1,815.0	0.2
BR	20.23	1,205	4,249	6.4	1,831.3	1,831.3	1,831.4	0.1
BS	20.60	885	3,712	7.4	1,848.8	1,848.8	1,849.5	0.7
BT	20.97	670	3,437	7.9	1,866.2	1,866.2	1,866.9	0.7
BU	21.24	745	3,219	8.5	1,880.9	1,880.9	1,881.0	0.1

<sup>1</sup>Miles Above Confluence With New River

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FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, AZ  
AND INCORPORATED AREAS

FLOODWAY DATA

SKUNK CREEK

SEP 23 1998

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Skunk Creek (Cont'd)								
BV	21.51	700	3,272	8.3	1,890.9	1,890.9	1,891.1	0.2
BW	21.86	1,450	3,138	8.7	1,908.9	1,908.9	1,908.9	0.0
BX	22.12	1,125	3,939	6.9	1,922.6	1,922.6	1,923.0	0.4
BY	22.33	1,100	3,348	8.2	1,933.0	1,933.0	1,933.4	0.4
BZ	22.52	723	2,916	9.4	1,944.1	1,944.1	1,945.0	0.9
CA	22.89	742	3,526	6.9	1,964.5	1,964.5	1,965.3	0.8
CB	23.08	600	2,721	9.0	1,972.7	1,972.7	1,972.7	0.0
CC	23.37	334	2,057	11.9	1,987.2	1,987.2	1,987.8	0.6
CD	23.67	467	2,324	10.5	2,003.9	2,003.9	2,004.5	0.6
CE	23.99	353	1,386	8.5	2,018.9	2,018.9	2,019.1	0.2
CF	24.24	207	1,221	9.7	2,028.9	2,028.9	2,029.8	0.9
CG	24.60	214	977	9.9	2,043.7	2,043.7	2,044.4	0.7
CH	24.73	79	611	15.9	2,050.0	2,050.0	2,050.5	0.5
CI	24.99	151	658	11.9	2,061.9	2,061.9	2,061.9	0.0
CJ	25.23	153	656	11.9	2,072.8	2,072.8	2,072.8	0.0
CK	25.50	646	1,983	3.9	2,085.0	2,085.0	2,086.0	1.0
CL	25.68	824	1,551	5.0	2,095.8	2,095.8	2,095.9	0.1
CM	25.95	126	615	12.7	2,112.5	2,112.5	2,113.1	0.6
CN	26.29	83	536	14.6	2,132.5	2,132.5	2,132.7	0.2
CO	26.49	418	1,252	5.7	2,143.7	2,143.7	2,143.7	0.0
CP	26.65	383	1,047	6.9	2,153.6	2,153.6	2,153.6	0.0
CQ	26.83	487	1,039	6.9	2,164.4	2,164.4	2,164.4	0.0
CR	27.07	273	856	8.4	2,179.1	2,179.1	2,179.1	0.0
CS	27.24	449	1,067	6.7	2,190.4	2,190.4	2,190.4	0.0
CT	27.35	249	873	8.2	2,196.4	2,196.4	2,196.4	0.0
CU	27.67	193	461	7.9	2,220.3	2,220.3	2,220.3	0.0

<sup>1</sup>Miles Above Confluence With New River

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FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, AZ  
AND INCORPORATED AREAS

**FLOODWAY DATA**

SKUNK CREEK

SEP 23 1990

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Skunk Creek (Cont'd)								
CV	27.86	288	608	6.0	2,235.7	2,235.7	2,235.7	0.0
CW	27.99	137	375	9.7	2,245.5	2,245.5	2,245.5	0.0
CX	28.11	80	320	11.4	2,254.7	2,254.7	2,254.7	0.0

<sup>1</sup>Miles Above Confluence With New River

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FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, AZ  
AND INCORPORATED AREAS

**FLOODWAY DATA**

SKUNK CREEK

SEP 23 1990

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## Appendix G

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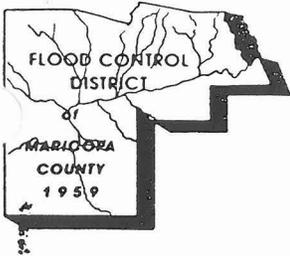
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## Appendix H

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**MONTGOMERY WATSON**



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009-6399  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

BOARD OF DIRECTORS  
Betsey Bayless  
Jan Brewer  
Fulton Brock  
Don Stapley  
Mary Rose Garrido Wilcox

MAR 3 1997

Fred Duren, P.E., P.G.  
Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016-2030

SUBJECT : Request for change order No. 3 - Additional Funds for GIS Services  
Skunk Creek Floodplain Delineation Study (Contract No. FCD 95-16)

Dear Mr. Duren :

This is in response to your Request for Change Order No 3. - Additional Funds for GIS Services for the subject project, dated January 15, 1997, and February 4, 1997.

Based on the facts presented in your requests, and subsequent telephone conversations with Ms. Laurie Miller, P.E., Project Manager, the District feels that it is necessary to revise Task 9.2 of the contract on the above mentioned project. Under the revised Task 9.2, after the digital data passes the review by the GIS personnel, the District will generate the necessary Check Plots to verify the accuracy of the database, within ten (10) business days. Montgomery Watson shall be responsible for verifying the database with the aid of these generated check plots and make necessary adjustments and/or corrections. A final review of the adjusted data performed by the GIS personnel will determine the acceptance of the final delivered data. As a result of the revised task 9.2, a lump sum amount of \$956.00, based on the fee estimate provided in your request, dated, February 4, 1997, will be reduced from the originally negotiated contract amount of \$209,900. This would take effect as per the attached change order number 3. The revised Task 9.2 is also explained in detail in the attached Change Order Request.

Please sign the Change Order Request in duplicate and return to the DISTRICT at your earliest convenience. Should you have further questions in this regard, please do not hesitate to contact me at 506-1501.

Sincerely,

Hasan Mushtaq, P.E.  
Engineering Division

**RECEIVED**

MAR - 4 1997

MONTGOMERYWATSON  
PHOENIX OFFICE

Contract Change Order No. 3

Date: February 24, 1997

FCD Contract No./Name: FCD 95-16

Skunk Creek Floodplain Delineation Study

To: Montgomery Watson, Contractor/Consultant.

You are hereby directed to make the herein described changes from the plans and specifications or do the following described work not included in the plans and specifications on the above-mentioned project.

Changes requested by: Hasan Mushtaq, P.E., Project Manager

Provide description of work to be done, estimate of quantities, and prices to be paid. Segregate between additional work at contract price, agreed price, and actual cost. Unless otherwise stated, rates for rental of equipment on actual cost work cover only such time as equipment is actually used and no allowance will be made for idle times.

\* (1) Estimate of increases and/or decreases in contract items at contract prices.

\*\* (2) Estimate of extra work at agreed price and/or actual cost.

Sheet No. 1 of 1

Description of Change Order	
Task 9.2 of the Contract is revised as following :	
9.2	This task is further divided into following categories.
9.2.1	Montgomery Watson shall submit the digital data sets for each theme as described in Attachment A, according to the criteria set forth in Task 9.1. After the digital data passes the review by the GIS personnel, the DISTRICT will generate the Check Plots within ten (10) business days.
9.2.2	The check plots will be prepared with a minimum of annotation and shall serve <u>ONLY</u> to verify specific information contained in the feature attribute tables associated with each data set. These check plots shall be at the same scale as the consultant-supplied hydrologic and planimetric delineation maps and shall be provided on scale-stable vellum.
9.2.3	The Check Plots will be returned to Montgomery Watson for verification of feature coding.
9.2.4	Montgomery Watson shall make necessary adjustments and/or corrections before submitting the translated data for a final review.
9.2.5	A final review by the GIS personnel will determine the acceptance of the deliverable as described in Task 10.2.5.
As a result of the above revisions to Task 9.2, the negotiated contract amount for this project is reduced by a lump sum amount of _____.	

We, the undersigned Contractor/Consultant, having given careful consideration to the change(s) proposed, hereby agree, if this proposal is approved, that we will provide all equipment, furnish all material (except as may otherwise be noted above), and perform all services necessary for the work above specified, and we will accept as full payment therefor the prices shown above.

By reason of this proposed change, 63 days extension of time will be allowed, which will expire June 30, 1997.

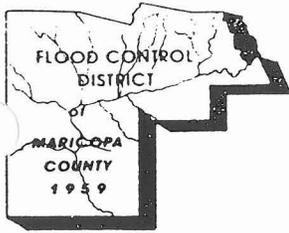
Total new contract amount through this Change Order No. 3 is \_\_\_\_\_.

Contractor/Consultant: Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, Arizona 85016

By: [Signature]  
 Title: Mr. Reg. P.E. Mgr.  
 Date: 3/10/97

Recommended by: [Signature]  
 Date: 3/13/97

Approved by: [Signature]  
 Interim Chief Engineer and General Manager  
 Date: 3-18-97



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

---

BOARD OF DIRECTORS  
Betsey Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

December 26, 1996

DEC 30 1996

Montgomery Watson  
6245 North 24th Parkway, Suite 208  
Phoenix, AZ 85016

Reference: Change Order No. 2  
Contract FCD 95-16 Skunk Creek FDS

Enclosed for your file is one original signature copy of the subject change order.

*Dortha Klaahsen*

Dortha Klaahsen  
Contracts Coordinator

Date: 11/26/1996

FCD Contract No./Name: FCD 95-16  
Skunk Creek Floodplain Delineation Study

To: Montgomery Watson, Contractor/Consultant.

You are hereby directed to make the herein described changes from the plans and specifications or do the following described work not included in the plans and specifications on the above-mentioned project.

Changes requested by: Hasan Mushtaq, Project Manager

Provide description of work to be done, estimate of quantities, and prices to be paid. Segregate between additional work at contract price, agreed price, and actual cost. Unless otherwise stated, rates for rental of equipment on actual cost work cover only such time as equipment is actually used and no allowance will be made for idle times.

\* (1) Estimate of increases and/or decreases in contract items at contract prices.

\*\* (2) Estimate of extra work at agreed price and/or actual cost.

Sheet No. 1 of 1

Description of Change Order

Extend this contract to April 28, 1997.

The schedule for the floodplain delineation portion of the study has been significantly impacted due to the following reason. A portion of the hydraulic modeling of the Skunk Creek Wash, from Desert Hills Drive to Honda Bow Road, was to be supplied by the Del Webb Corporation, from a related drainage development study. The final submission of the hydraulic model was made on 11/13/96 instead of June, 1996, as originally assumed under a verbal agreement with Del Webb Corporation. Therefore, a revised completion date is necessary to complete the contracted work.

We, the undersigned Contractor/Consultant, having given careful consideration to the change(s) proposed, hereby agree, if this proposal is approved, that we will provide all equipment, furnish all material (except as may otherwise be noted above), and perform all services necessary for the work above specified, and we will accept as full payment therefor the prices shown above.

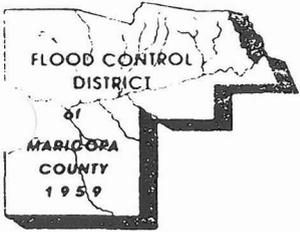
By reason of this proposed change 154 days extension of time will be allowed, which will expire on April 28, 1997. Total unrevised contract amount through this Change Order No. 2 is \_\_\_\_\_.

Contractor/Consultant: Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, AZ 85016

By: [Signature]  
Title: Proj. Dir. M&D  
Date: 12/3/96

Recommended by: [Signature]  
Date: 12/17/96

Approved by: [Signature]  
for Interim Chief Engineer and General Manager  
Date: 12/17/96



# FLOOD CONTROL DISTRICT

of

## Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009

Telephone (602) 506-1501

Fax (602) 506-4601

TT (602) 506-5859

---

### BOARD OF DIRECTORS

Betsey Bayless

Ed King

Tom Rawles

Don Stapley

Mary Rose Garrido Wilcox

August 13, 1996

Montgomery Watson  
6245 North 24th Parkway, Suite 208  
Phoenix, AZ 85016

Reference: Change Order No. 1  
Contract FCD 95-16 Skunk Creek FDS

Enclosed for your file is one original signature copy of the subject change order.

Dortha Klaahsen  
Contracts Coordinator

AUG 15 1996

Date: 7/31/1996

FCD Contract No./Name: FCD 95-16

Skunk Creek FDS

To: Montgomery Watson, Contractor/Consultant.

You are hereby directed to make the herein described changes from the plans and specifications or do the following described work not included in the plans and specifications on the above-mentioned project.

Changes requested by: Hasan Mushtaq, Project Manager

Provide description of work to be done, estimate of quantities, and prices to be paid. Segregate between additional work at contract price, agreed price, and actual cost. Unless otherwise stated, rates for rental of equipment on actual cost work cover only such time as equipment is actually used and no allowance will be made for idle times.

\* (1) Estimate of increases and/or decreases in contract items at contract prices.

\*\* (2) Estimate of extra work at agreed price and/or actual cost.

Sheet No. 1 of 1

Description of Change Order
<p>Extend this contract to November 25, 1996.</p> <p>The hydrology study portion of the project was delayed by unforeseen difficulties encountered in updating existing studies to current District criteria. Additional delays resulted from the need to obtain additional aerial mapping. The revised completion date of November 25, 1996, is based on the assumption that additional unforeseen difficulties do not occur in the future.</p>

We, the undersigned Contractor/Consultant, having given careful consideration to the change(s) proposed, hereby agree, if this proposal is approved, that we will provide all equipment, furnish all material (except as may otherwise be noted above), and perform all services necessary for the work above specified, and we will accept as full payment therefor the prices shown above.

By reason of this proposed change 90 days extension of time will be allowed.

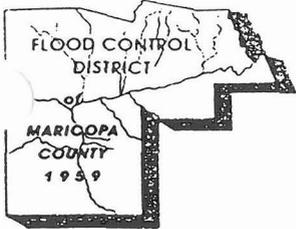
Total new contract amount through this Change Order No. 1 is \_\_\_\_\_

Contractor/Consultant: Montgomery Watson  
6245 North 24th Parkway  
Suite 208  
Phoenix, AZ 85016

By: [Signature]  
 Title: Project Manager  
 Date: 8/1/96

Recommended by: [Signature]  
 Date: AUGUST 5, 1996

Approved by: [Signature]  
 Chief Engineer and General Manager  
 Date: 8-9-96



# FLOOD CONTROL DISTRICT

of

## Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009

Telephone (602) 506-1501

Fax (602) 506-4601

TT (602) 506-5859

### BOARD OF DIRECTORS

Betsy Bayless

Ed King

Tom Rawles

Don Stapley

Mary Rose Garrido Wilcox

November 24, 1995

Montgomery Watson  
6245 North 24th Parkway, Suite 208  
Phoenix, Arizona 85016

Attention: Ms. Laurie Miller

Subject: Contract FCD 95-16 Skunk Creek Floodplain Delineation Study

Dear Ms. Miller:

This will confirm the November 2, 1995 verbal notice to proceed with work on the subject contract. Enclosed for your files is one fully executed copy of the contract.

Sincerely,

Dortha L. Klaahsen  
Contracts Coordinator

NOV 28 1995  
MONTGOMERY WATSON  
PHOENIX OFFICE

CONTRACT FOR CONSULTANT SERVICES

CONTRACT FCD 95-16

CS 96 5 036

Pursuant to the provisions of the Arizona Revised Statutes Section 48-3603, the Board of Directors has the authority to enter into contracts.

The Flood Control District of Maricopa County, Arizona, hereinafter called the "DISTRICT", is desirous of having certain professional services performed in connection with Contract FCD 95-16 Skunk Creek Wash Floodplain Delineation Study, hereinafter called the "PROJECT" and as more fully described in Exhibit "A", Scope of Work, attached; and

MONTGOMERY WATSON, hereinafter called "CONSULTANT", is desirous of performing said services;

THEREFORE, the parties hereto mutually agree as follows:

SECTION I - SERVICES OF THE CONSULTANT

The CONSULTANT, under the general supervision of the Manager, Engineering Division shall prepare studies, reports, surveys, plans, drawings, specifications and cost estimates as are necessary for the PROJECT and according to the directions and designated standards of the DISTRICT and in accordance with Exhibit A. It is understood and agreed that the DISTRICT's authorized representative shall be the Manager, Engineering Division or his duly authorized representative, hereinafter called the "AGENT" and that he/she shall be the sole contact for administering this contract.

The CONSULTANT shall meet periodically with the AGENT so as to keep the DISTRICT informed of the progress of the work in accordance with the schedule defined in Exhibit "A".

The CONSULTANT shall promptly advise the AGENT of any factors, which may develop during the PROJECT, that would likely result in construction or design costs in excess of budgetary constraints.

SECTION II - PERIOD OF SERVICE

The CONSULTANT shall complete all work per the schedule provided in Exhibit "A", Scope of Work within 240 calendar days after receipt of the Notice to Proceed, exclusive of DISTRICT review time. The DISTRICT is expected to require up to 60 calendar days for review time, for a total contract time period of 300 calendar days. Should extension of this contract period be necessary, and any such extension(s) continue the date of contract expiration for a time period of more than one year from the date of contract execution, adjustment(s) of the consultant's fee(s) may, upon agreement by both the DISTRICT and the CONSULTANT, be made in accordance with the Consumer Price Index for Urban Consumers, Western Division published by the U.S. Department of Labor, Bureau of Labor Statistics, using the published edition coinciding with the initial contract expiration date. Any such fee adjustment shall only apply to the extended contract time period.

### SECTION III - PAYMENTS TO THE CONSULTANT

The CONSULTANT shall be paid for work under this Contract a lump sum fee of \_\_\_\_\_ for Phase I, and a negotiated lump sum not to exceed \_\_\_\_\_ for Phase II, for a total contract amount of \_\_\_\_\_, plus any adjustments that have been approved in writing in accordance with the Maricopa County Procurement Code. Refer to Summary Fees by Task attached as Exhibit "B" to this contract and incorporated by reference.

The DISTRICT shall pay the CONSULTANT upon completion of the work as accepted by the DISTRICT, except that progress payments may be made as billed by the CONSULTANT based on approved monthly progress reports subject to the limitations set forth in Exhibit "A", Scope of Work. Ten percent of all contract payments made on an interim basis shall be retained by the DISTRICT as insurance of proper performance of the contract or, at the option of the CONSULTANT, a substitute security may be provided by the CONSULTANT in an authorized form pursuant to procedures established by the DISTRICT. The CONSULTANT is entitled to all interest from any such substitute security.

When the contract is fifty percent (50%) completed, one-half (1/2) of the amount retained will be paid to the CONSULTANT provided the CONSULTANT is making satisfactory progress on the contract and there is no specific cause or claim requiring a greater amount to be retained. After the contract is fifty percent (50%) completed, no more than five percent (5%) of the amount of any subsequent progress payments shall be retained providing the CONSULTANT is making satisfactory progress on the project, except if at any time the DISTRICT determines satisfactory progress is not being made, ten percent (10%) retention shall be reinstated for all progress payments made under the contract subsequent to the determination.

If the CONSULTANT desires a partial payment in accordance with the provisions above, the CONSULTANT will complete and forward, a DISTRICT provided form, indicating payment distribution to MBE/WBE firms.

Any retention monies shall be paid or substitute security returned or released, as applicable, to the CONSULTANT within forty-five (45) calendar days after: (1) Completion of the work in Exhibit "A" through the submittal of District accepted/approved documents to FEMA, (2) receipt of a completed "Certificate of Substantial Performance" form, (3) the CONSULTANT's statement that no project disputes exist; and (4) invoicing for any retained monies has been received by the DISTRICT. It is expressly understood that the release of retention is NOT applicable to any of the work to be accomplished under Task 9 - HIS DATA. This Task is outside those tasks necessary to accomplish the FEMA work. Upon acceptance and approval of the project by FEMA and the completion of all final work required by the DISTRICT, the CONSULTANT shall submit a final Certificate of Performance and its invoice for any sums remaining due and payable under this Contract.

### SECTION IV - THE DISTRICT'S RESPONSIBILITIES

The DISTRICT shall furnish the CONSULTANT, at no cost to the CONSULTANT, the following information or services for this PROJECT:

A. One copy of on-hand maps, records, survey ties, bench marks or other data pertinent to the PROJECT. This does not, however, relieve the CONSULTANT of the responsibility of searching records for additional information, for requesting specific information or for verification of that information provided. The DISTRICT does not warrant the accuracy or comprehensiveness of any such information.

B. All available information and data relative to policies, standards, criteria, and studies, etc. impacting the PROJECT as identified by the CONSULTANT.

C. Availability of staff for consultation with the CONSULTANT during the performance of studies and plan development in order to identify the problems, needs, and other functional aspects of the PROJECT.

D. Examination of documents submitted by the CONSULTANT and rendering of decisions pertaining thereto promptly, to avoid unreasonable delay in the progress of the work by the CONSULTANT. The DISTRICT will keep the CONSULTANT advised concerning the progress of the DISTRICT's review of work.

#### SECTION V - ALTERATION IN SCOPE OF WORK

Any alteration in the scope of work that will result in a substantial change in the nature of the PROJECT so as to materially increase or decrease the contract fee will require negotiation of an amendment to the contract to be executed by the DISTRICT and the CONSULTANT. No work shall commence on the change until the contract amendment has been approved by the DISTRICT and the CONSULTANT has been notified to proceed by the AGENT. It is distinctly understood and agreed that no claim for extra work done or materials furnished by the CONSULTANT will be allowed by the DISTRICT except as provided herein, nor shall the CONSULTANT do any work or furnish any materials not covered by this agreement unless such work is first authorized in writing in accordance with the Maricopa County Procurement Code. Any such work or materials furnished by the CONSULTANT without such written authorization first being given shall be at his own risk, cost, and expense, and he hereby agrees that without such written authorization he will make no claim for compensation for such work or materials furnished.

#### SECTION VI - RECORDS

Records of the CONSULTANT's payroll expense pertaining to this PROJECT and records of accounts between the DISTRICT and the CONSULTANT shall be kept on a generally recognized accounting basis and shall be available upon request to the DISTRICT or its authorized representative for audit during normal business hours. The records shall be subject to audit by appropriate grantor agency if the PROJECT is funded all or in part by a grant.

#### SECTION VII - PROJECT COMPLETION

If during the course of this contract situations arise which prevent completion within the allotted time, an extension may be granted by the AGENT.

## SECTION VIII - TERMINATION

The DISTRICT may terminate this contract at any time upon reimbursement to the CONSULTANT of expenses which include reasonable charges for time and material for the percentage of work satisfactorily completed and turned over to the DISTRICT.

The DISTRICT reserves the right to postpone, terminate or abandon this PROJECT for the CONSULTANT's failure to complete the PROJECT on time, or failure to comply with the provisions of the contract. The DISTRICT also reserves the right to terminate any or all parts of this contract for its own convenience as the DISTRICT may determine at its sole discretion.

The DISTRICT hereby gives notice that pursuant to A.R.S. Section 38-511 "A" this contract may be cancelled without penalty or further obligation within three years after execution if any person significantly involved in initiation, negotiation, securing, drafting, or creating a contract on behalf of the DISTRICT is, at anytime while the contract or any extension of the contract is in effect, an employer, agent, or any other party to the contract in any capacity or a consultant to any other party of the contract with respect to the subject matter of the contract. Cancellation under this section shall be effective when written notice from the Chief Engineer and General Manager is received by all of the parties of the contract. In addition, the DISTRICT may recoup any fee for commission paid or due to any person significantly involved in initiation, negotiation, securing, drafting, or creating the contract on behalf of the DISTRICT from any other party to the contract arising as a result of the contract.

The CONSULTANT may terminate this contract in the event of nonpayment of fees as specified in Section III, PAYMENTS TO THE CONSULTANT.

## SECTION IX - OWNERSHIP OF DOCUMENTS

All original documents including, but not limited to studies, reports, tracings, drawings, physical and computer models, estimates, field notes, investigations, design analyses, calculations, computer software, and specifications, prepared in the performance of this Contract are to be and remain the property of the DISTRICT and are to be delivered to the AGENT before final payment is made to the CONSULTANT. The DISTRICT reserves the right to reuse the documents as it sees fit. However, the DISTRICT will not reuse, alter, or modify these documents without noting such alterations, modifications, or intent of their reuse, and will hold the CONSULTANT harmless from any claims arising from the reuse, alteration, or modification of the documents. The CONSULTANT may retain reproducible copies of all such documents delivered to the DISTRICT.

## SECTION X - COMPLIANCE WITH LAWS

The CONSULTANT is required to comply with all Federal, State and local laws, local ordinances and regulations. The CONSULTANT's signature on this contract certifies compliance with the provisions of the I-9 requirements of the Immigration Reform and Control Act of 1986 for all personnel that the CONSULTANT and any subconsultants employ to complete this PROJECT. It is understood that the DISTRICT shall conduct itself in accordance with the provisions of the Maricopa County Procurement Code.

## SECTION XI - GENERAL CONSIDERATIONS

A. Prior to beginning the work, the CONSULTANT shall furnish the DISTRICT for approval the names of its key employees, and of its sub-consultants and their key employees to be used on this PROJECT. Any subsequent changes are subject to the written approval of the DISTRICT.

With the exception of the DISTRICT or the Federal Emergency Management Agency, the CONSULTANT agrees not to accept any clients within the area of the 100-year floodplain for the project, during the period of the Contract, without the expressed written authority from the Chief Engineer and General Manager of the District.

The CONSULTANT in replacing a MBE/WBE subcontractor should attempt to contract with another MBE/WBE.

B. The failure of either party to enforce any of the provisions of this Contract or to require performance of the other party of any of the provisions hereof shall not be construed to be a waiver of such provisions, nor shall it affect the validity of this Contract or any part thereof, or the right of either party to thereafter enforce each and every provision.

C. The CONSULTANT shall be responsible for the cost of any additional design, field layout, testing, construction and supervision necessary to correct those errors or omissions attributable to the CONSULTANT and for any damage incurred by the DISTRICT as a result of additional construction costs caused by such CONSULTANT errors or omissions.

D. The fact that the DISTRICT has accepted or approved the CONSULTANT's work shall in no way relieve the CONSULTANT's responsibility.

E. It is mutually understood and agreed that this Contract shall be governed by the laws of the State of Arizona, both as to interpretation and performance. Any action at law, suit in equity, or judicial proceeding for the enforcement of this Contract, or any provision thereof, shall be instituted only in the courts of the State of Arizona.

## SECTION XII - SUCCESSORS AND ASSIGNS

This Contract shall not be assigned by either party without prior written approval of the other except that the CONSULTANT may use in the performance of this Contract without prior approval of the DISTRICT, personnel or services of its related entities and affiliated companies as if they were an integral part of the CONSULTANT; and it shall extend to and be binding upon the heirs, executors, administrators, successors and assigns of the parties hereto.

## SECTION XIII - NO KICK-BACK CERTIFICATION

The CONSULTANT warrants that no person has been employed or retained to solicit or secure this Contract upon any agreement or understanding for a commission, percentage, brokerage, or contingent fee; and that no member of the Board of Directors/Supervisors or any employee of the DISTRICT has any interest, financially or otherwise, in the CONSULTANT firm.

For breach or violation of this warranty, the DISTRICT shall have the right to annul this Contract without liability, or at its discretion to deduct from the Contract price or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

#### SECTION XIV - ANTI-DISCRIMINATION PROVISION

The Flood Control District of Maricopa County will endeavor to ensure in every way possible that minority and women-owned business enterprises shall have every opportunity to participate in providing professional services, purchased goods, and contractual services to the Flood Control District of Maricopa County without being discriminated against on the grounds of race, religion, sex, age, disability, or national origin.

The CONSULTANT agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, age, disability, or national origin and further agrees not to engage in any unlawful employment practices. The CONSULTANT further agrees to insert the foregoing provisions in all subcontracts hereunder.

#### SECTION XV - AMENDMENTS

This Contract may be amended by mutual written agreement of the DISTRICT and the CONSULTANT.

#### SECTION XVI - INDEMNIFICATION AND INSURANCE

A. The CONSULTANT shall provide and maintain the following minimum insurance requirements:

1. Professional Liability. The CONSULTANT shall show evidence of maintaining continuous insurance for the past three (3) years with a minimum coverage limit of \$1,000,000.00 each claim and/or in the aggregate.

The CONSULTANT shall provide and maintain Professional Liability Insurance with a minimum single limit of \$1,000,000.00 for each claim made and an aggregate limit of \$1,000,000.00 for all claims made through this contract's completion date or the policy's life, whichever is longer.

2. Commercial General Liability. Commercial general liability insurance with a minimum single limit of \$1,000,000.00 for each coverage/occurrence. The policy shall include coverage for bodily injury and personal injury, broad form property damage and blanket contractual coverage.

3. Automobile Liability. Automobile liability insurance, with an individual single limit for bodily injury and property damage of no less than \$1,000,000.00, each occurrence, with respects to CONSULTANT's vehicles (whether owned, hired, non-owned), assigned to or used in the performance of this contract.

4. Workers' Compensation Insurance. This insurance shall be maintained during the life of the contract.

5. Additional Insured. The policies, except professional liability and workers' compensation, required by this section shall name the DISTRICT as Additional Insured, and shall specify that insurance afforded the CONSULTANT shall be primary insurance, and that any insurance coverage carried by the DISTRICT or its employees shall be excess coverage, and not contributory coverage to that provided by the CONSULTANT. No policy issued under this contract shall lapse, be cancelled, allowed to expire, or be materially changed to affect the coverage available to the DISTRICT without thirty (30) days written notice to the DISTRICT.

6. DISTRICT approved documentation outlining the coverages specified in this section shall be filed with the DISTRICT prior to issuance of the Notice to Proceed.

B. The CONSULTANT agrees to indemnify and save harmless the DISTRICT, any of its departments, agencies, officers, or employees from all suits, including attorney's fees and costs of litigation, actions, loss, damage, expense, cost or claims, of any character or any nature arising out of the CONSULTANT's wanton, willful or negligent acts, errors or omissions in the performance of work under this Contract, and any wanton, willful or negligent acts, errors or omissions by any subconsultant or other agent used by the CONSULTANT in the performance of work under this Contract.

IN WITNESS WHEREOF, the parties herein have executed this Contract.

MONTGOMERY WATSON

By: Marc M. Brown  
Principal (Signature)

Marc M. Brown  
Printed Name

Vice President  
Title

Date: September 29, 1995

95-187-8805  
Federal Tax Identification Number

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY:

Stanley L. Smith, Jr.  
Stanley L. Smith, Jr., P.E.  
Acting Chief Engineer and General Manager

Date: 10-3-95

ACCEPTED AND APPROVED:

Jan Raudes  
Chairman, Board of Directors

ATTEST:  
Jan M. Dewey  
Clerk of the Board

Date: NOV 01 1995

LEGAL REVIEW

Approved as to form and within the powers and authority granted under the laws of the State of Arizona to the Flood Control District of Maricopa County.

Julie M. Sommer  
General Counsel, District

Date: 10/5/95

EXHIBIT "A"  
SCOPE OF WORK  
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
FLOODPLAIN DELINEATION AND TOPOGRAPHIC MAPPING  
FOR  
SKUNK CREEK WASH FROM CAP TO NEW RIVER MOUNTAIN

## GENERAL

The project consists of approximately 10 river miles of floodplain delineations for portions of Skunk Creek from the Central Arizona Project Aqueduct to the south to New River Mountains to the north. The study area is defined as:

A portion of Skunk Creek from the CAP Aqueduct to 13.1 river miles upstream (cross section CN), incorporating 2.6 miles of existing floodplain mapping on the Del Webb property (10.5 river miles of study). A maximum of 9.25 river miles will be delineated as part of this project, with the identification of the limits of study to be determined in Phase II of the Scope of Work defined below.

An extension to the west of Skunk Creek floodplain delineation in Section 31 near the Town of New River, from Skunk Creek westerly 0.75 miles to the western boundary of Section 31.

This will require the development of the necessary topographic data and approximately 43 square miles of watershed hydrology. Montgomery Watson will develop the hydrology using the Corps of Engineer's HEC-1 computer model, and the floodplain and floodway delineations using primarily the HEC-2 computer model and the HEC-1 computer model if appropriate. Montgomery Watson must use sound engineering judgment in the development of the hydrologic and hydraulic models. The results of the models must be analyzed carefully and refinements made to the input parameters in order to obtain the most realistic results. All work must meet Arizona Department of Water Resources (ADWR) and Federal Emergency Management Agency (FEMA) requirements for floodplain delineations. The results of this study must be reviewed and accepted by FEMA, the Town of New River, and the City of Phoenix prior to the finalization of this contract. All work under this Scope will be completed within 300 calendar days from the date of Notice to Proceed, including 60 days for District reviews.

## PHASE I - MAPPING AND HYDROLOGY

### TASK 1 - COORDINATION

- 1.1 Montgomery Watson shall submit a project schedule showing coordination meetings and completion dates for each of the tasks in the scope within 14 days of Notice To Proceed. Montgomery Watson shall update this project schedule when appropriate.
- 1.2 Montgomery Watson shall participate in regular coordination meetings (approximately monthly) with the District's Project Manager and in milestone coordination meetings in the development of the hydrologic and hydraulic analyses. Montgomery Watson is responsible for the minutes of any meetings. Coordination and milestone meetings, including hydrologic reviews and field trips, will be combined. This scope includes a total of 10 coordination/milestone meetings. It is assumed that five meetings will be conducted at the office of Montgomery Watson.

- 1.3 Montgomery Watson shall submit a quarterly estimation of the projected billing within 14 days of Notice to Proceed. Thereafter, this estimation will be updated and submitted to the District's project manager at least 10 days prior to the end of each quarter.
- 1.4 Montgomery Watson shall submit monthly progress reports at least 5 days before submittal of monthly invoices. The report shall be brief and should be no longer than two typed pages. At a minimum, the monthly report shall contain the following:
  - a. A description of the work accomplished by task during the reporting month.
  - b. Percent (%) completed for the month and percent (%) cumulative completed for each task.
  - c. A brief description of the work to be accomplished the following month.
  - d. A description of any problems encountered.
- 1.5 Montgomery Watson is responsible for placing the legal advertising at the beginning of the study, notifying the public of the study. The ad will be run in a widely circulated newspaper two times, with approximately one week between runs. The ad must also be run two times in a local newspaper that serves the area being studied. After the ad is run Montgomery Watson will supply the District with the original affidavit of publication from each of the newspapers for each day that the ad ran.
- 1.6 Montgomery Watson shall notify all property owners and obtain any necessary Rights of Entry for the study area. Montgomery Watson shall furnish the District with a list of all the property owners notified and a sample Right of Entry letter.
- 1.7 Montgomery Watson shall meet with officials from the City of Phoenix, Town of New River, and MCDOT. The purpose of this meeting is to identify local flooding problems and obtain information on current and planned public works projects, channel modifications, storm-drainage systems, development, and corporate limits.
- 1.8 The District shall plan and conduct two public meetings in conjunction with this study. The first meeting will be to inform the public of the purpose and scope of the study. The second meeting will be to inform the public and obtain public comment on the study results, and shall take place prior to the submittal of the final report to FEMA. Montgomery Watson/District shall be responsible for the preparation of the graphic displays for these meetings. One representative from Montgomery Watson shall attend each of the meetings. Montgomery Watson shall respond to the public's comments and make revisions to the study if necessary.
- 1.9 Consultant/District Performance Evaluations will be performed. An informal evaluation will be performed at the completion of the hydrologic analysis. A formal evaluation will be performed at the completion of the project upon receipt of all deliverables. Each of these meetings will be combined with a coordination/milestone meeting.

## **TASK 2 - DATA COLLECTION**

- 2.1 Montgomery Watson shall collect and review pertinent data from the District and other outside sources. Data to be collected will include previous flood hazard reports and hydrology for the study area; existing topographic mapping; historical flooding information; as-built plans for existing structures; FEMA Flood Hazard Boundary Maps and any Letters of Map Amendment and/or Revisions; and other pertinent information.

- 2.2 A written report summarizing the data collected shall be submitted to the District for information purposes. A preliminary draft of this report will be submitted within 90 days of Notice to Proceed.

### **TASK 3 - TOPOGRAPHIC MAPPING**

- 3.1 Digital contour and planimetric data developed for this study shall be delivered according to the District's HIS specifications.
- 3.2 Digital Terrain Models shall be delivered following the guidelines stated in Digital Terrain Model Mapping, Data Collection & Delivery Specifications, Release 1.0 May 1994.
- 3.3 Prepare topographic mapping to a 2-foot contour interval, with a scale of 1 inch = 200 feet, with spot elevations on all section line and mid-section line roads.
- 3.4 Ground Control:
  - a. Montgomery Watson shall provide all survey control using 1983 NAD.
  - b. Montgomery Watson shall systematically set panel points and establish horizontal and vertical control throughout the areas to be mapped for use in compilation by the aerial survey contractor. Where readily available, surveys will tie into the State Plane Coordinate System 1983 NAD. Field control shall be sufficient to readily allow for compilation of maps by the aerial survey contractor at the desired map scale and contour interval, and will be based on the National Geodetic Vertical Datum of 1929 (NGVD). A conversion factor, including documentation of how it was derived, will be provided by Montgomery Watson to allow comparison of NGVD 1929 elevations to NAVD 1988 elevations and will be included in the Technical Data Notebook.
  - c. The horizontal and vertical control points shall be located and marked by Montgomery Watson. The controls for the aerial mapping shall be in sufficient numbers and shall be in locations which will be compatible with the accuracy of the mapping requirements. The controls shall be of at least third order accuracy. Section corners, quarter corners, and mid-section points shall be used for control points wherever possible.
- 3.5 Montgomery Watson shall provide permanent non-erasable topographic mylars of the work study drawings. The drawings shall be 24" X 36" in size, with a scale of 1 inch = 200 feet and a contour interval of 2 foot for all mapping. A cover sheet will be provided with the project title, date of topographic mapping, and a location map showing geographic range covered by each specific mapping sheet. Each drawing shall include the floodplain and floodway delineations and a minimum of a north arrow, scale, section corners and quarter corners, current and proposed streets and highway names, State Plane Coordinate System, major drainage features, corporate boundaries, cross section lines, channel station center line, index map, and description and elevation of elevation reference marks (ERMs). A note explaining the proper means to convert the NGVD 1929 elevations to NAVD 1988 elevations shall be included in "NOTES" in the map border. The mapping will have an accuracy such that ninety percent (90%) of all contours shall be within one-half contour of the true elevations and the remaining ten percent (10%) of the contours shall not be in error by more than one contour interval.
- 3.6 Montgomery Watson shall compare the new topographic mapping to the mapping used to produce the current floodplain delineations. The comparison will include checking map datums; the presence and elevation of bridge structures; and location of channel banks and

flowlines. Ground elevations will be compared at up to 14 cross sections used in the current floodplain analysis HEC-2 model. A written report shall be submitted to the District summarizing the findings of the topographic mapping comparison, and making recommendations for the future direction of the floodplain delineation study.

- 3.7 Kenney Aerial Mapping, an aerial survey subcontractor, shall be retained by Montgomery Watson as part of this contract. Montgomery Watson shall coordinate all the aerial surveying work with the aerial surveying subcontractor to ensure that the specifications of the aerial surveying work are met. Montgomery Watson is responsible for ensuring that the topographic mapping covers the area of delineation. Quality control on surveys will be per FEMA Document 37, Flood Insurance Study Guidelines and Specifications for Study Contractors, January 1995.

The extent of mapping coverage will be determined from the existing floodplain delineation. The new mapping will extend a minimum of 400 feet beyond the existing floodplain boundary on both sides of the floodplain.

#### **TASK 4 - FIELD SURVEY**

- 4.1 Prepare topographic mapping to a 2 foot contour interval with a scale of 1 inch = 200 feet, with spot elevations or 1 foot contours on all section line and mid-section line roads, for floodplain/floodway delineation areas as identified in Task 6 or FEMA criteria, whichever is more stringent.

- 4.2 Ground Control for Floodplain Delineations:

- 4.2.1 All topographic mapping and survey work shall meet or exceed Federal Emergency Management Agency (FEMA) minimum criteria as defined in FEMA Document 37, Flood Insurance Study Guidelines and Specifications for Study Contractors, January 1995. This would include, but is not limited to: the establishment of "permanent" elevation reference marks (ERMs); field control; and verification of profiles by the ground survey profile procedure.

- 4.2.2 Horizontal and Vertical Control: Systematically set panel points and establish horizontal and vertical control throughout the area to be mapped for use in compilation by the aerial survey contractor. Where readily available, surveys will tie into State Plane Coordinate System 1983 NAD. Field control shall be sufficient, at least one "permanent" point per mile, such point(s) being used as Elevation Reference Marks (ERMs). Surveys will be based on National Geodetic Vertical Datum (NGVD) 1929, per FEMA guidelines. A conversion factor, including documentation of how it was derived, will be provided by Montgomery Watson to allow comparison of NGVD 29 elevations to NAVD 88 elevations and will be included in the Technical Data Notebook. "Permanent" survey points shall consist of existing monumentation, such as brass caps or similar survey monuments. Where additional monumentation is needed, survey markers conforming to Maricopa Association of Governments (MAG) Uniform Standard Detail for Public Works Construction, detail 120-1, Type C, shall be placed 2" +/- above grade, and topped with a brass cap. Elevation Reference Marks will be labeled on available maps and described in a manner which allow them to be readily located in the field.

- 4.2.3 All aerial targets are to be removed following completion of the topographic mapping.

- 4.3 Montgomery Watson shall verify the accuracy of the mapping by the procedures called for in FEMA Document 37 or other methods approved by FEMA. This shall include the verification of cross sections used in the floodplain delineation.
- 4.4 Field surveys of bridges, culverts, and hydraulic structures shall be obtained by Montgomery Watson when as-built plans are not available or when changes significant to the HEC-2 modeling, such as sedimentation, have occurred since the date of as-built. This information should be reduced and compiled into an 11"x 17" (maximum size) drawing for inclusion in the final report. The information presented in the drawing should be in a format appropriate for use in the HEC-2 model. Field surveys of bridges, culverts, hydraulic structures, and routing reaches must also be obtained where necessary for proper hydrologic modeling. It may be necessary to field survey some structures since the as-built plans may not be on 1929 NGVD.
- 4.5 Field survey tasks will be performed by Collins-Piña Engineers as a subcontractor to Montgomery Watson. All ground survey tasks will be coordinated and managed by Montgomery Watson.

#### **TASK 5 - HYDROLOGY**

- 5.1 The hydrologic study of the watershed shall be delivered to the District under separate cover from the hydraulic analysis. Montgomery Watson shall use the U.S. Army Corps of Engineers computer program HEC-1, 1990 Version 4.0, to develop a hydrologic model for the area. Using appropriate hydrologic judgment, sub-basins are to be identified that provide reasonable depiction of the watershed condition. The sub-basins must be as homogeneous as possible, using watershed area, watershed type (mountainous and flat lands or urban and undeveloped areas), and time of concentration as criteria. Sub-basin break-downs will be done in sufficient detail to provide peak discharges at structures, major road crossings, confluences, and at boundary lines. An appropriate time step and number of ordinates is to be selected that allows for complete calculation of the flood hydrograph without sacrificing resolution of the flood peak. All calculations, or assumptions used in developing sub-basin and routing parameters shall be documented and made a part of the appendix for the hydrology report. Field surveys may need to be taken for HEC-1 modeling purposes.
- 5.2 Input parameters used in the Harris-Toups Associates rainfall-runoff model for the current FIS hydrology (available for the watershed upstream of Carefree Highway) will be evaluated with respect to the District's hydrologic criteria. Current model data will be incorporated where possible. Recent (1990) hydrologic models for the Cline Creek and Roger Creek watersheds will be updated by the District and provided to Montgomery Watson. The revised models will then be incorporated as is into the new HEC-1 model.
- 5.3 Four meetings associated with four tasks, and two field trips shall be held with the Flood Control District staff at the following milestones:
  - a. One field trip at the start of the project to scope out the critical points of the watershed and problem areas.
  - b. Meeting number 1: as soon as basic data are gathered and the sub-basins have been delineated. Sample HEC-1 parameter estimations should also be presented and discussed at this meeting. A copy of the draft maps of the sub-basins must be delivered to the District at this meeting.
  - c. Meeting number 2: after all the parameters have been estimated. A draft copy of the parameters must be delivered to the District at least one week prior to this meeting.

- d. Meeting number 3: after the preliminary HEC-1 results have been obtained and a draft report has been prepared. A copy of the draft report and the copy of the HEC-1 on a floppy disc, compatible with the Districts computer, must be delivered two weeks prior to the meeting.
- e. Meeting number 4: to review comments by the District. A second field trip may be scheduled for the same day so the results obtained could be discussed.

The four meetings identified above will be conducted concurrently with the regular coordination/milestone meetings identified in Task 1.

#### 5.4 The specific hydrologic techniques to be used in this study are:

- a. **Rainfall Depth:** Point precipitation values shall be determined using the information and procedures described in the Drainage Design Manual for Maricopa County, Arizona: Volume I - Hydrology.

**Rainfall Distribution:** Peak discharges and peak volumes for the 100-year 6-hour storm shall be estimated using the District's Distribution(s). Peak discharges and peak volumes for the 100-year 24-hour storm shall be estimated using the SCS Type II rainfall distribution.

- b. **Areal Reduction:** The point precipitation values shall be areally reduced for critical concentration points. Areal reduction for the 6 hour rainfall duration shall be applied using the curves in the Drainage Design Manual for Maricopa County, Arizona: Volume I - Hydrology. NOAA HYDRO-40 shall be used with the 24 hour rainfall reduction. Copies can be obtained from the District.
- c. **Rainfall Excess:** The Green and Ampt methodology shall be utilized for estimation of rainfall losses. The Lotus spreadsheet and procedures, provided by the District, shall be used to determine composite parameter values for each sub-basin.
- d. **Unit Hydrograph:** The Clark and S-Graph method shall be used following the procedures outlined in the Drainage Design Manual for Maricopa County, Arizona: Volume I - Hydrology. The choices in methodology shall be at the discretion of Montgomery Watson, with consent from the District.
- e. **Time of Concentration and S-Graph Lag Equation:** The Papadakis method shall be used with the Clark unit hydrograph, along with the MCUHP1 computer program, to determine the time of concentration. If this method results in unsuitable times of concentration, other method(s) must be used and compared for the most realistic result. The S-graph lag equation, along with the MCUHP2 computer program, shall be used with the appropriate S-graph (Phoenix mountain or Phoenix Valley).
- f. **Channel Routing:** Channel routing shall be accomplished using either the Muskingum-Cunge or the Normal-Depth option of HEC-1. The choice of methodology shall be at the discretion of Montgomery Watson, with consent from the District. Average cross sections shall be developed utilizing available mapping and field reconnaissance data. Sufficient field cross sections shall be taken to ensure that routing reaches are reasonable and representative of field conditions.

The HEC-1 routing parameters for the reaches modeled using HEC-2 shall be adjusted after the HEC-2 cross sections are available. The resulting velocities and depths, for all reaches, must be assessed for realistic values.

- g. Reservoir Routing: Detailed analysis of structures and ponding areas shall be accomplished using the Modified Puls reservoir routing option of HEC-1. Stage versus discharge tables for hydraulic structures shall be estimated using appropriate hydraulic methodology.
- h. Channel Transmission Losses: Attempts shall be made to estimate infiltration losses through channel bottoms based on existing field data or literature. If sufficient data is not available, the final report must acknowledge so and explain how the peaks and volumes of flow are affected by not including the transmission losses.

5.5 The District shall provide appropriate references to facilitate parameter estimation.

5.6 Output of the computer model shall be reviewed to see if the peak flows and volumes are realistic. Flows will be tested for reasonableness using approximate methods, including ADWR regional regression equations, District unit discharge relationships, and agreement with other hydrologic studies in the area. Flows at the CAP Aqueduct will be compared to a statistical flood-frequency analysis of the USGS streamgage data collected at I-17. Adjustments to input for obtaining the most realistic results is normal to the scope.

5.7 Every attempt will be made to recover historic stream gage data and use it to compare with the results obtained by the hydrologic model. Major differences will be discussed in the final report.

5.8 Results from the new hydrologic analysis will be reviewed and compared with those from the earlier Harris-Toups Associates and Corps studies. Both studies will be reviewed in greater detail for areas where there may be significant discrepancies. Following resolution of any differences, any changes in hydrology will be re-evaluated for their effect on the final floodplain delineation.

5.9 If peak discharges from the new HEC-1 modeling differ significantly from currently adopted discharges, Montgomery Watson shall assess the potential impacts of the new flows on current Base Flood Elevations and floodplain widths. In order to evaluate the sensitivity of the new hydrology, two test reaches will be established. The existing HEC-2 model will be used and modified as appropriate to reflect revised parameters and discharges.

5.10 Montgomery Watson shall obtain the approval of the District at each of the following steps:

- a. Soil maps, watershed boundary maps, and land use maps.
- b. HEC-1 parameter estimation.
- c. HEC-1 flow diagram and input parameters.
- d. HEC-1 results.

5.11 The Hydrologic Report

5.11.1 The findings of the hydrologic study shall be presented in Section 3 of the Technical Data Notebook and shall be prepared in accordance with ADWR State

Standards Attachment 1-90 (SSA 1-90). The report shall be organized as specified by the District, following SSA 1-90 format.

5.11.2 Tables and Figures for the appendices:

- a. Topographic base map(s) showing the sub-basins, routing reaches, Tc flow paths or lag flow paths, major man-made structures, and references (i.e. street names, Township, Range, Section, etc.) at a scale of 1 inch = 2000 feet.
- b. Soils map(s) at the same scale as the base map.
- c. Land use map(s) at the same scale as above.
- d. Schematic map for the HEC-1 showing the sub-basins (area, Tc), the flow paths, the routing reaches (length, slope, friction, width, velocities, transmission losses, etc.), order of combining the hydrographs, channel, pipe or culvert dimensions (where appropriate).
- e. Pertinent data on all the structures in the watershed (such as spillway elevation, rating curves, etc.).
- f. One set of study maps (i.e. sub-basin boundary maps, flow path maps, soils maps, land use maps) to be folded and delivered in a binder.

Specific deviations from this hydrologic scope shall not be undertaken without the specific written concurrence from the Flood Control District.

#### **TASK 6 - EXISTING HYDRAULIC MODEL REVIEW**

- 6.1 Montgomery Watson shall obtain the existing FIS HEC-2 model from Carefree Highway to the upstream study limit. Model parameters and modeling assumptions shall be reviewed and verified with respect to current District and FEMA guidelines. The accuracy of the current model, based on the existing topographic data, will be evaluated. In addition, the feasibility of using existing model input data with the new topographic mapping will be assessed. This will include an evaluation of the probable impact of new bridge structures at Carefree Highway and New River Road on the current floodplain mapping. This review will not be performed on the 2.6-mile reach through the Del Webb property.
- 6.2 Montgomery Watson shall prepare a written summary of the existing HEC-2 model review, specifying necessary parameter adjustments and model corrections to meet present standards.

#### **TASK 7 - DECISION ON STUDY DIRECTION**

- 7.1 Montgomery Watson and the District shall meet to determine the future direction of the study, based on the results of the Phase 1 work tasks. The validity of the current hydrology and HEC-2 modeling for use in an updated floodplain delineation study will be assessed. Possible decisions on study direction include:
  - (1) Prepare LOMRs for isolated areas where the current mapping is not adequate for floodplain management purposes (e.g., at new bridges).
  - (2) Prepare new floodplain mapping for up to 10 river miles of study reach using the currently adopted discharges and new topography.

- (3) Prepare new floodplain mapping for up to 10 river miles of study reach using the new discharges and new topography.

7.2 Based on the results of the decision reached in Task 7.1, Montgomery Watson and the District shall agree to a final scope of work and fee to complete the remaining project tasks.

(Note: The Scope of Work and Fee Estimates for Phases 2 and 3 assume that new floodplain mapping will be prepared for up to 10 river miles of study reach utilizing new discharges and new mapping.)

## PHASE II - DETAILED HYDRAULIC ANALYSIS

### TASK 8 - FLOODPLAIN DELINEATION

- 8.1 Floodplain delineations shall be obtained using the U.S. Army Corps of Engineers HEC-2 Water Surface Profiles computer model, version 4.6.2, May 1991, and methodology acceptable to FEMA. This model will simulate the effects of floodplain geomorphology, flow changes, bridges, culverts, hydraulic roughness factors, effective flow limitations, split-flows, and other considerations. Montgomery Watson shall prepare the study using the guidelines established in FEMA Document 37, Flood Insurance Study Guidelines and Specification for Study Contractors, January 1995, and FIA Document 12, Appeals, Revisions, and Amendments to Flood Insurance Maps, January 1990.
- 8.2 The delineation work shall meet requirements for floodplain and floodway delineations as prescribed by FEMA and the Arizona Department of Water Resources.
- 8.3 The delineation study shall be based on the final results of the hydrologic study as directed by the District.
- 8.4 The hydraulic analysis for the reach upstream of Carefree Highway and exclusive of the Del Webb study area shall be based on the current FIS HEC-2 model. Existing cross section locations shall be reviewed for adequacy with respect to the new topographic mapping and floodplain conditions, and shall be retained if possible and adjusted where necessary.
- 8.5 Floodplain mapping for the Del Webb property (approximately 2.6 miles) will be taken directly from the LOMR analysis currently being conducted by others. HEC-2 input data from the LOMR will be integrated directly into the HEC-2 model for this floodplain mapping study to produce a single uniform model. Any resulting discrepancies at model boundaries will be resolved and/or brought to the attention of the District.
- 8.6 The hydraulic analysis between the CAP Aqueduct and Carefree Highway shall be new HEC-2 modeling, matching previous FIS cross section locations as closely as possible.
- 8.7 Floodplain mapping shall be extended west of Skunk Creek in Section 31 near the Town of New River, to account for the influence of two tributaries to the main Skunk Creek channel. The western limit of study for Skunk Creek will be the western boundary of Section 31.
- 8.8 Montgomery Watson shall make refinements to the HEC-2 model based on review of the model results by the District, ADWR, FEMA, and the Technical Evaluation Contractor. Montgomery Watson shall review the HEC-2 model results for reasonableness. Adjustments to the input parameters for obtaining the most realistic results is normal to the scope.

8.9 Floodways shall be determined using equal conveyance encroachment method 4 to start with, but only encroachment method 1 will be used in the final analysis. The floodway encroachment is to be as near the one foot maximum rise in elevation as possible.

8.10 Montgomery Watson shall obtain District approval at each of the following steps:

- a. Field reconnaissance report and estimation of Manning's "n" values.
- b. Proposed location and alignment of the cross sections and channel centerline.
- c. Floodplain (natural) delineation.
- d. Floodway delineation using equal conveyance encroachment.
- e. Floodway delineation using encroachment method 1.
- f. Final Hydraulics Report.

8.11 Field Reconnaissance

8.11.1 Montgomery Watson shall conduct a field reconnaissance of the full study reach. This will include observation of channel and floodplain conditions for estimation of Manning's "n" values; photographic documentation of floodplain characteristics; determination of channel bank stations; observation of possible overflow areas; inspection of levees or other flood control structures; and measurement of bridge dimensions.

8.11.2 Mannings "n" values shall be determined using the methodology in the USGS report, *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona*, April 1991. Copies of the report are available through the District.

8.11.3 A draft report on the field reconnaissance shall be submitted to the District for review and approval prior to beginning the HEC-2 modeling. The report shall present the determination of channel and overbank "n" values using captioned color photographs or color photocopies. The report shall also discuss floodplain conditions affecting the delineation, describe structures and obstructions, and provide color photos or photocopies of major hydraulic structures. Photo locations, structures, and "n" values shall be displayed on reduced scale mapping and included in the Final Report.

8.12 Cross Sections

8.12.1 The location and alignment of cross sections and channel centerline shall be submitted for the District's review and approval prior to digitizing the cross section data. Cross section stationing shall be from left to right looking downstream with the thalweg as station 10000. Cross sections will be spaced approximately every 500 feet, unless geographic or structural constraints dictate otherwise, and shall extend the full width of the area inundated by 100-year flood waters. Identification of cross sections shall be in river miles, increasing upstream. The stationing shall tie into the specified river mile of the existing FEMA studies. Cross section orientation may need to be altered after running of HEC-2 model to ensure that sections are perpendicular to flow per FEMA criteria.

- 8.12.2 All cross sections shall be plotted using a pen, laser, or electrostatic plotter. The cross section plots shall show water surface profiles, ineffective flow areas, "n" values, encroachments, channel stationing and other pertinent information. All plots are to be accompanied by a legend. These plots are to be available at all reviews.
- 8.12.3 Cross section plots are limited to one plot at the following three stages of work: (a.) a plot of digitized "GR", STCHL, STCHR, centerline (station 10000) to be used as a check of input data and for working sections during compilation of the floodplain model; (b.) a plot of the cross section for the completed floodplain run which shows the floodplain water surface elevation, ineffective flow areas, "n" factor, and encroachments to be used as working sections for development of the floodway model; (c.) a plot of the final floodway model cross sections which will show Type 1 encroachments and encroached water surface, in addition to data covered in items (a.) and (b.). These cross sections, generated under (c.), will be submitted as part of the Final Report.
- 8.13 Bridges and culverts shall be modeled in compliance with HEC-2 modeling requirements for the selected routine. Where multiple bridges occur, each bridge shall be modeled separately. The HEC-2 modeling results for bridges, culverts, and other hydraulic structures must be checked by using an independent method approved by the District to analyze these structures.
- 8.14 Flood zones shall determined according to FEMA criteria and clearly labeled on the final drawings.
- 8.15 The total area of the floodplain and floodway shall determined for each reach in square miles and acres.
- 8.16 The findings of the floodplain/floodway delineation study shall be presented in Section 4 of the Technical Data Notebook and shall be prepared in accordance with ADWR State Standards Attachment 1-90 (SSA 1-90). The report shall be organized as specified by the District standards, following SSA 1-90 format.
- 8.17 Montgomery Watson shall coordinate and manage all portions of the work performed by its subconsultant, Hoskin Engineering Consultants. All work products generated by Hoskin Engineering Consultants will be reviewed and incorporated with Montgomery Watson's work products.

### PHASE III - SUBMITTALS

#### TASK 9 - HIS DATA

- 9.1 Digital data shall be prepared in conformance with the District's HIS Data Delivery Specifications, Revision 2.0, June 20, 1995, for the themes identified in Attachment A.
- 9.2 Separate check plots shall be produced from either Arc-Info or Arc-CAD from the digital database(s) of each theme in Attachment A. The check plots shall be prepared with a minimum of annotation and shall serve only to verify the information in the data base. If the hydrologic and delineation maps have not derived directly from the digital data delivered to the District, then Montgomery Watson shall certify that the check plots have been examined and that the check plots faithfully represent the data and maps used in the report and /or work maps.

## TASK 10 - DELIVERABLES

- 10.1 FEMA Submittal: Montgomery Watson will submit the following items to the District for review by FEMA and any other appropriate governmental agency. All of the following products are considered deliverables for the FEMA submittal:
- 10.1.1 Original Affidavits of Publication.
  - 10.1.2 Two (2) complete sets of blueline topographic base maps with the floodplain/floodway delineations shown. All drawings shall be signed and sealed by persons of appropriate professional registration(s). Each registrant shall provide a specific statement as to what service they performed.
  - 10.1.3 Two (2) complete copies of the Technical Data Notebook, including HEC-1 and HEC-2 input/output files on diskettes. The Technical Data Notebook shall be prepared in accordance with ADWR State Standards Attachment 1-90 (SSA 1-90). The notebook shall be organized as specified by the District, following SSA 1-90 format.
  - 10.1.4 Two (2) sets of completed FEMA forms shall be submitted in a notebook separate from the Final Report.
  - 10.1.5 One (1) copy of the Digital Terrain Model (DTM) shall be submitted following the guidelines stated in the Digital Terrain Model Mapping, Data Collection & Delivery Specifications, Release 1.0, May 1994.
  - 10.1.6 Three (3) sets of complete survey notes shall be submitted in a notebook separate from the Final Report.
  - 10.1.7 Two (2) copies of the current FIRM panels showing the proposed delineation.
- 10.2 Final Submittal: The following products are considered deliverables for the final submittal to the District after FEMA approval is issued:
- 10.2.1 One (1) complete set of non-erasable topographic mylars of the work study drawings. Sheets shall be 24" X 36" in size and numbered to correspond to the delineation maps.
  - 10.2.2 One (1) complete set of mylars and four (4) complete sets of sealed blueline topographic base maps with the floodplain/floodway delineations shown. All drawings shall be signed and sealed by persons of appropriate professional registration(s). Each registrant will provide a specific statement as to what service they performed.
  - 10.2.3 One (1) complete set of transparent overlays of photo-mylars. Sheet size, numbering, and layout shall correspond to the delineation work maps.
  - 10.2.4 One (1) complete set of 9" X 9" contact prints of the aerial stereo photographs sequentially numbered and catalogued.
  - 10.2.5 Digitized topographic data and floodplain/floodway boundaries in conformance with the District's HIS Specifications.

- 10.2.6 Four (4) complete copies of the Technical Data Notebook including HEC-1 and HEC-2 input/output files on diskettes. The Technical Data Notebook shall be prepared in accordance with ADWR State Standards Attachment 1-90 (SSA 1-90). The notebook shall be organized as specified by the District, following SSA 1-90 format. This submittal of the Technical Data Notebook shall include any correspondence and/or meeting minutes with the reviewing agencies and shall reflect any revisions required by those reviewing agencies. Revisions may include, but are not limited to, modifications to the delineation maps, the HEC-1 model, the HEC-2 model, and/or the Final Report.

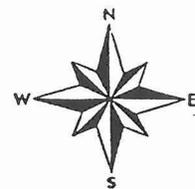
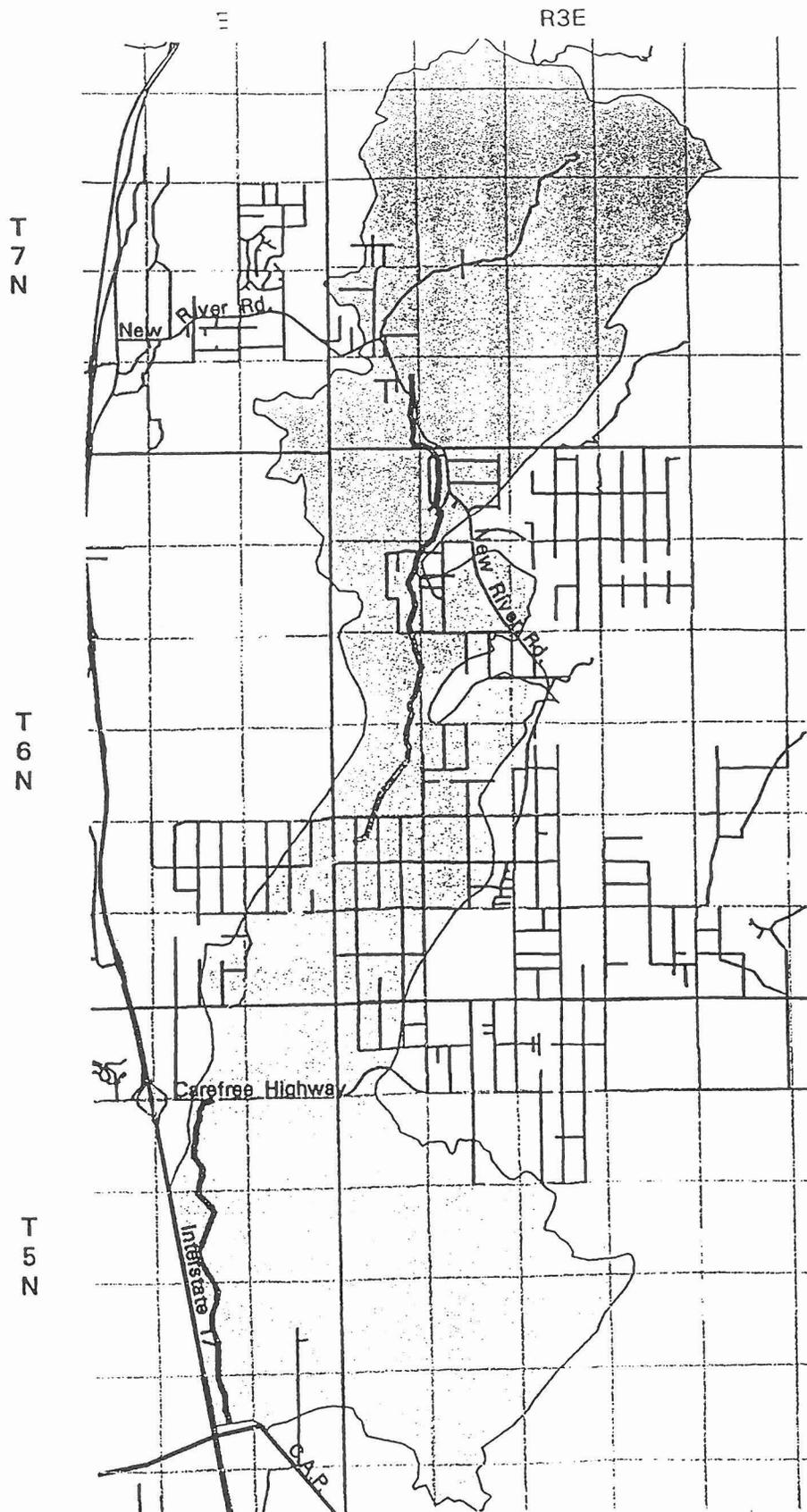
## TASK 11 - QUALITY CONTROL

- 11.1 Formal Technical Review Meetings will be conducted at two key milestones in the project: at the 80% completion level for the hydrologic analyses and the 80% completion level for the floodplain delineation analyses. Additional informal quality control checks will be performed throughout the project for all intermediate deliverables submitted to the District.

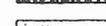
ATTACHMENT A  
SKUNK CREEK WASH FROM CAP TO NEW RIVER MOUNTAIN

Gis Deliverables Rev.2.0

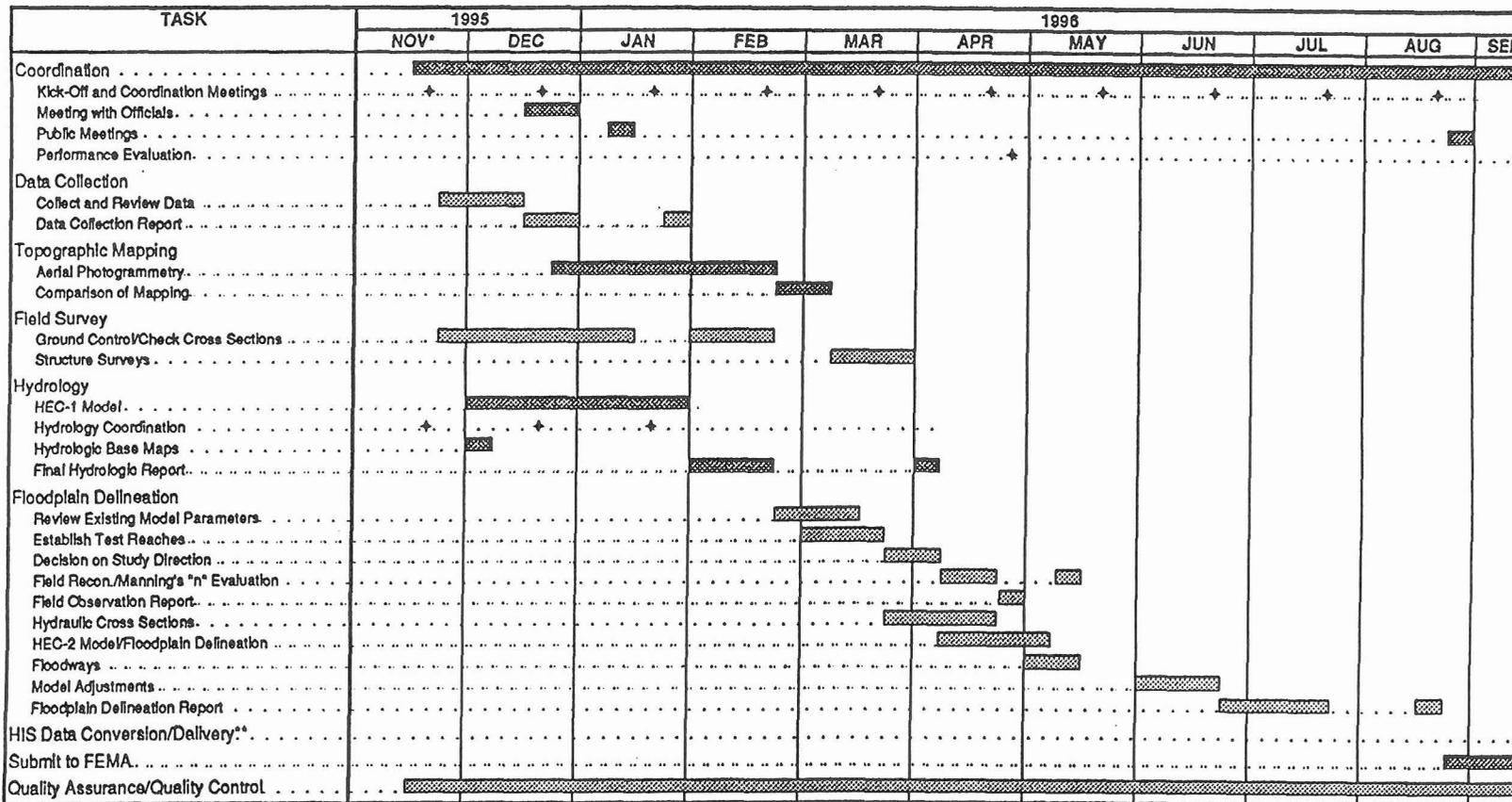
NDXPRJ (Project map Index)	LP-40
PRJ (Project Boundaries)	LP-60
CARTO (Miscellaneous Cartographic Features)	LP-110
CORNERS (PLSS Survey Control Points)	LP-210
CTRL (Miscellaneous Survey Points)	LP-215
STRCT (Structures : bridges,culverts, ...)	LP-360
DQ.REL (Data Quality)	LP-410
PRJ.REL (Project Information Table)	LP-430
FPBLN (Floodplain Baseline)	LP-520
FPCTRL (Fema control points)	LP-525
FPSRFFCD (Surface Water Elevation)	LP-535
FPXFCD (Cross Sections from HEC2)	LP-540
FPZNFCD (Floodplain zones)	LP-550
CNL (Canals, if any )	LP-610
FLTY-FCD (FCD Maintained Structures, if any)	LP-620
RR (Railroads, if any )	LP-650
ELV (Contours and Spot Elevations)	LP-710
DRNBSN (Drainage Basins)	LP-920
DRNPTH (Drainage Path)	LP-930
LAKE (Lakes, if any)	LP-950
RIVER (Stream flow lines)	LP-960



Scale = 1:10000

- ATTACHMENT 2
-  = Street Centerlines
  -  = Township & Range Lines
  -  = Section Lines
  -  = Central Arizona Project (C.A.P.)
  -  = Skunk Creek from C.A.P. to Carefree Highway - Approx. 3.85 River Miles
  -  = Skunk Creek from Carefree Highway to Del Webb Development Area - Approx. 3.44 River Miles
  -  = Skunk Creek within Del Webb Development Area - Approx. 2.58 River Miles
  -  = Skunk Creek from N. Boundary of Del Webb Development Area to End of Detailed Study - Approx. 3.17 River Miles
  -  = Drainage Basin - Area Approximately 42.49 Square Miles

**PROJECT SCHEDULE**  
**SKUNK CREEK FLOODPLAIN DELINEATION PROJECT**  
**FCD 95-16**  
**Revised 9/29/95**



\*Assumed Notice-to-Proceed 11-15-95.  
 \*\* Completion assumed 3 months following FEMA approval.

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## **Appendix I**

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## KEY TO CROSS-SECTION LABELING

Community Name: Maricopa County, Arizona, and Incorporated Areas  
 County: Maricopa County  
 State: Arizona  
 Prepared by: Montgomery Watson Americas, Inc.  
 Stream Name: Skunk Creek  
 Run Date: April 1997

Field Survey Section No.	XS Letter-Draft FIS	Computer Stationing	XS Letter-Final FIS	EPA Reach No.
		13.00		
		13.02		
		13.04		
		13.08		
		13.16		
		13.28		
		13.40		
		13.56		
		13.66		
		13.86		
		14.07		
		14.30		
		14.54		
		14.74		
		14.89		
		15.06		
		15.12		
		15.22		
		15.41		
		15.55		
		15.75		
		15.89		
		16.07		
		16.19		
		16.27		
		16.49		
		16.68		
		16.86		
		16.87		
		16.96		
		17.06		
		17.18		
		17.30		
		17.39		
		17.48		

Field Survey Section No.	XS Letter-Draft FIS	Computer Stationing	XS Letter-Final FIS	EPA Reach No.
		17.57		
		17.65		
		17.78		
		17.84		
		17.95		
		18.09		
		18.16		
		18.23		
		18.29		
		18.49		
		18.57		
		18.74		
		18.84		
		18.96		
		19.07		
		19.18		
		19.26		
		19.41		
		19.52		
		19.62		
		19.72		
		19.83		
		19.92		
		20.05		
		20.16		
		20.26		
		20.38		
		20.48		
		20.62		
		23.11		
		23.27		
		23.39		
		23.47		
		23.59		
		23.69		
		23.79		
		24.01		
		24.09		
		24.17		
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		24.62		
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		24.88		
		25.02		

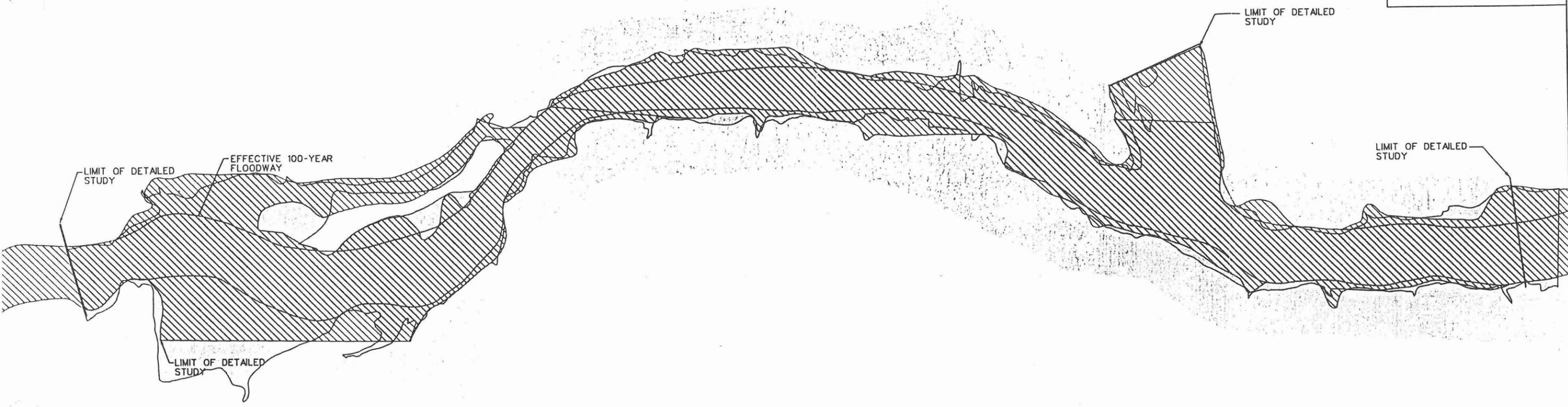
<b>Field Survey Section No.</b>	<b>XS Letter- Draft FIS</b>	<b>Computer Stationing</b>	<b>XS Letter- Final FIS</b>	<b>EPA Reach No.</b>
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		25.26		
		25.42		
		25.52		
		25.59		
		25.70		
		25.77		
		25.85		
		25.86		
		25.98		
		26.09		
		26.31		



**LEGEND:**

 EXISTING FIRM

 PROPOSED 100-YEAR FLOODPLAIN



REV	DATE	BY	DESCRIPTION

SCALE: 1"=1000'

WARNING: IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.

DESIGNED \_\_\_\_\_  
 DRAWN \_\_\_\_\_  
 CHECKED \_\_\_\_\_

SUBMITTED  
**LAURIE T. MILLER** 20934  
 PROJECT ENGINEER R. C. E. NO. DATE

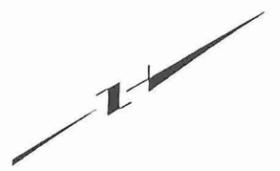
RECOMMENDED  
**FRED K. DUREN, JR.** 12250  
 MONTGOMERY WATSON R. C. E. NO. DATE

 **MONTGOMERY WATSON**  
 Phoenix, Arizona

MONTGOMERY WATSON  
 6245 N. 24TH PARKWAY, SUITE 208  
 PHOENIX, AZ 85016-2030  
 (602) 954-6781

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
 FLOODPLAIN DELINEATION STUDY  
**SKUNK CREEK**  
 FCDMC CONTRACT NO. 95-16

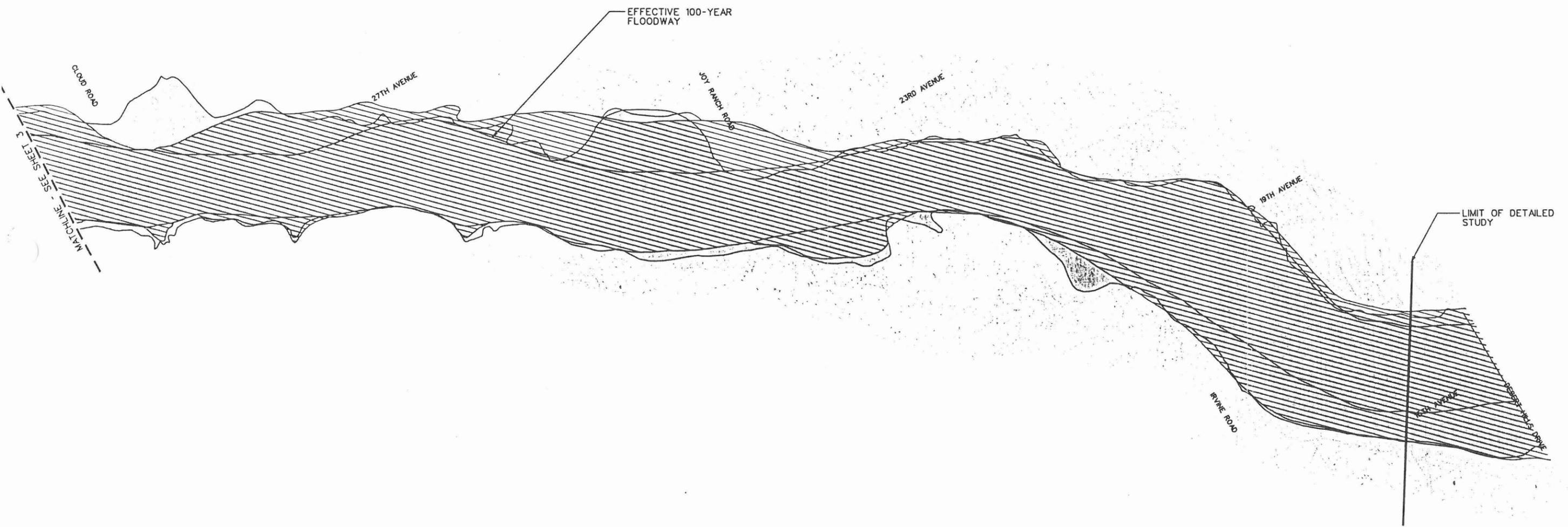
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**1**  
 OF 4 SHEETS



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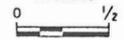
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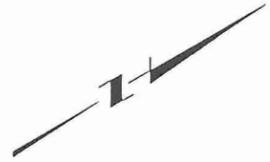
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PROJECT ENGINEER		R. C. E. NO.	DATE
RECOMMENDED	FRED K. DUREN, JR.	12250	
	MONTGOMERY WATSON	R. C. E. NO.	DATE

 **MONTGOMERY WATSON**

Phoenix, Arizona

MONTGOMERY WATSON  
6245 N. 24TH PARKWAY, SUITE 208  
PHOENIX, AZ, 85016-2030  
(602) 954-6781

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
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FCDMC CONTRACT NO. 95-16



**LEGEND:**

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 PROPOSED 100-YEAR FLOODPLAIN



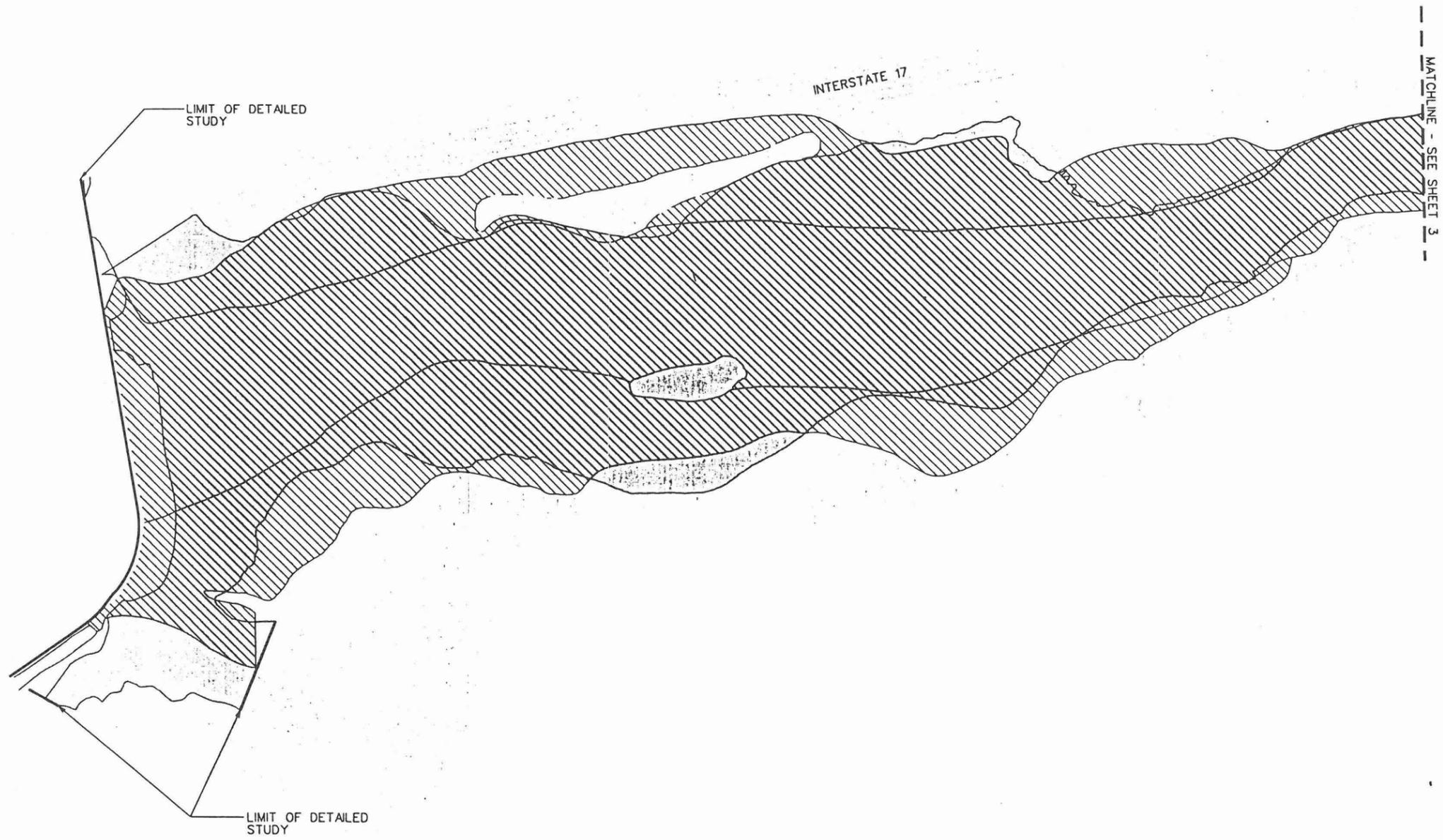
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**LEGEND:**

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 PROPOSED 100-YEAR FLOODPLAIN



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**LAURIE T. MILLER** 20934  
 PROJECT ENGINEER R. C. E. NO. DATE

RECOMMENDED  
**FRED K. DUREN, JR.** 12250  
 MONTGOMERY WATSON R. C. E. NO. DATE

 **MONTGOMERY WATSON**  
 Phoenix, Arizona

MONTGOMERY WATSON  
 6245 N. 24TH PARKWAY, SUITE 208  
 PHOENIX, AZ. 85016-2030  
 (602) 954-6781

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
 FLOODPLAIN DELINEATION STUDY  
**SKUNK CREEK**  
 FCDMC CONTRACT NO. 95-16

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 OF 4 SHEETS

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## Appendix J

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MONTGOMERY WATSON

**Technical Memorandum No. 1  
Comparison of Topographic Mapping  
and Hydraulic Structures**

# TECHNICAL MEMORANDUM NO. 1



MONTGOMERY WATSON



---

<b>To:</b>	Hasan Mushtaq 2801 West Durango Phoenix, Arizona 85009	<b>Date:</b>	February 27, 1996
<b>From:</b>	Laurie T. Miller, P.E.	<b>Reference:</b>	1213.0050 (FCD 95-16)
<b>Subject:</b>	Comparison of Topographic Mapping and Hydraulic Structures	<b>Project:</b>	Skunk Creek Floodplain Delineation

---

## INTRODUCTION

This technical memorandum is submitted in accordance with Task 3.6 of Phase I of the Scope of Work. This report summarizes findings of the topographic mapping and hydraulic structures comparisons and will be used as one criterion in determining the future direction of the floodplain delineation study.

The current floodplain delineation study is an update of an existing Flood Insurance Study (FIS) which was prepared in the late 1970s. The limits of the current study include a portion of Skunk Creek from the Central Arizona Project (CAP) Aqueduct to 13.1 river miles upstream, terminating at the north side of the New River Road crossing. Excluded from the study are 2.6 miles of Skunk Creek that lie within the Del Webb property north of Desert Hills Drive because floodplain mapping for this portion of the creek is being undertaken by Del Webb.

The study is separated into three phases, including Mapping and Hydrology (Phase I), Detailed Hydraulic Analysis (Phase II), and Submittals (Phase III). Results from Phase I investigations, such as the topographic mapping comparison, will be used to determine the direction and extent of Phase II activities.

## ANALYSES

Several sources of data were used to compare existing and new topography and hydraulic structures, including the original Harris-Toups work maps, the FIS flood profiles, and the FIS HEC-2 input data file. From this information, three comparisons were made between the topographic data used in the previous FIS and the new topography developed in the current floodplain delineation study in three areas:

- profile of thalweg
- selected cross sections
- hydraulic structures

These comparisons are summarized below.

## Profile of Thalweg

The first step in the analysis was to plot and compare the existing and new thalweg profiles. The existing thalweg profile was identified from two sources. For the southern portion of the study (i.e., the CAP Aqueduct to Carefree Highway), the flood profiles from the FIS were used as a basis of comparison. For the northern portion, (i.e., the Carefree Highway to cross section CN north of New River Road bridge crossing), the existing HEC-2 input data were used. These data were plotted against the elevation of the new thalweg as determined from the new topographic mapping (Figure 1).

Differences in elevation between the existing and new thalweg profiles were noted throughout the study reach, with some areas differing as much as eight feet. However, it is noted that there may be intrinsic problems in this type of comparison because the existing and new thalwegs may not be at the same location in some areas due to lateral and longitudinal shifting and erosion and deposition in the channel bed.

## Selected Cross Sections

Using the Harris-Toups work maps, selected cross sections from the original FIS were established on the new topographic maps for comparison. The comparison was limited to areas north of Carefree Highway because cross section data from the existing HEC-2 input were not available south of Carefree Highway.

Cross sections were selected based on the following criteria:

- include areas most likely and least likely to change (based on thalweg profile data)
- located near physical features or landmarks in order to verify the location
- most easily duplicated

Three cross sections were selected, as shown in Figures 2, 3, and 4, respectively. It should be noted that after initially plotting the prior and current cross sections, the current sections were shifted to coincide with the shape of the existing sections. This was done because, due to the uncertainty of plotting the cross sections from the same frame of reference, it was felt that matching the shape of cross sections through shifting would be most representative of the actual condition of the channel. It can be seen from the cross section plots that, as with the comparison of thalwegs, there are significant differences in elevation across the sections.

A quantitative evaluation of the change in cross sectional area of flow was made in order to objectively evaluate the differences in topography.

The following results were obtained from the cross section area evaluation:

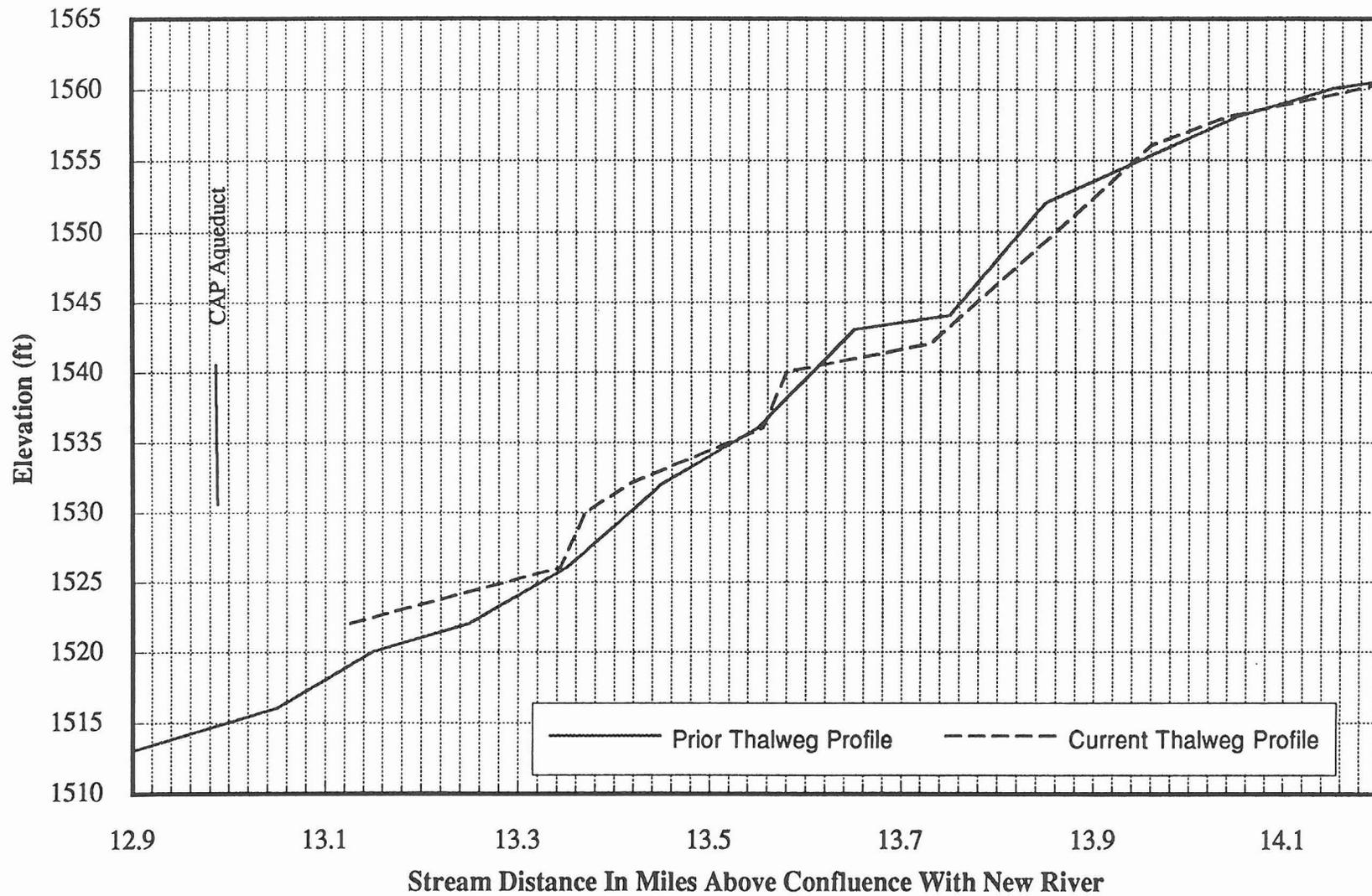
### 1. Cross Section BN:

100-year Flood Water Surface Elevation (WSEL) = 1,791 ft.

Prior cross sectional area below flood level = 5,495 sq. ft.

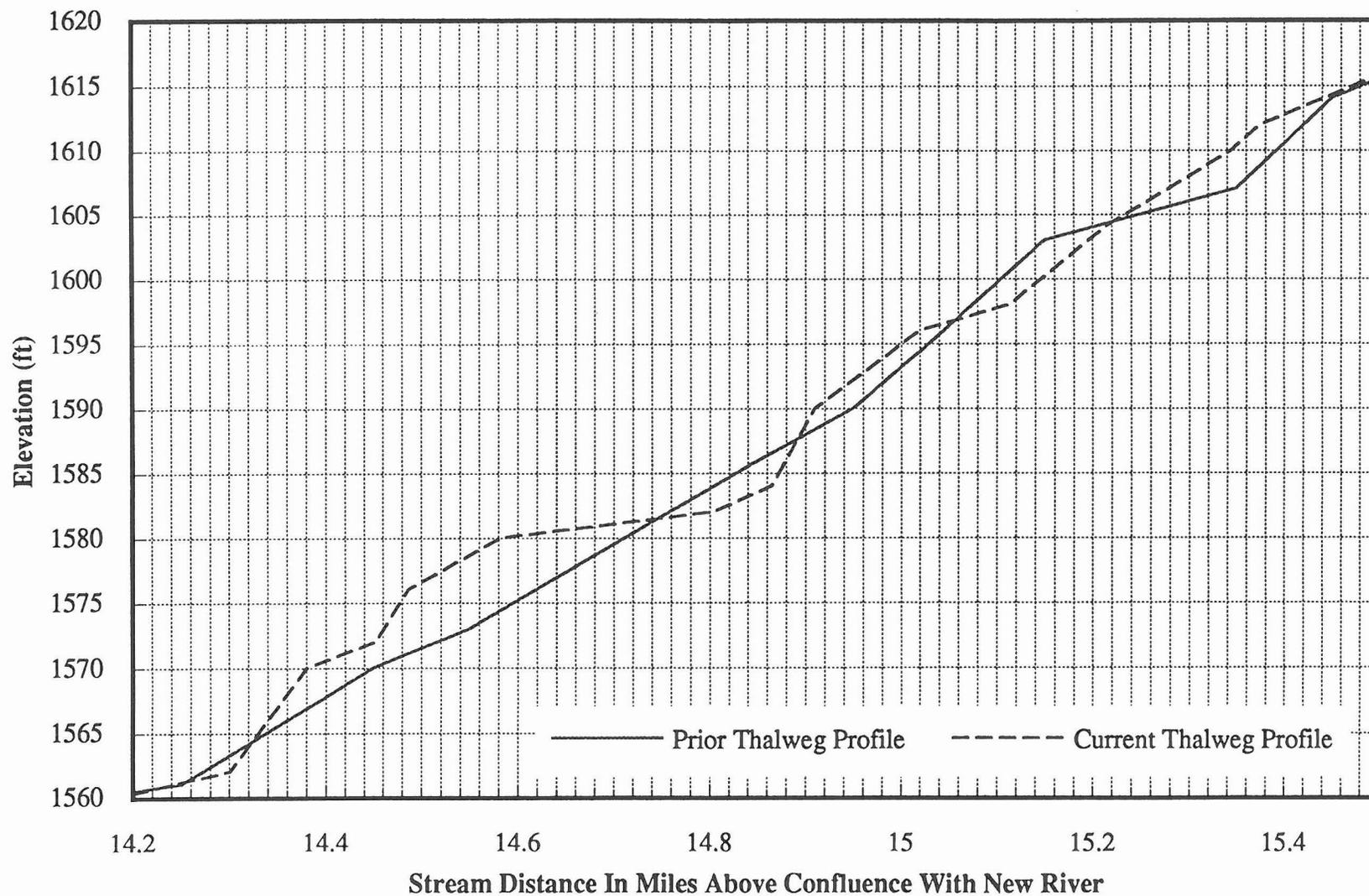
Current cross sectional area below flood level = 4,627 sq. ft.

Net Change = 16% decrease



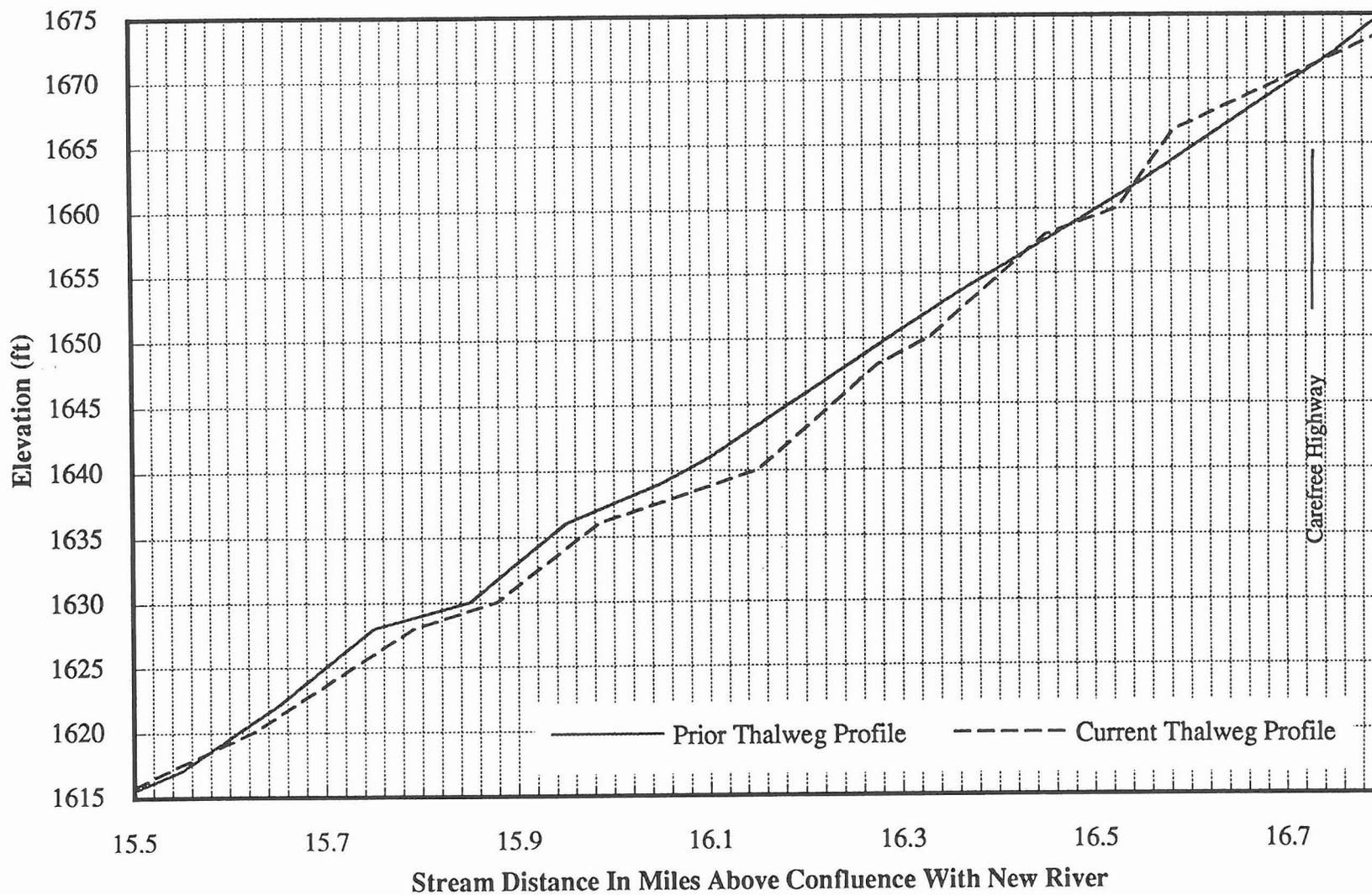
COMPARISON OF THALWEG PROFILES

FIGURE 1



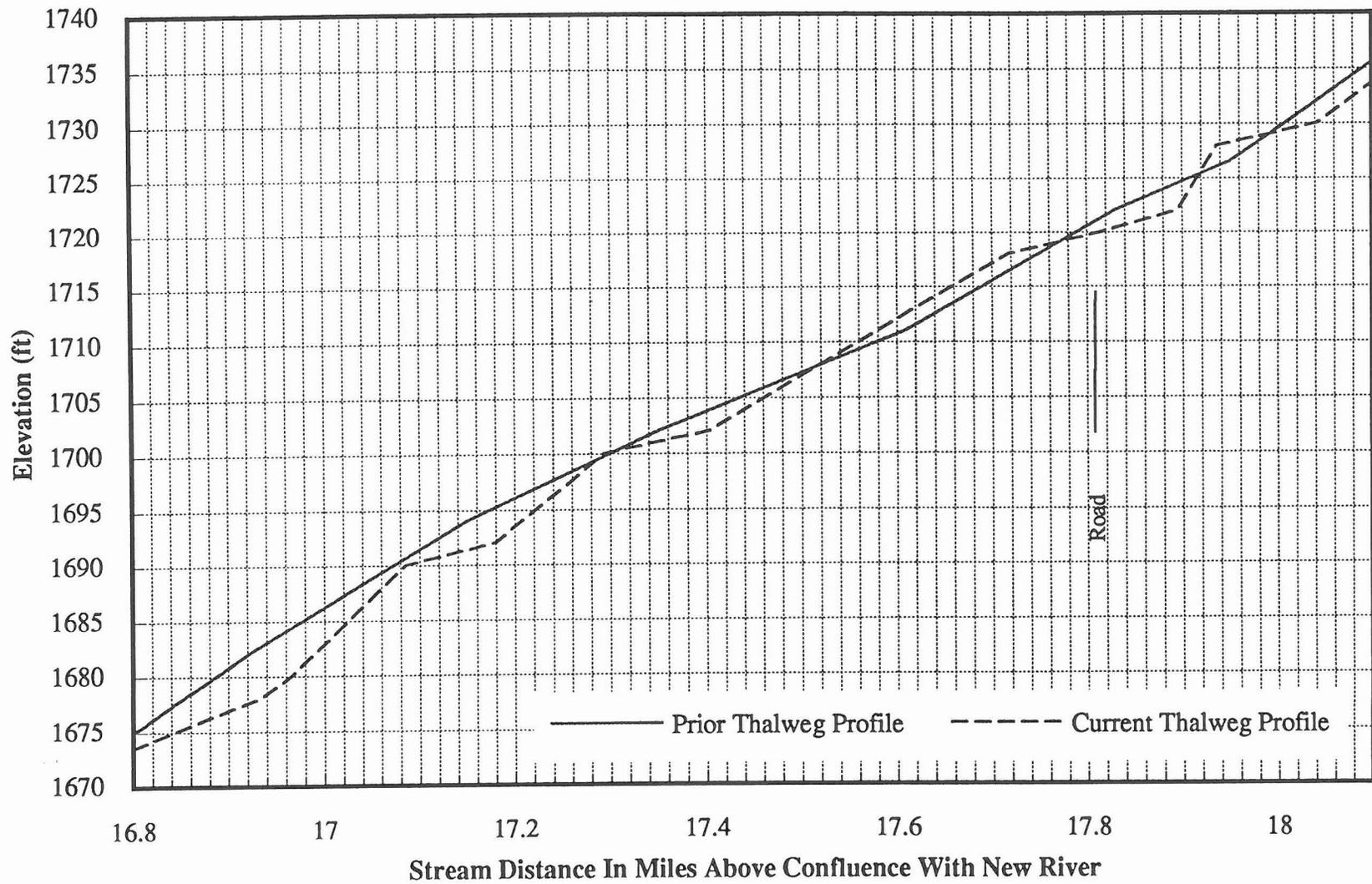
**COMPARISON OF THALWEG PROFILES**

**FIGURE 1 (Cont.)**



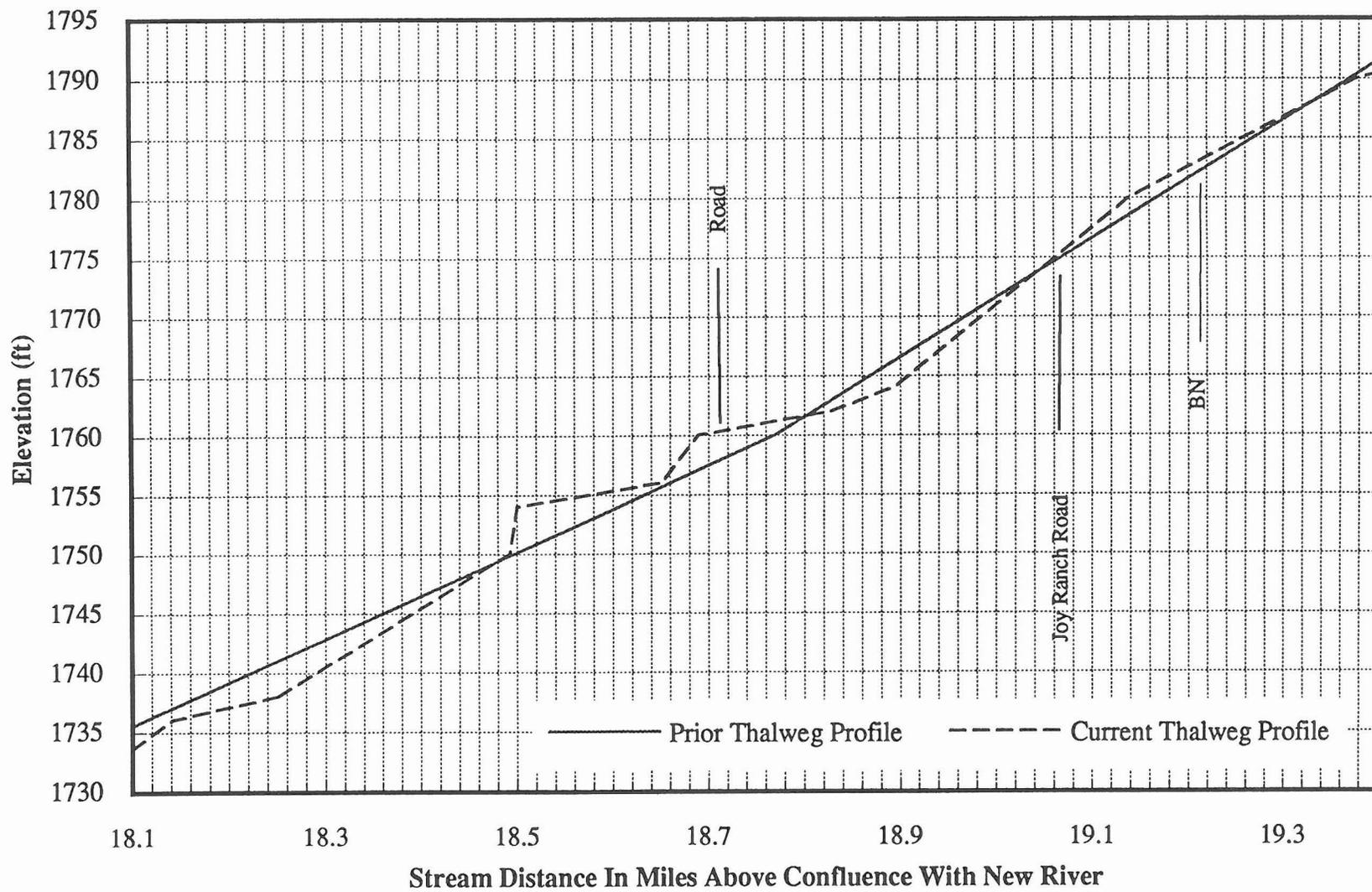
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



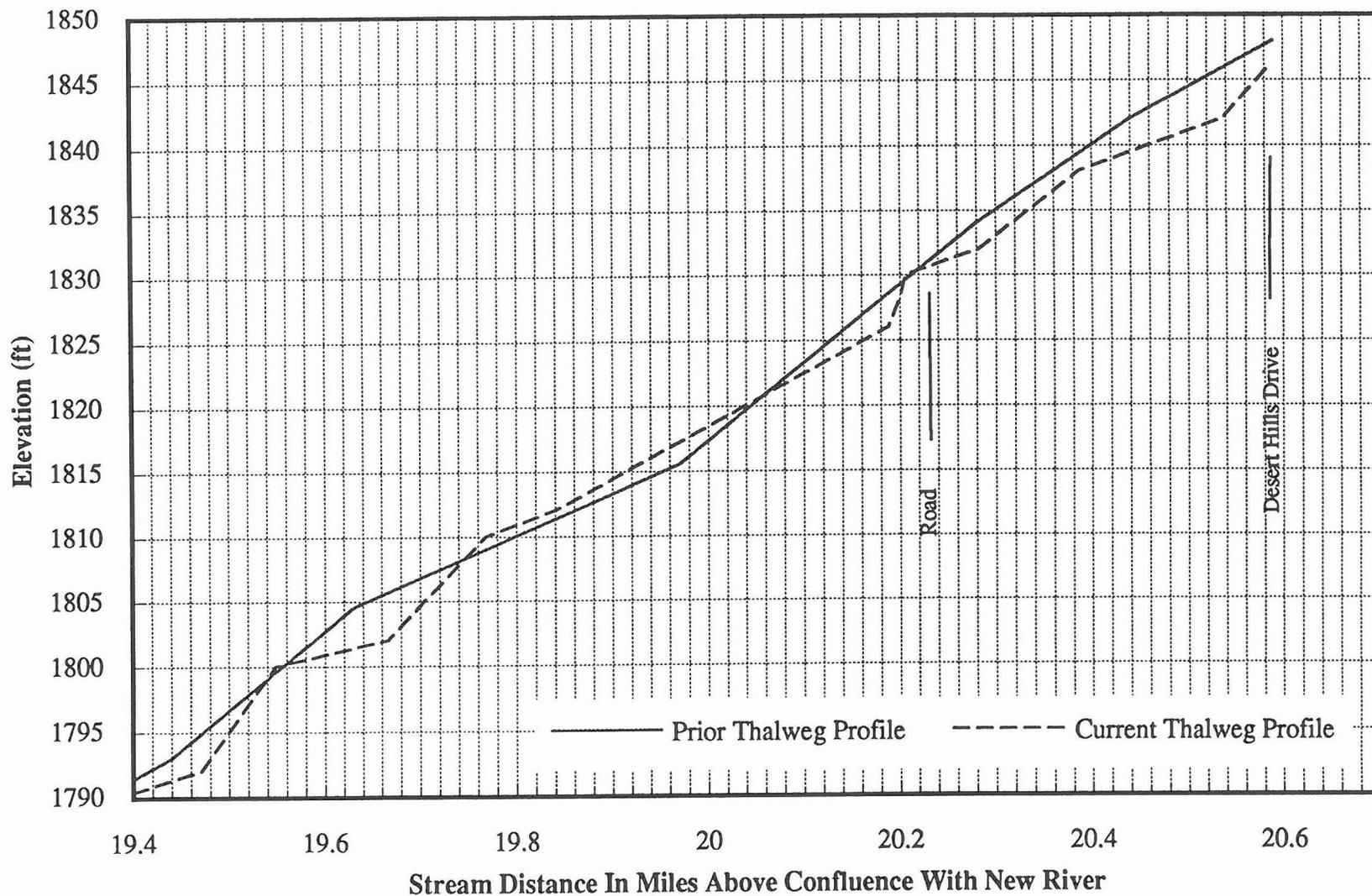
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



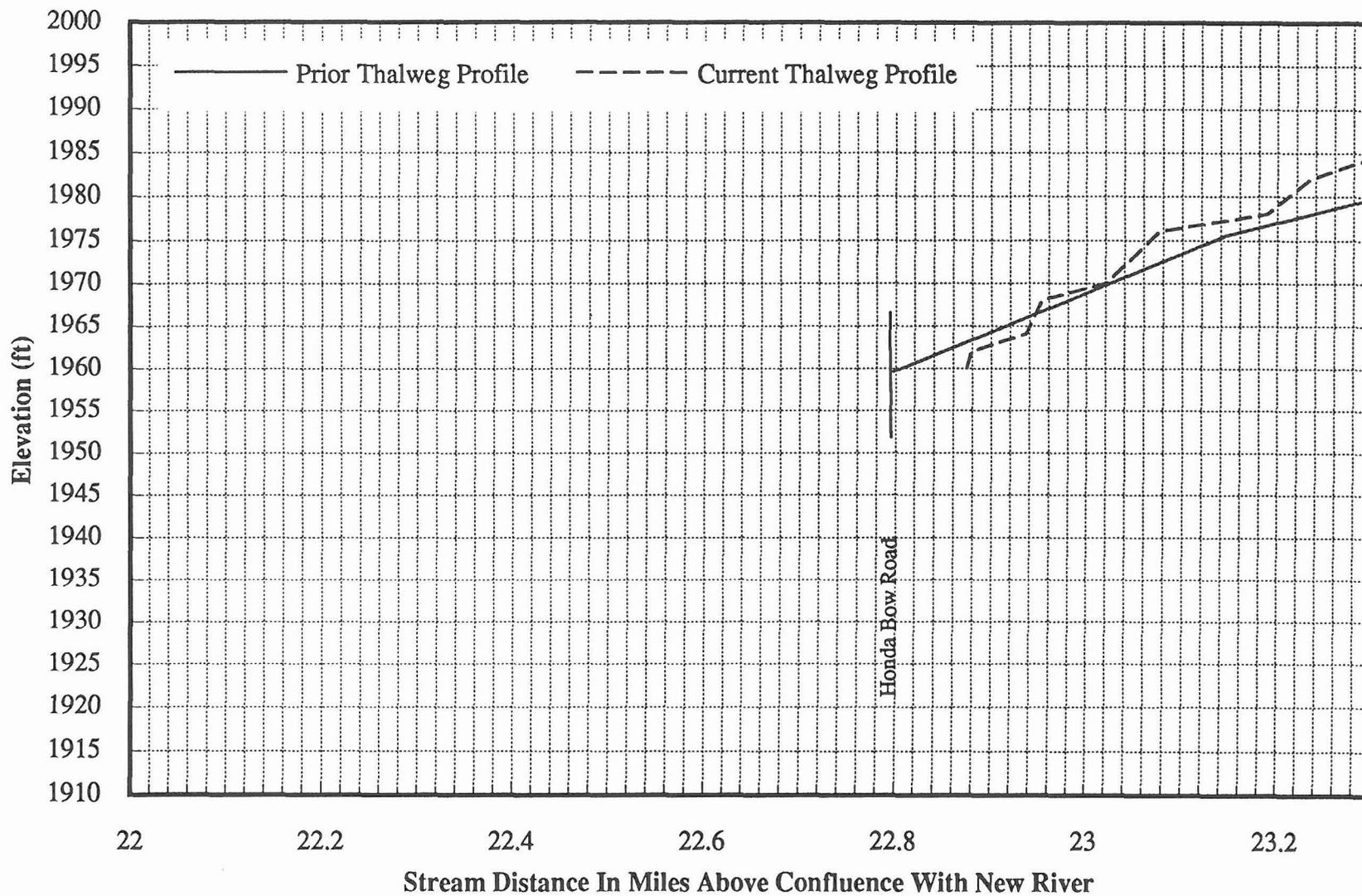
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



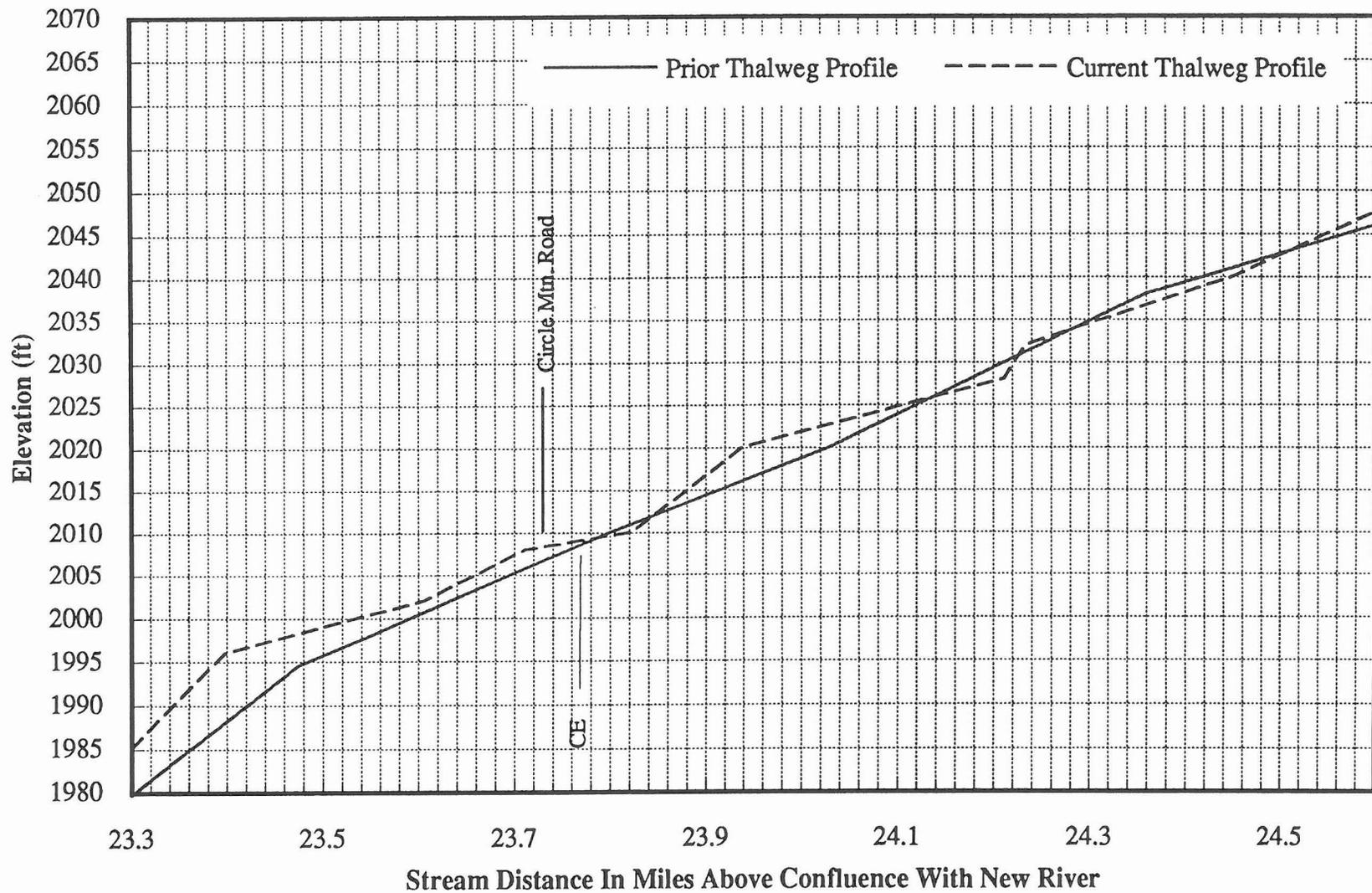
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



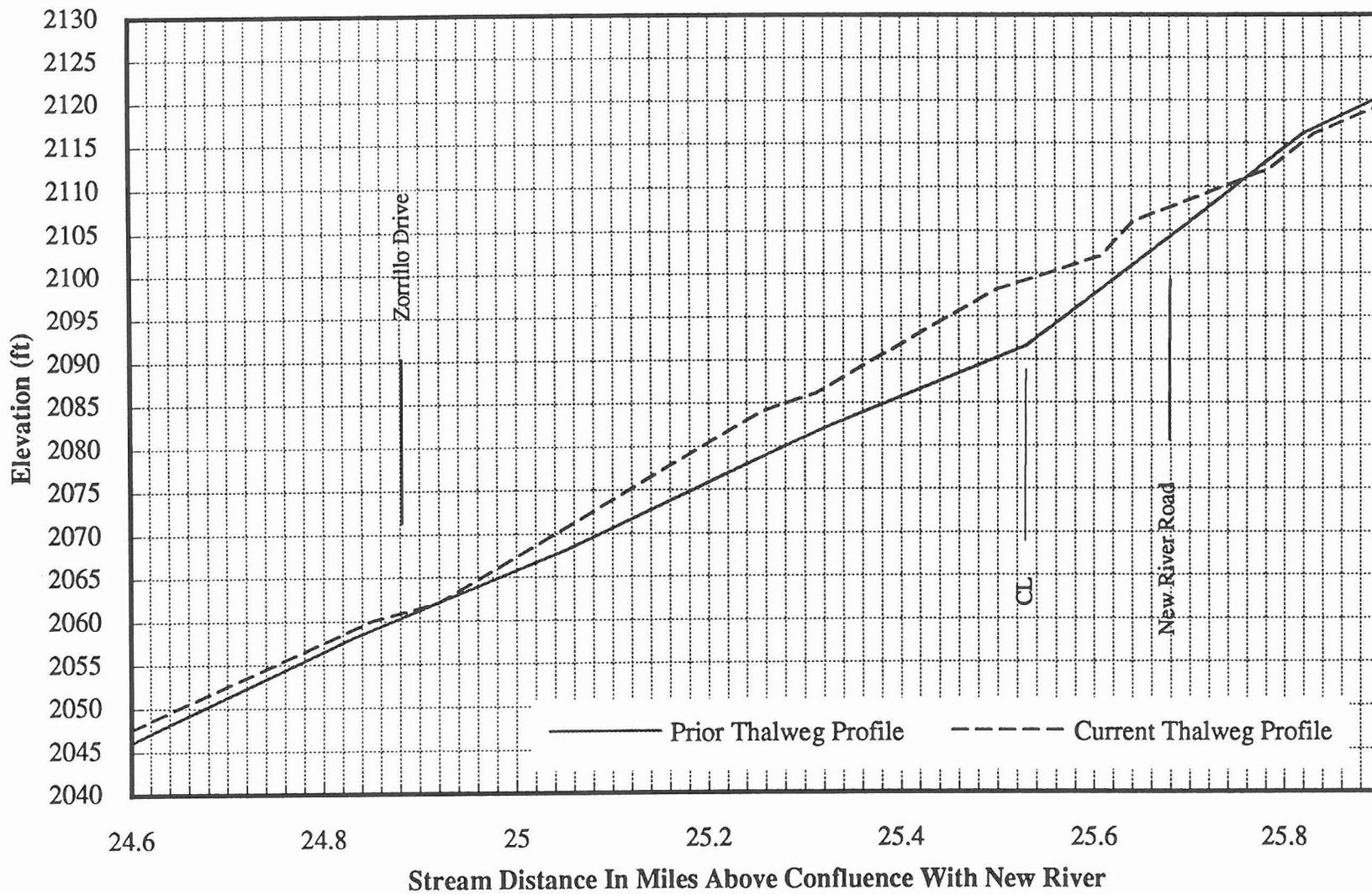
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



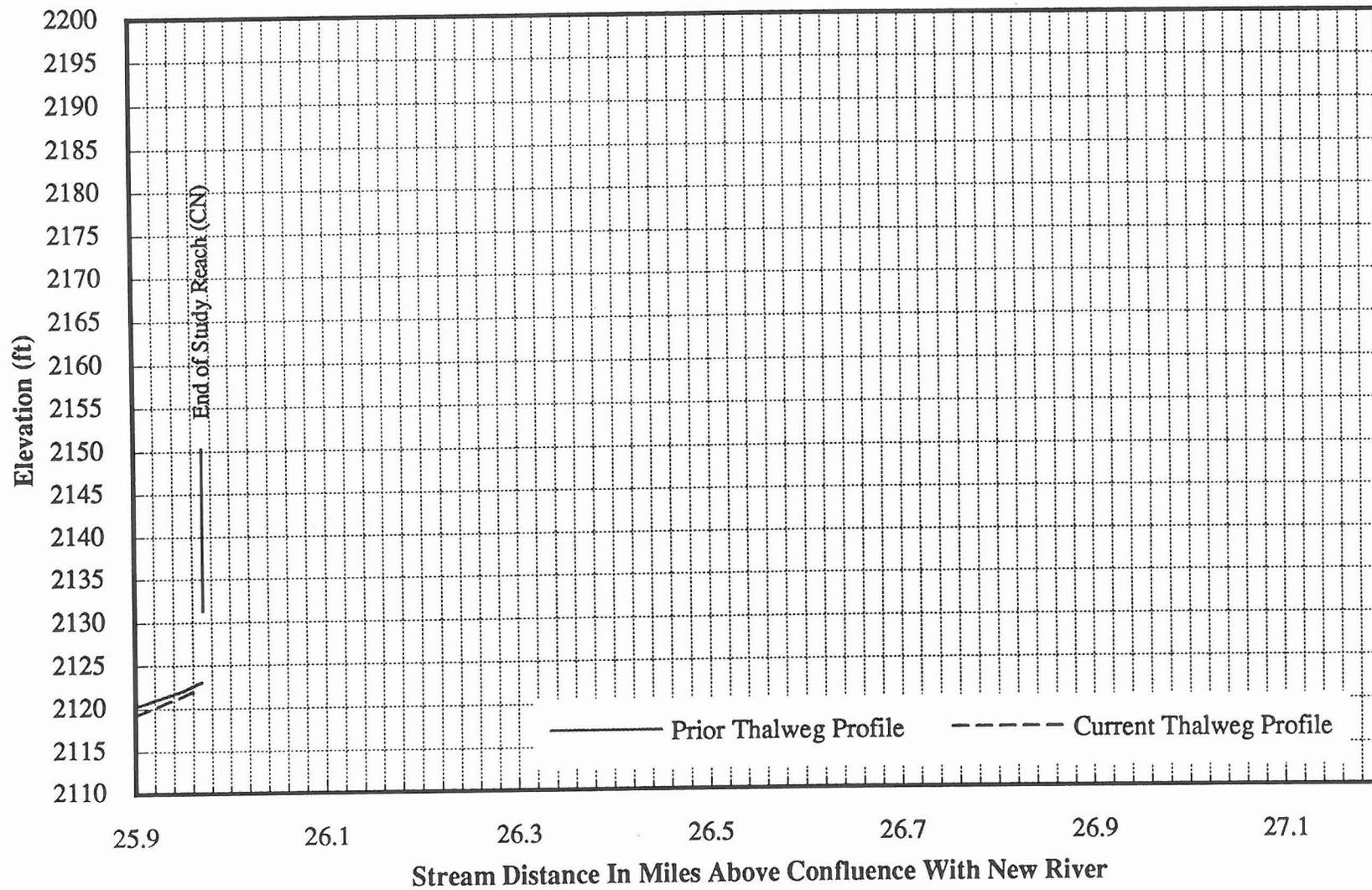
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



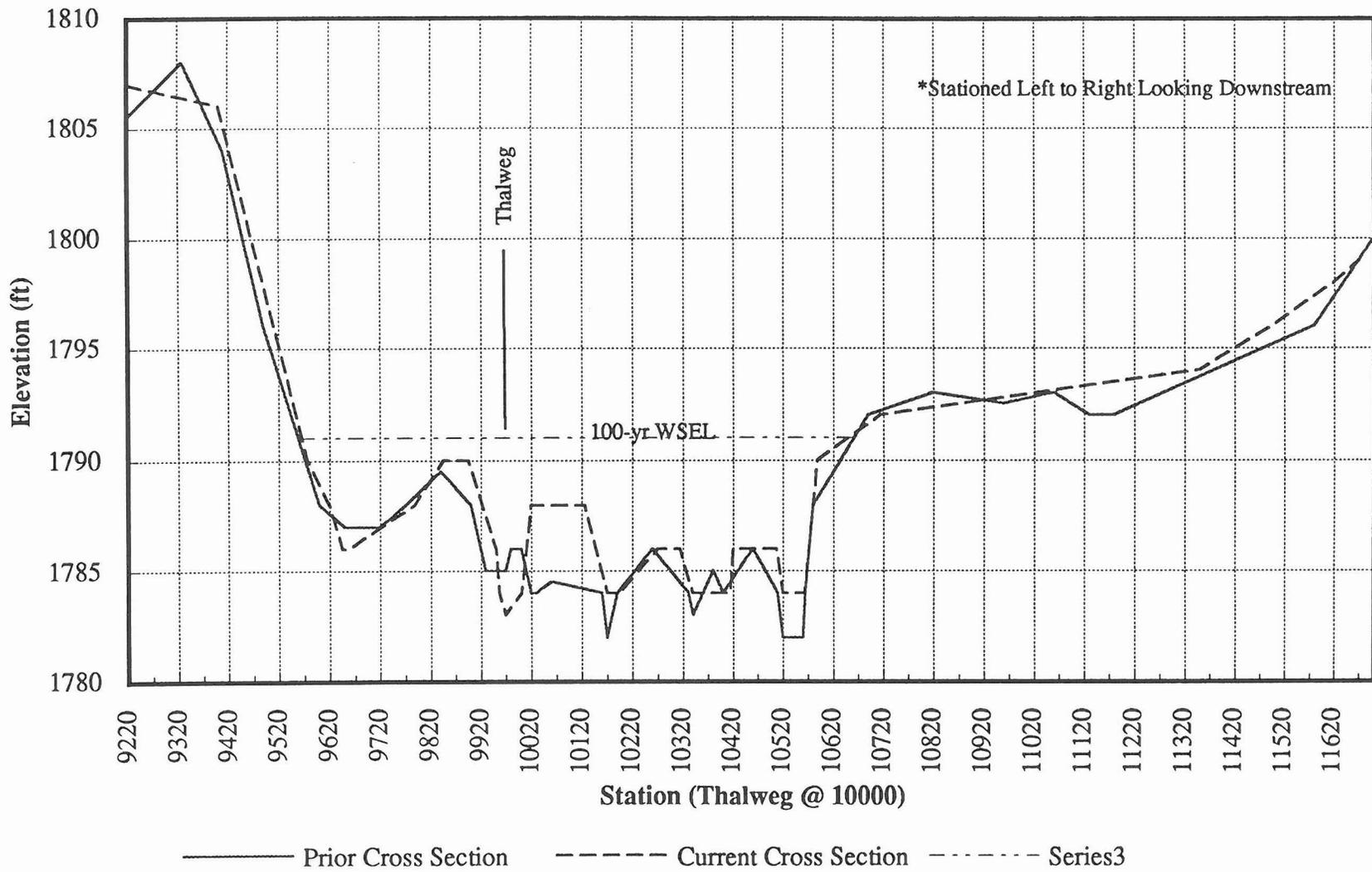
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



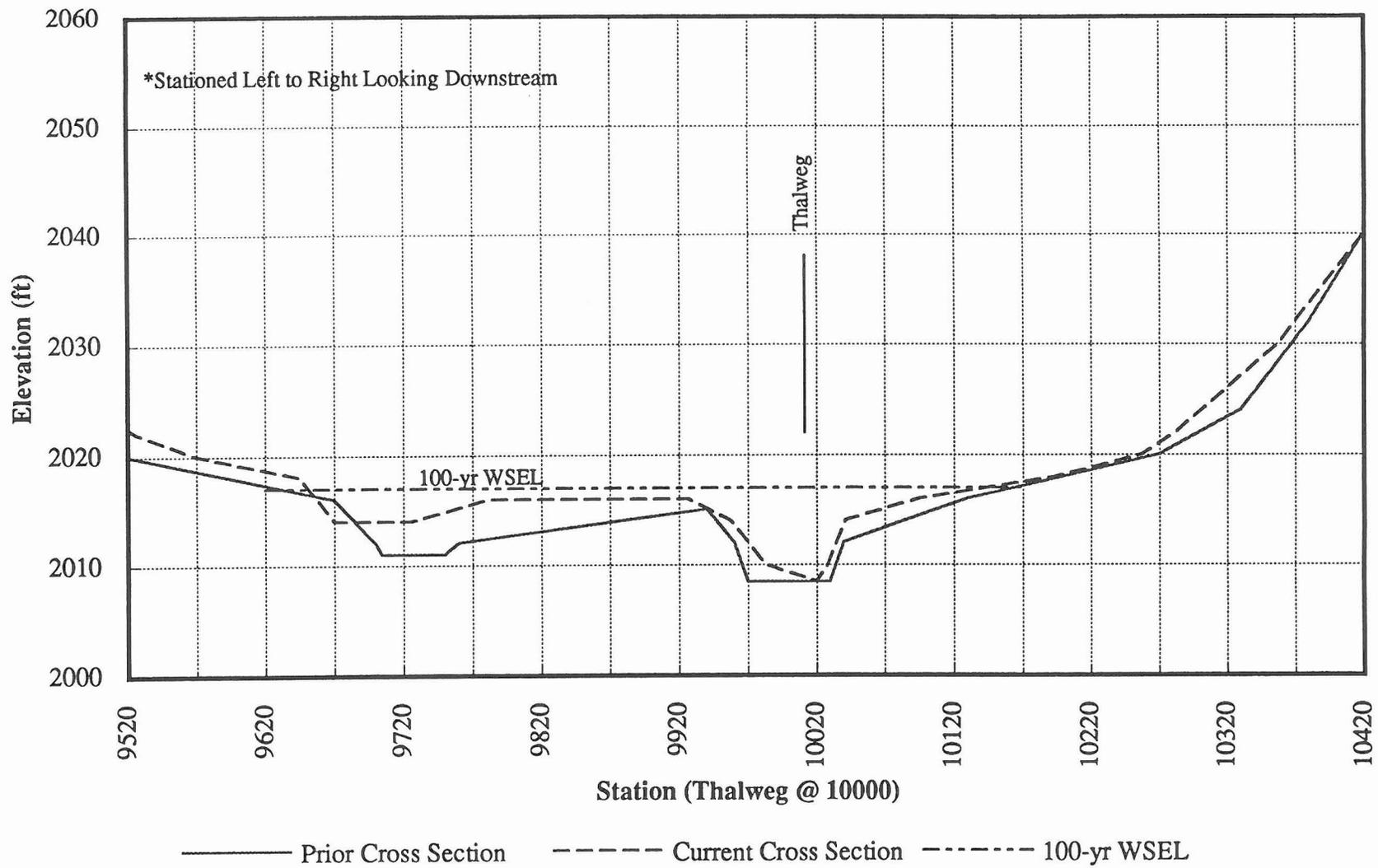
COMPARISON OF THALWEG PROFILES

FIGURE 1 (Cont.)



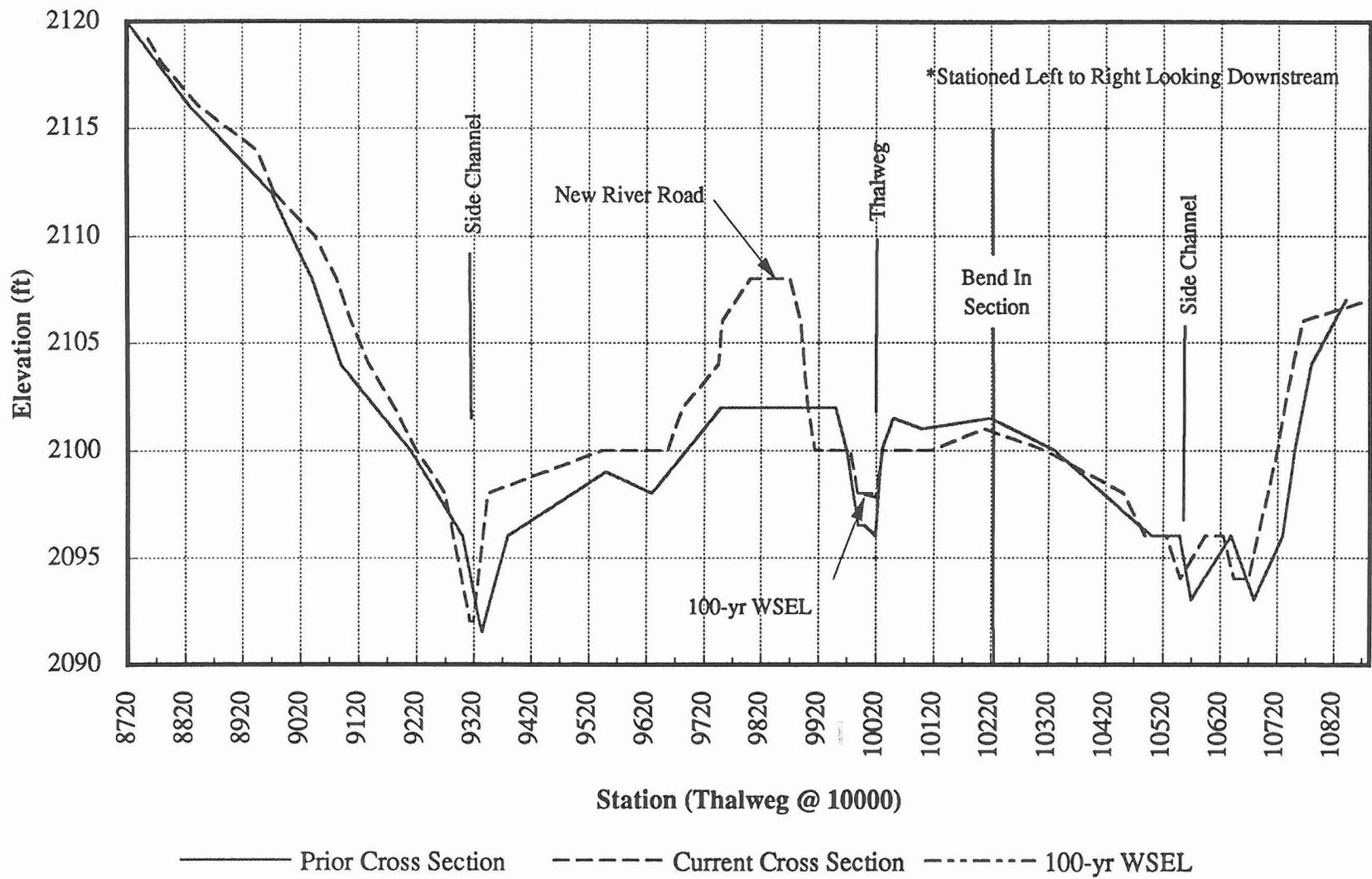
CROSS SECTION BN (Shifted)

FIGURE 2



CROSS SECTION CE (Shifted)

FIGURE 3



CROSS SECTION CL (Shifted)

FIGURE 4

**2. Cross Section CE:**

100-year Flood WSEL = 2,017 ft.

Prior cross sectional area below flood level = 2,103 sq. ft.

Current cross sectional area below flood level = 1,196 sq. ft.

Net Change = 43% decrease

**3. Cross Section CL:**

100-year Flood WSEL = 2,098 ft.

Prior cross sectional area below flood level = 57 sq. ft.

Current cross sectional area below flood level = 4 sq. ft.

Net Change = 93% decrease

Significant differences are shown to exist between flow areas below the 100-year flood levels at the three cross sections evaluated above. It is anticipated that similar differences also occur at other cross section locations in the existing FIS.

**Hydraulic Structures**

The final comparison identified for this analysis is the comparison of known elevation data such as that which would be collected for bridge structures. However, at the time the existing study was performed, no bridges existed within the study reach. The Carefree Highway bridge was constructed several years after the study was completed, and the New River Road bridge was completed in late 1995. Therefore, bridge data were not applicable for comparing existing and new FIS conditions.

However, due to the existence of new bridges along Skunk Creek since the prior FIS, it is expected that the floodplain boundaries in the vicinity of these bridges will differ from those developed in the prior FIS.

**VERIFICATION OF MAP DATUMS**

Map datums were compared to ensure that the topographic evaluations were based on the same datum. It was verified that both map datums are based on the National Geodetic Vertical Datum of 1929 (NGVD).

**SUMMARY OF COMPARISON**

The analyses conducted in this comparison of topography and hydraulic structures between the prior FIS and current data indicate that significant differences occur. Therefore, it is expected that flood profiles and flood boundaries developed from the current topographic and hydraulic structures data using the existing FIS floodflows would be significantly different (i.e., greater than 1.0 foot difference in WSEL) throughout the study reach from those developed in the prior FIS.

**Technical Memorandum No. 2  
Data Collection Report**

# TECHNICAL MEMORANDUM NO. 2



MONTGOMERY WATSON



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<b>To:</b>	Hasan Mushtaq	<b>Date:</b>	April 18, 1996
<b>From:</b>	Laurie T. Miller, P.E.	<b>Reference:</b>	1213.0050 (FCD 95-16)
<b>Subject:</b>	Data Collection Report	<b>Project:</b>	Skunk Creek Floodplain Delineation

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Montgomery Watson was retained by the Flood Control District of Maricopa County (District) to perform a floodplain delineation study for a portion of Skunk Creek, located in northern Maricopa County. This Technical Memorandum is submitted in accordance with Task 2.2 of the Scope of Work as a summary of data collection and review activities for the Skunk Creek Floodplain Delineation Study.

The current floodplain delineation study is an update of an existing Flood Insurance Study (FIS) which was prepared in the late 1970s. The limits of the current study include a portion of Skunk Creek from the Central Arizona Project (CAP) Aqueduct to 13.1 river miles upstream, terminating at the north side of the New River Road crossing. Excluded from the study are 2.6 miles of Skunk Creek that lie within the Del Webb property north of Desert Hills Drive because floodplain mapping for this portion of the creek is being undertaken by Del Webb.

## PREVIOUS FLOOD HAZARD AND HYDROLOGY REPORTS

Several previous hydrologic studies have been performed in the vicinity of the study area. The U.S. Army Corps of Engineers (Corps) developed hydrology for the Skunk Creek watershed prior to constructing Adobe Dam. The peak 100-year discharge for Skunk Creek at the CAP Aqueduct was estimated by the Corps to be 35,000 cubic feet per second (cfs).

In the late 1970s, hydrology for the original (effective) Flood Insurance Study (FIS) for Skunk Creek was developed by Harris Toups. The Harris Toups study used the Corps' peak discharge of 35,000 cfs at the CAP Aqueduct. Upstream of Carefree Highway, peak flows were estimated using the Soil Conservation Service's TR-20 computer program.

Upstream of Carefree Highway, floodplain delineation studies were performed by Baker Engineers in 1989 for two tributaries to Skunk Creek: Cline and Rodger Creeks. The floodplain delineation studies included the development of hydrologic models using the HEC-1 Flood Hydrograph Package computer program.

## **EXISTING TOPOGRAPHIC MAPPING DATA**

Development of the HEC-1 hydrologic model was based on U.S. Geological Survey (USGS) topographic maps, at a scale of 1 inch = 2000 feet, were collected for use in developing the HEC-1 hydrologic model. For the purpose of floodplain delineation, work maps were collected from the Harris-Toups study. These maps include topographic information at a scale of 1 inch = 400 feet.

New aerial mapping was prepared for the study reach to provide mapping in digital form, and to represent current topographic conditions for the study reach. Because of the uncertainty of accuracy in mapping which was performed nearly 20 years ago, a comparison of topographic mapping was performed between the two sources at several locations upstream of Carefree Highway. It was found that significant differences exist between the two sources of data. A detailed evaluation of this comparison was presented previously as Technical Memorandum No. 1, Comparison of Topographic Mapping and Hydraulic Structures.

## **HISTORICAL FLOODING INFORMATION**

The USGS has maintained a gaging station on Skunk Creek since 1959. The station is located near the Interstate 17 crossing of Skunk Creek, approximately one mile downstream of the CAP Aqueduct. Annual peak discharges were collected for the period of record 1960-1994. These discharges were used to perform a flood frequency analysis to compare historic discharges with those estimated using HEC-1 and regression equations developed by USGS and the Arizona Department of Water Resources (ADWR).

## **EXISTING STRUCTURES**

At the time of the original Harris-Toups study, no flood control structures existed on Skunk Creek upstream of the CAP Aqueduct. Since that time, two bridges have been constructed on Skunk Creek within the study reach.

A bridge was constructed at Carefree Highway. A peak 100-year discharge of 31,400 cfs for the Carefree Highway bridge was taken from the Harris-Toups study. In 1995, New River Road was re-aligned and a bridge was constructed. A 100-year discharge of 7,200 cfs for the New River Road bridge was also taken from the Harris-Toups study.

There are also a number of road crossings of Skunk Creek, but all are dip sections.

## **HYDRAULIC PROFILE DATA**

Upstream of Carefree Highway, a HEC-2 Flood Surface Profiles model was provided by the District. This HEC-2 model was prepared by Harris-Toups for the original FIS. For the lower portion of the study reach, the District contacted Baker Engineers, the Technical Evaluation Contractor for the Federal Emergency Management Agency (FEMA), to obtain the original HEC-2 model. Baker Engineers researched its files and could not locate a hydraulic model for the lower portion of the study reach between Carefree Highway and the CAP Aqueduct.

## **FEMA FLOOD HAZARD BOUNDARY MAPS**

The FEMA Flood Hazard Boundary Maps for the study reach was obtained for use in the floodplain delineation portion of this study. No Letters of Map Amendment (LOMA) or Revision (LOMR) exist within the study reach.

## **MISCELLANEOUS REFERENCES**

In addition to the data collected and described above, a number of references have been collected for use in the Skunk Creek Floodplain Delineation study. These are identified below:

### **Federal Emergency Management Agency**

- Flood Insurance Study Guidelines and Specifications for Study Contractors (1995)
- Appeals, Revisions, & Amendments to National Flood Insurance Program Maps, A Guide for Community Officials (1993)

### **U.S. Geological Survey**

- Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona (1991)

### **Arizona Department of Water Resources**

- Instructions for Organizing and Submitting Technical Documentation for Flood Studies (1990)
- Requirements for Flood Study Technical Documentation (1990)

### **Flood Control District of Maricopa County**

- Data Deliver Specifications: The Hydrologic Information System, Rev. 2.0 (1995)
- Digital Terrain Model Mapping Data Collection & Delivery Specifications (1994)
- Hydrologic Design Manual (1995)
- Hydrologic Information System User's Guide (1993)

**Technical Memorandum No. 3**  
**Field Estimation of Manning's "n" Values**

# TECHNICAL MEMORANDUM NO. 3



**MONTGOMERY WATSON**



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<b>To:</b>	Hasan Mushtaq Flood Control District of Maricopa County	<b>Date:</b>	July 3, 1996
<b>From:</b>	Laurie T. Miller, P.E.	<b>Reference:</b>	1213.0070 (FCD 95-16)
<b>Subject:</b>	Field Estimation of Manning's "n" Values	<b>Project:</b>	Skunk Creek Floodplain Delineation Study

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This Technical Memorandum No. 3 is submitted in accordance with Task 8.11 of Phase II of the Scope of Work. Computations of water surface elevations within Skunk Creek and the adjacent floodplain require estimation of roughness characteristics of the channel and overbank areas. Therefore, a field reconnaissance survey was performed to estimate Manning's roughness coefficients (i.e., "n" values) to represent the physical characteristics of the study reaches. This memorandum summarizes findings of the field reconnaissance estimation of Manning's "n" values. Upon review and acceptance of the information contained in the memorandum by the District, results of this work will be incorporated into the HEC-2 model for Skunk Creek.

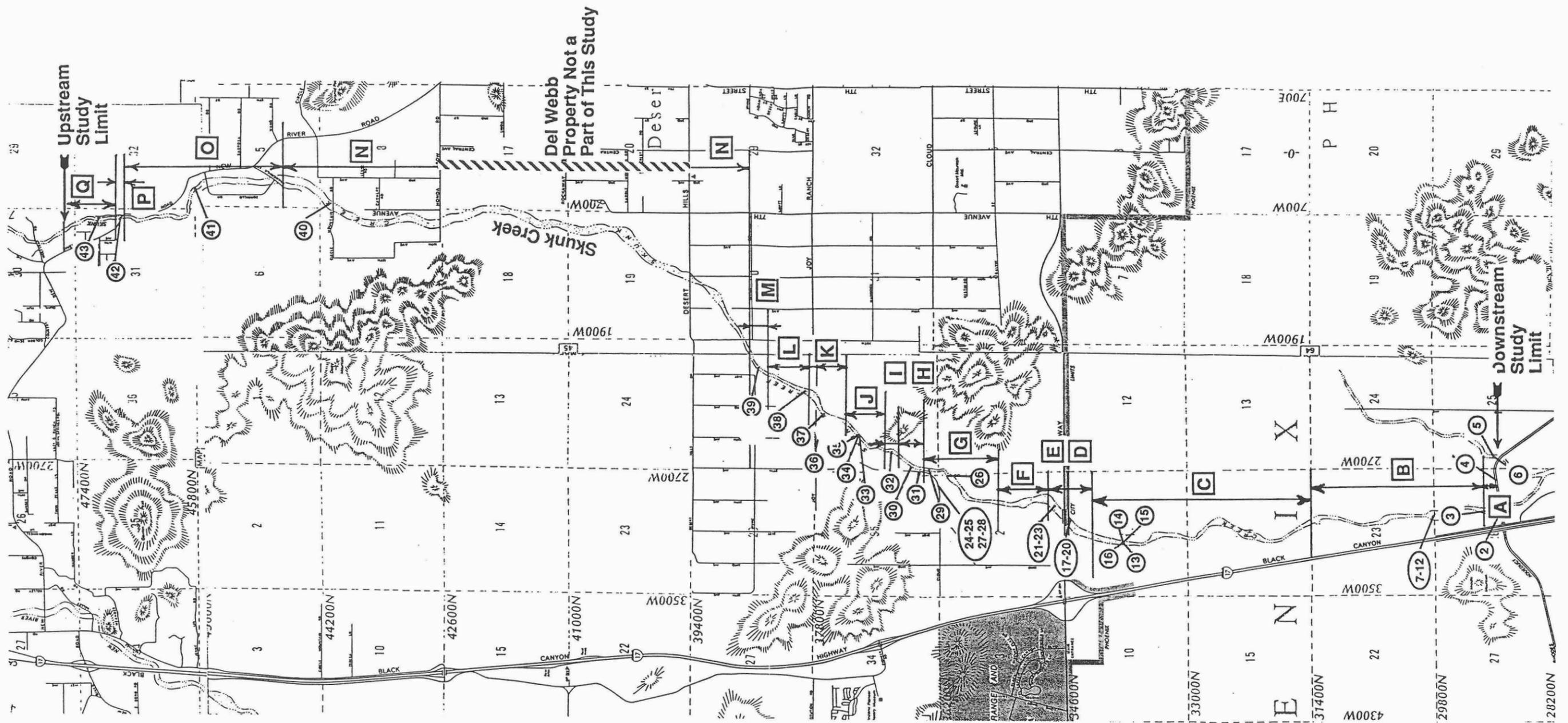
The current floodplain delineation study is an update of an existing Flood Insurance Study (FIS) which was prepared in the late 1970s. The limits of the current study include the portion of Skunk Creek from the Central Arizona Project (CAP) Aqueduct to 13.1 river miles upstream, terminating at the north side of the New River Road crossing (Figure 1). Excluded from this 13.1-mile length are 2.6 miles of Skunk Creek that lie within the Del Webb property north of Desert Hills Drive.

## FIELD CONDITIONS

Field reconnaissance of the study reaches was conducted on June 17 and 18, 1996. During this reconnaissance, visual observation of hydraulic conditions was made, hydraulic structures were located and measured, and photographs were taken. A summary of the information obtained during field reconnaissance is presented in the following paragraphs.

### General Characteristics

There are two distinct hydraulic conditions within the study area, each displaying unique characteristics. The floodplain in the lower portion, between the CAP Aqueduct and Carefree Highway, consists of braided channels which are not well-defined in some areas. There are few tributaries in this portion of Skunk Creek, the most prominent being at the CAP Aqueduct embankment where drainage from the Union Hills area commingles with Skunk Creek.



**LEGEND**

- ③ Location of Photograph Shown in Figure 3
- A Portion of Skunk Creek Represented by Manning's n Value Shown in Table 1

 N  
 SCALE = 4500' (approx.)

Location Map  
Figure 1

North of Carefree Highway, the channel is more clearly defined. However, the drainage area is considerably larger, and there are a number of tributaries which join with Skunk Creek upstream of Carefree Highway.

The following is a discussion of the channel and overbank characteristics that are reflected in the roughness coefficient estimation for the Skunk Creek study area. Representative photographs (Figures 2 through 43) are included in the Appendix. Photograph locations are shown in Figure 1. Topographic maps which show the location of cross sections are submitted separately.

### **Channel Alignment**

Channel alignment in the study area is fairly straight in areas where there is little tributary contribution and where no topographic barriers exist. However, upstream of Carefree Highway, the channel becomes curved in the vicinity of tributary confluences and in areas where the channel is topographically confined.

### **Cross Section Shape**

Cross section shape varies throughout the study reach. Downstream of Carefree Highway, the channel is wide and braided. Upstream of Carefree Highway, the channel is generally trapezoidal, narrow, and has wide overbanks.

### **Overbank Characteristics**

Overbanks in the study reach generally consist of finer-grained material and denser vegetation than the main channel. In areas where the floodplain is wide, overbanks are gently sloping and relatively flat. Near topographic barriers, overbanks are narrower and moderately sloping.

### **Channel Bed Material**

In the lowest portion of the study area, in the vicinity of the CAP Aqueduct, the channel bed material is composed of coarse sand and cobbles. The overbanks are composed of finer materials. There is evidence of sedimentation at the CAP Aqueduct.

Further upstream, the bed material is composed of coarse sand, gravel, cobbles, and cemented rock outcrops. Continuing upstream, the bed material is predominantly cobbles and large gravel with some exposed cemented rock as the channel nears Carefree Highway.

Upstream of Carefree Highway, the channel bed is mainly composed of fine to coarse sand and gravel with a few locations of scattered boulders. However, near the confluence of tributaries, channel materials are predominantly coarse sand, cobbles, and small boulders. Channel sideslopes range from gently sloping, moderately consolidated sand to jagged, cemented conglomerate.

The channel overbanks upstream of Carefree Highway are fairly uniform and consist primarily of firm sand and silt.

### **Vegetation**

Vegetation within the study reach is typical of desert washes and is heaviest along the channel sideslopes and overbanks in the vicinity of the wash. At the CAP Aqueduct, vegetation exists in the main channel as well as on the overbanks. Vegetation includes creosote, salt cedar, mesquite, palo verde, and desert brush. Further upstream of the CAP Aqueduct, vegetation remains within the channel but in lesser quantities.

Upstream of Carefree Highway, the channel bed has little to no vegetation. Any channel vegetation is generally limited to shrubs and grasses, which are confined to inter-channel islands and/or areas associated with tributary confluences. Trees are prevalent on the sideslopes and overbanks. In comparison to downstream of Carefree Highway, there more and larger diameter trees and less ground cover. There are very sparse desert grasses with some catclaw and cholla.

## **METHODOLOGY**

The procedure used in this study was developed by the U.S. Geological Survey's (USGS) Water Resources Division and is described in "Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona" (Thomsen and Hjalmarson, 1991). In accordance with this procedure, the base n-value was estimated from Table 1 of the USGS report. Values developed by Chow as presented in the referenced report were generally used as representative of the study area. A total n-value was then estimated by applying adjustments to the base "n" from Table 2 of this report for individual roughness components of channel irregularities, obstructions to flow, and vegetation:

### **SELECTION OF "n" VALUE COMPONENTS**

Roughness coefficients were estimated for 17 reaches (Reach A through Reach Q) within the study area, as shown in Figure 1. Reaches are defined here as sections along Skunk which display similar roughness coefficients. Therefore, a number of consecutive cross sections may be represented by the same roughness coefficients.

#### **Base "n" Selection**

As prescribed in the USGS procedure, the base n-value is for a straight, uniform channel of a given bed material. Base "n" values selected for the Skunk Creek channel ranged from 0.020 for the graded area at New River Road bridge to 0.032 for predominantly cobbled areas.

The base "n" of the overbank areas south of Carefree Highway ranged from 0.022 to 0.032. Upstream of Carefree Highway, the bed material is consistently fine to coarse sand throughout the study reaches. Therefore, 0.025 was selected as a representative base "n" for both the left and right overbanks in this portion of the study.

#### **Irregularity Component**

Channel irregularity pertains to the characteristics of the side slopes, including smoothness, shape, and sloughing. The degree of channel irregularity was found to be smooth to minor throughout much of the study area. However, in some areas downstream of Carefree Highway, channel irregularity was more pronounced. Therefore, values as high as 0.01 were chosen for side slopes composed of partially eroded conglomerate.

#### **Obstruction Component**

Obstructions include debris deposits, stumps, logs, isolated boulders, and many other objects that obstruct flow in the channel or overbank areas.

Since for areas north of Carefree Highway larger diameter trees were judged to be an obstruction of flow, trees were typically accounted for in the obstruction component instead of in the vegetation component.

The effects of obstructions in the channel were estimated to be negligible to minor in the study area, and selected adjustment values were selected to range from 0 to 0.005. These values correspond to channels with scattered obstructions that do not occupy more than approximately 5 percent of the cross-sectional area.

The effects of obstructions in the overbank areas were estimated to be negligible to appreciable, and selected values range from 0.002 to 0.025. This choice of values generally corresponds to surfaces with obstruction occupancy of 5 to 15 percent.

### Vegetation

The vegetation component of the referenced report focuses primarily on ground cover, i.e., turf grass or weeds. As previously stated, below Carefree Highway ground cover is more prevalent than in the upper reaches of the study area. Therefore, the vegetation component was greater in the lower portion, ranging from 0.005 (small) to 0.015 (medium). In the upper portion, the vegetation component ranged from 0 to 0.005 (small).

### RESULTS

A summary of the estimation of roughness coefficients ("n" values) selected during the field evaluation are included as Table 1. As previously stated, photographs taken of Skunk Creek and overbank areas are presented as Figures 2 through 43 in the Appendix, and are located in Figure 1.

**Table 1**  
**Summary of Manning's n Evaluation**  
**Skunk Creek Floodplain Delineation Study**

Reach	Manning's "n" Component*	Left Overbank	Channel	Right Overbank
A	$n_b$	.022	.025	.022
	$n_i$	.008	.008	.000
	$n_o$	.004	.002	.002
	$n_v$	<u>.035</u>	<u>.015</u>	<u>.020</u>
	$\Sigma n$	.069	.050	.044
B	$n_b$	.028	.028	.032
	$n_i$	.000	.010	.000
	$n_o$	.000	.004	.000
	$n_v$	<u>.010</u>	<u>.010</u>	<u>.010</u>
	$\Sigma n$	.038	.052	.042
C	$n_b$	.026	.024	.028
	$n_i$	.008	.008	.004
	$n_o$	.010	.002	.000
	$n_v$	<u>.015</u>	<u>.005</u>	<u>.010</u>
	$\Sigma n$	.059	.039	.042
D	$n_b$	-	.028	.024
	$n_i$	-	.008	.008
	$n_o$	-	.002	.010
	$n_v$	-	<u>.005</u>	<u>.015</u>
	$\Sigma n$	N/A**	.043	.057
E	$n_b$	.026	.022	.024
	$n_i$	.008	.006	.003
	$n_o$	.005	.000	.000
	$n_v$	<u>.020</u>	<u>.005</u>	<u>.015</u>
	$\Sigma n$	.059	.033	.042
F	$n_b$	.028	.026	.032
	$n_i$	.000	.008	.004
	$n_o$	.005	.004	.002
	$n_v$	<u>.015</u>	<u>.008</u>	<u>.010</u>
	$\Sigma n$	.048	.046	.048
G	$n_b$	.025	.030	.025
	$n_i$	-	.002	-
	$n_o$	.020	.005	.020
	$n_v$	<u>.015</u>	<u>.005</u>	<u>.015</u>
	$\Sigma n$	.060	.042	.060

**Table 1 (Continued)**  
**Summary of Manning's n Evaluation**  
**Skunk Creek Floodplain Delineation Study**

Reach	Manning's "n" Component*	Left Overbank	Channel	Right Overbank
H	n <sub>b</sub>	.025	.026	.025
	n <sub>i</sub>	-	-	-
	n <sub>o</sub>	.020	.002	.020
	n <sub>v</sub>	<u>.010</u>	<u>.002</u>	<u>.010</u>
	Σ n	.055	.030	.055
I	n <sub>b</sub>	.025	.030	.025
	n <sub>i</sub>	-	.002	-
	n <sub>o</sub>	.020	.005	.020
	n <sub>v</sub>	<u>.010</u>	<u>.005</u>	<u>.010</u>
	Σ n	.055	.042	.055
J	n <sub>b</sub>	.025	.025	.025
	n <sub>i</sub>	-	-	-
	n <sub>o</sub>	.013	.002	.013
	n <sub>v</sub>	<u>.002</u>	<u>.003</u>	<u>.002</u>
	Σ n	.040	.030	.040
K	n <sub>b</sub>	.025	.030	.025
	n <sub>i</sub>	-	.005	-
	n <sub>o</sub>	.004	.005	.004
	n <sub>v</sub>	<u>.002</u>	<u>.005</u>	<u>.002</u>
	Σ n	.031	.045	.031
L	n <sub>b</sub>	.025	.028	.025
	n <sub>i</sub>	-	-	-
	n <sub>o</sub>	.020	.002	.025
	n <sub>v</sub>	<u>.005</u>	<u>.002</u>	<u>.005</u>
	Σ n	.050	.032	.055
M	n <sub>b</sub>	.025	.030	.025
	n <sub>i</sub>	-	.002	-
	n <sub>o</sub>	.025	.005	.025
	n <sub>v</sub>	<u>.010</u>	<u>.005</u>	<u>.010</u>
	Σ n	.060	.042	.060
N	n <sub>b</sub>	.025	.025	.025
	n <sub>i</sub>	-	.002	-
	n <sub>o</sub>	.025	.003	.025
	n <sub>v</sub>	<u>.010</u>	<u>.002</u>	<u>.010</u>
	Σ n	.060	.032	.060

**Table 1 (Continued)**  
**Summary of Manning's n Evaluation**  
**Skunk Creek Floodplain Delineation Study**

Reach	Manning's "n" Component*	Left Overbank	Channel	Right Overbank
O	$n_b$	.025	.028	.025
	$n_i$	-	-	-
	$n_o$	.025	-	.025
	$n_v$	<u>.010</u>	<u>.002</u>	<u>.010</u>
	$\Sigma n$	.060	.030	.060
P	$n_b$	.025	.020	.025
	$n_i$	-	-	-
	$n_o$	.025	-	.025
	$n_v$	<u>.010</u>	-	<u>.010</u>
	$\Sigma n$	.060	.020	.060
Q	$n_b$	.025	.025	.025
	$n_i$	-	.002	-
	$n_o$	.020	.003	.020
	$n_v$	<u>.010</u>	<u>.002</u>	<u>.010</u>
	$\Sigma n$	.055	.032	.055

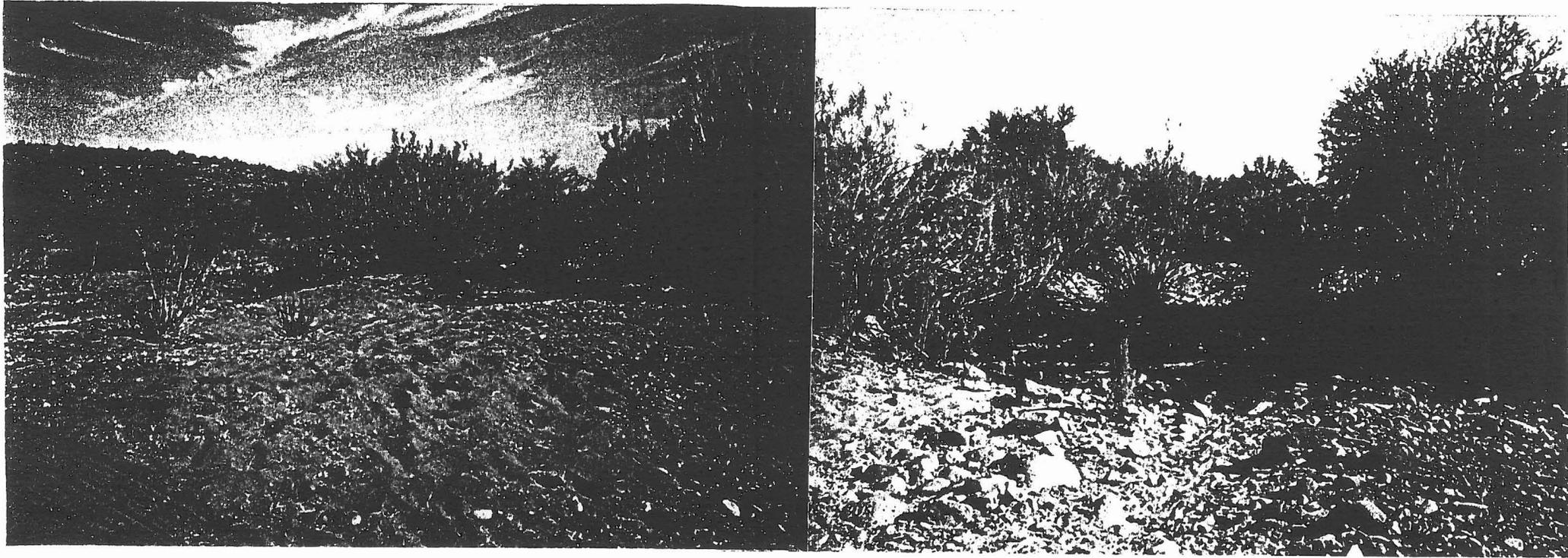
\* $n_b$  = base component  
 $n_i$  = irregularity component  
 $n_o$  = obstruction component  
 $n_v$  = vegetation component

\*\*Due to adjacent bluff, no left overbank exists at this location.

**APPENDIX**



**Figure 2. Reach A. Looking downstream across CAP overchute No.1 (nearest to I-17, BOR Sta 470+80).**



**Figure 3. Reach A. Looking upstream along main channel, approximately 200 feet north of CAP overchute No.1**

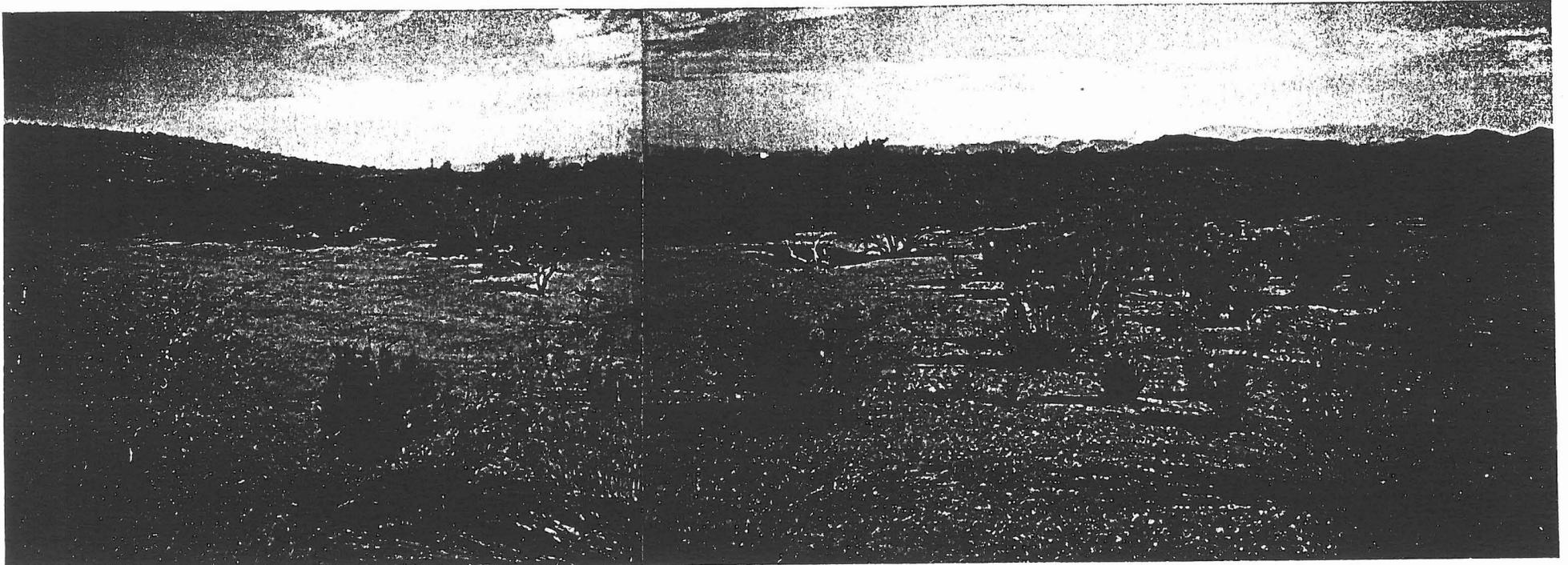
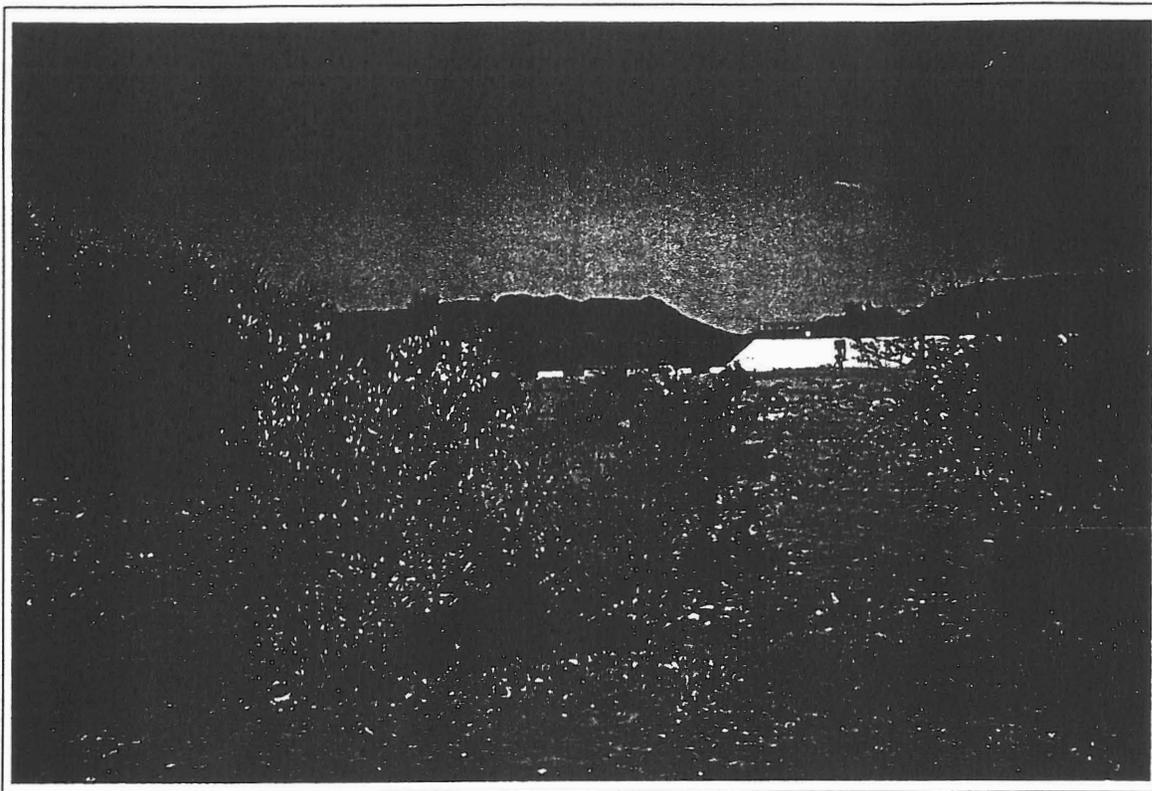


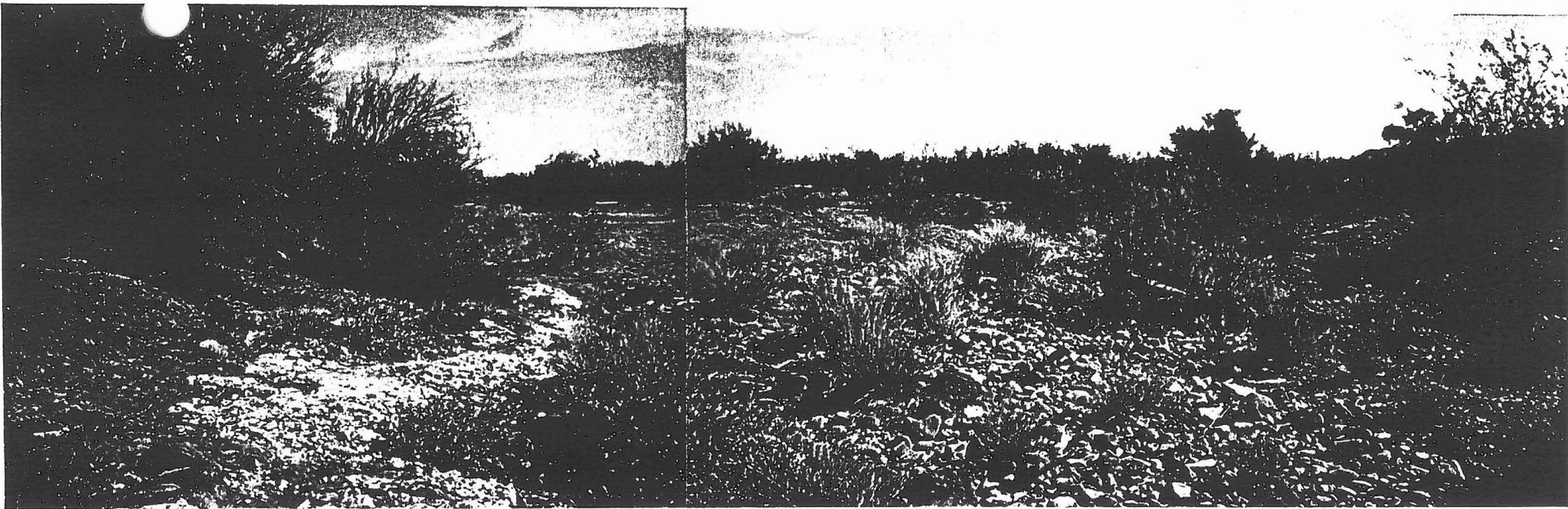
Figure 4. Reach A. Looking upstr from CAP dike, along left overbank.



**Figure 5. Reach A. Looking downstream across CAP overchute No. 2 (BOR Sta 492+04).**



**Figure 6. Reach A. Looking upstream from approximately 200 feet north of CAP overchute No.2.**



**Figure 7. Reach B. Looking upstream from Cross-Section "AW", main channel No. 1 (nos. increase from W-E).**



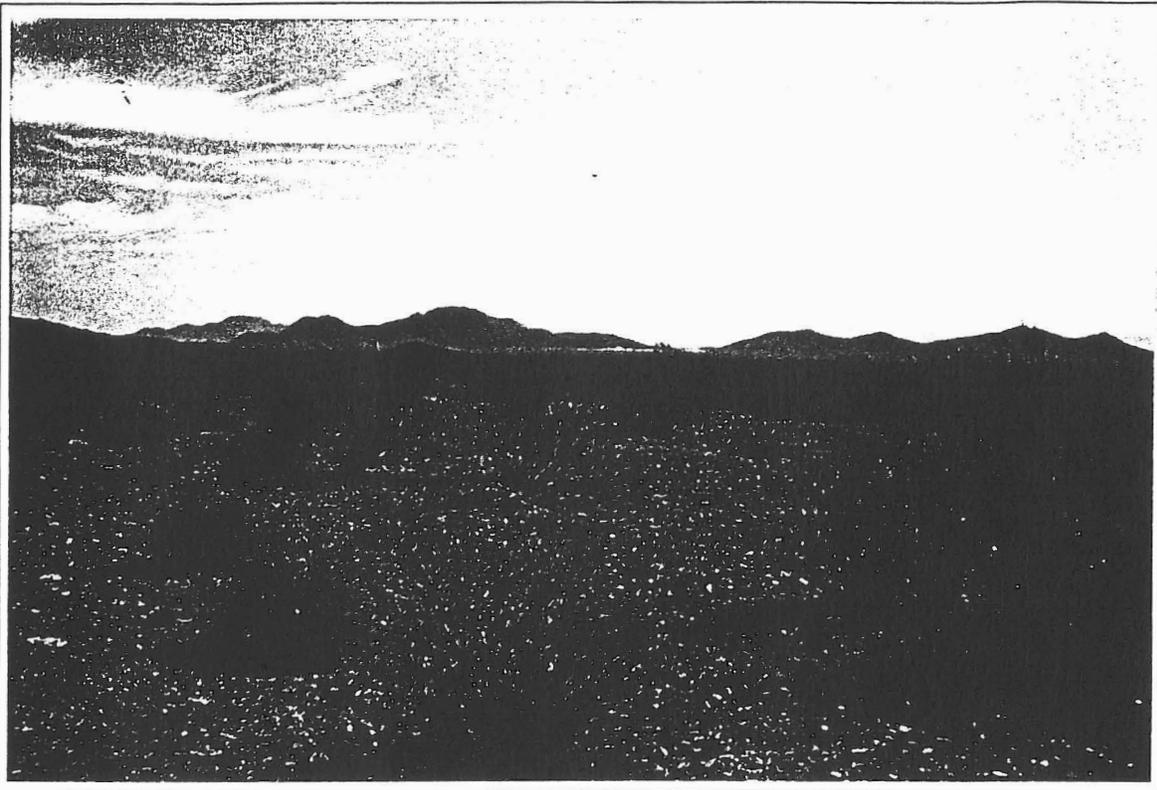
**Figure 8. Reach B. Looking upstream from Cross-Section "AW", main channel No. 2.**



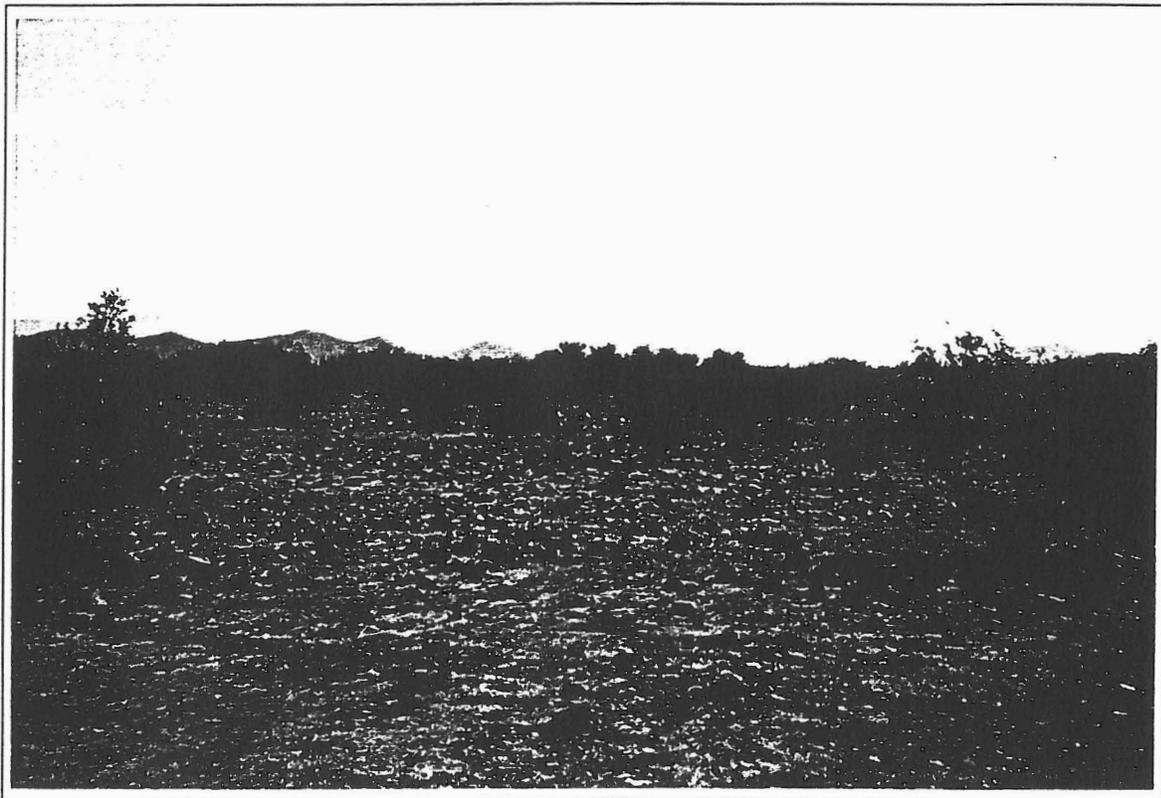
Figure 9. Reach B. Looking upstream from Cross-Section "AW", main channel no.3.



Figure 10. Reach B. Looking upstream from Cross-Section "AW", main channel no.4.



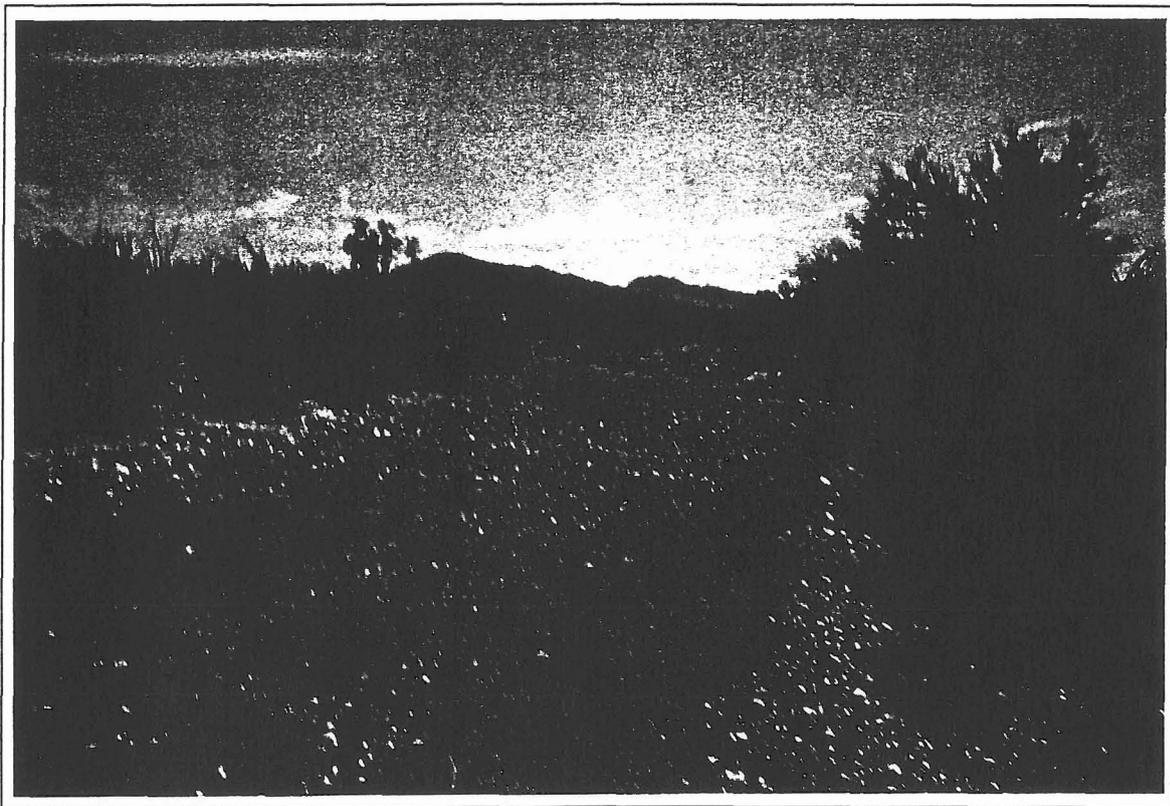
**Figure 11. Reach B. Looking upstream from Cross-Section "AW", left overbank.**



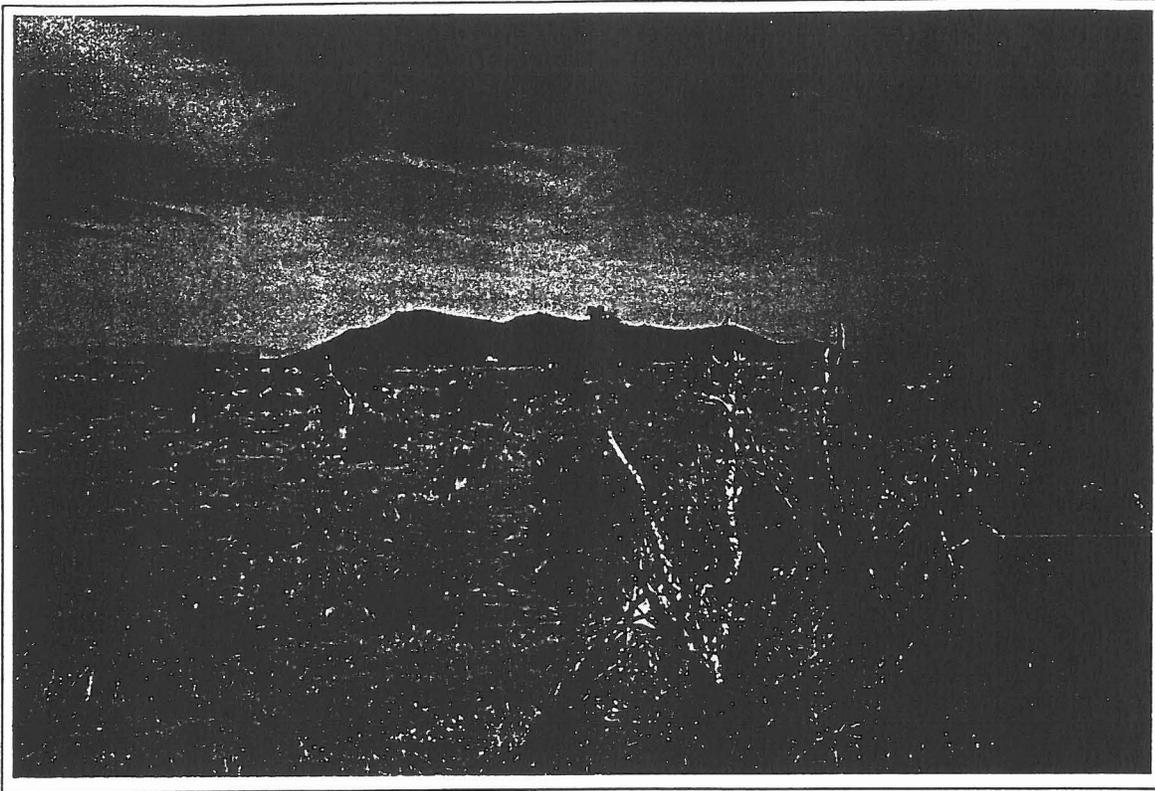
**Figure 12. Reach B. Looking upstream from Cross-Section "AW", right overbank.**



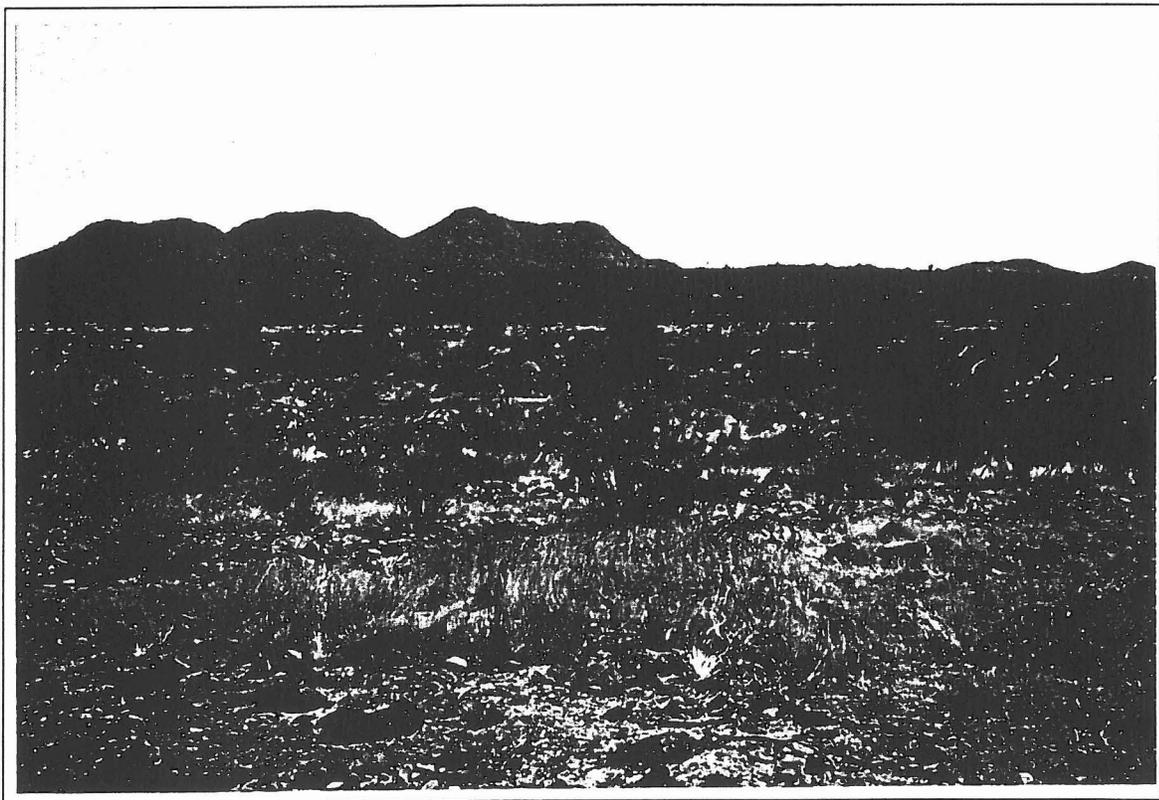
**Figure 13. Reach C. Looking upstream north of Cross-Section "S", main channel no.1.**



**Figure 14. Reach C. Looking upstream north of Cross-Section "S", main channel no. 2.**



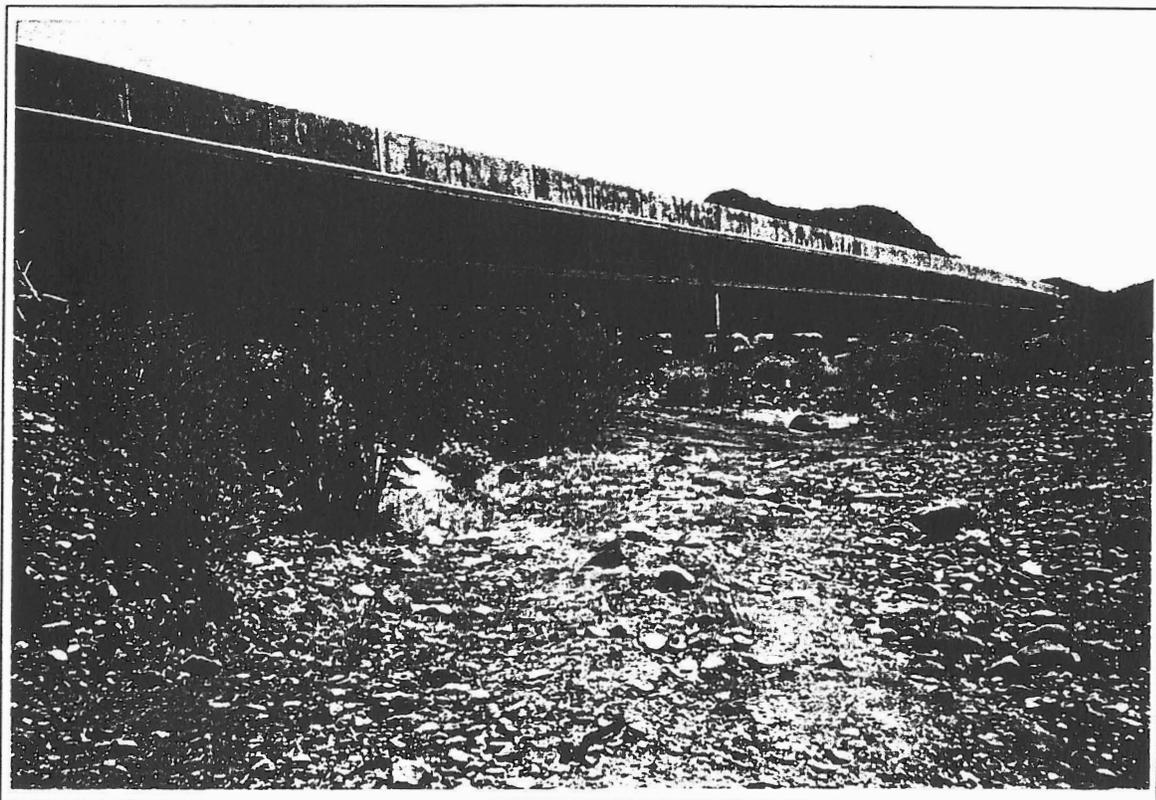
**Figure 15. Reach C. Looking upstream north of Cross-Section "S", left overbank.**



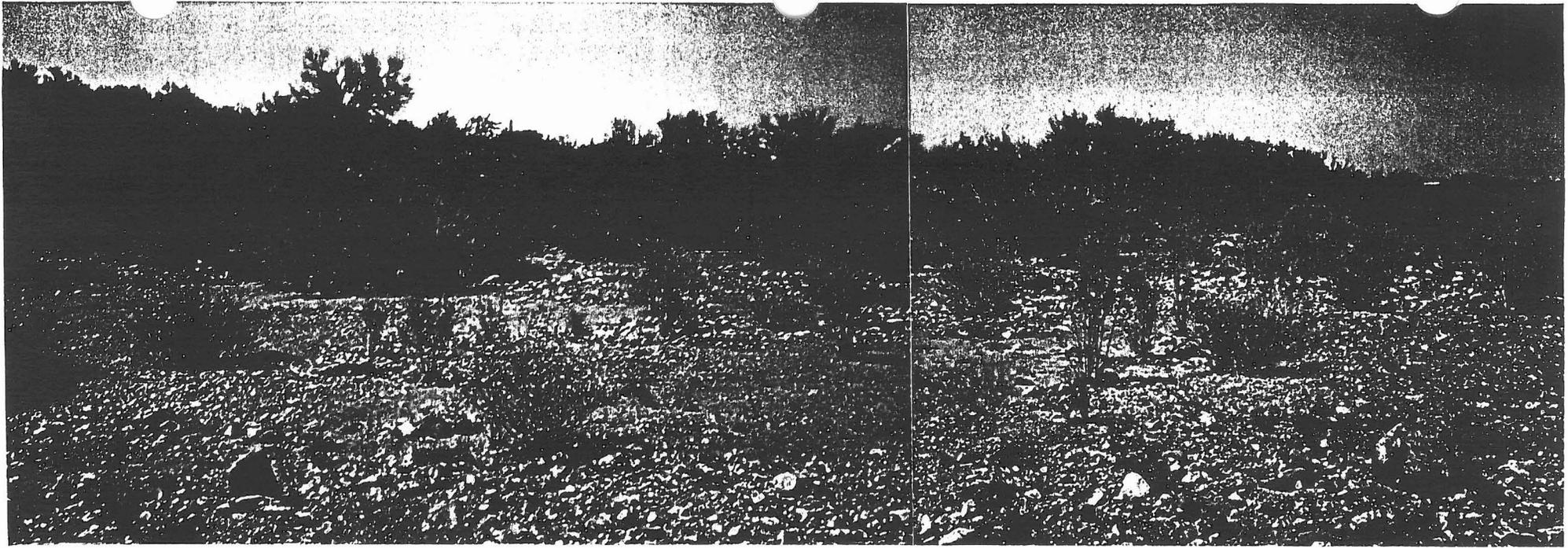
**Figure 16. Reach C. Looking west-east north of Cross-Section "S", right overbank.**



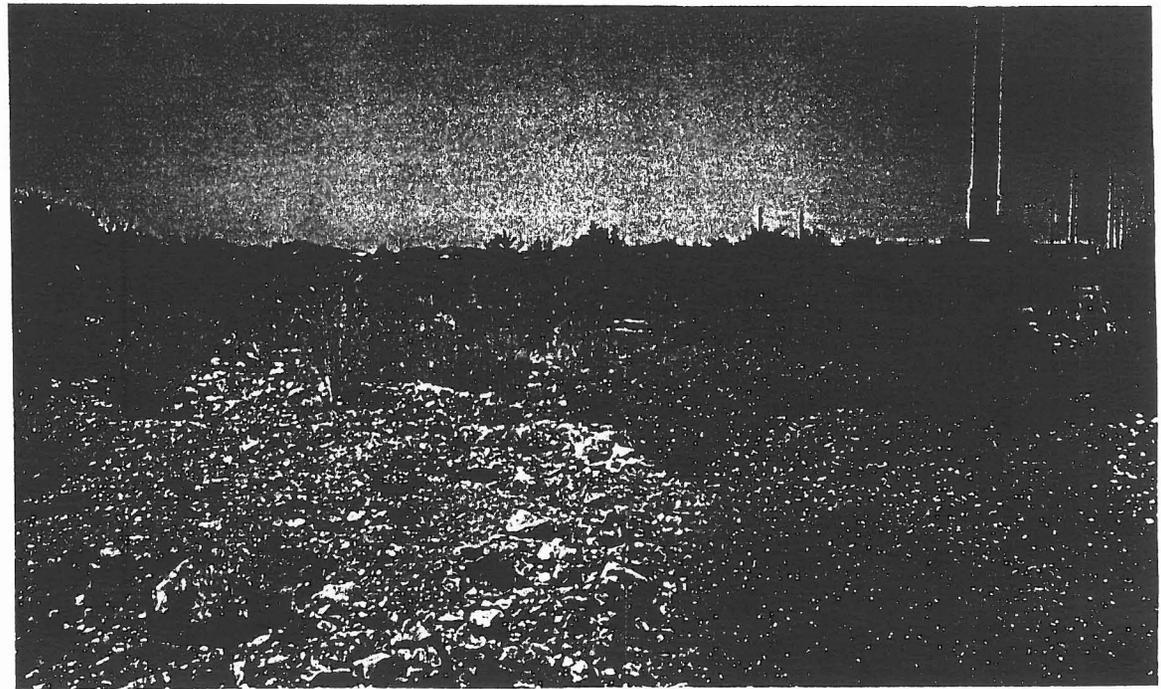
**Figure 17. Reach D. Looking upstream toward Carefree Highway bridge, left channel.**



**Figure 18. Reach D. Looking upstream toward Carefree Highway bridge, right channel.**

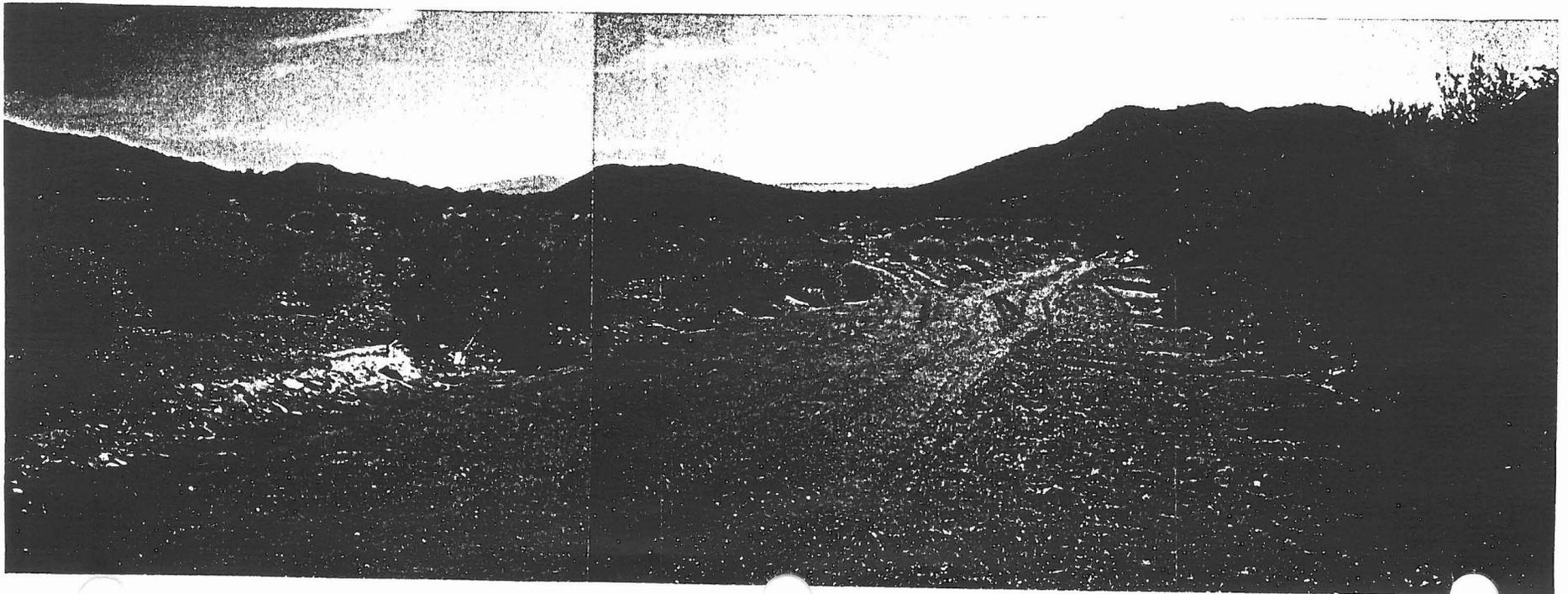


**Figure 19. Reach D. Looking downstream approximately 200 feet south of Carefree Highway bridge.**





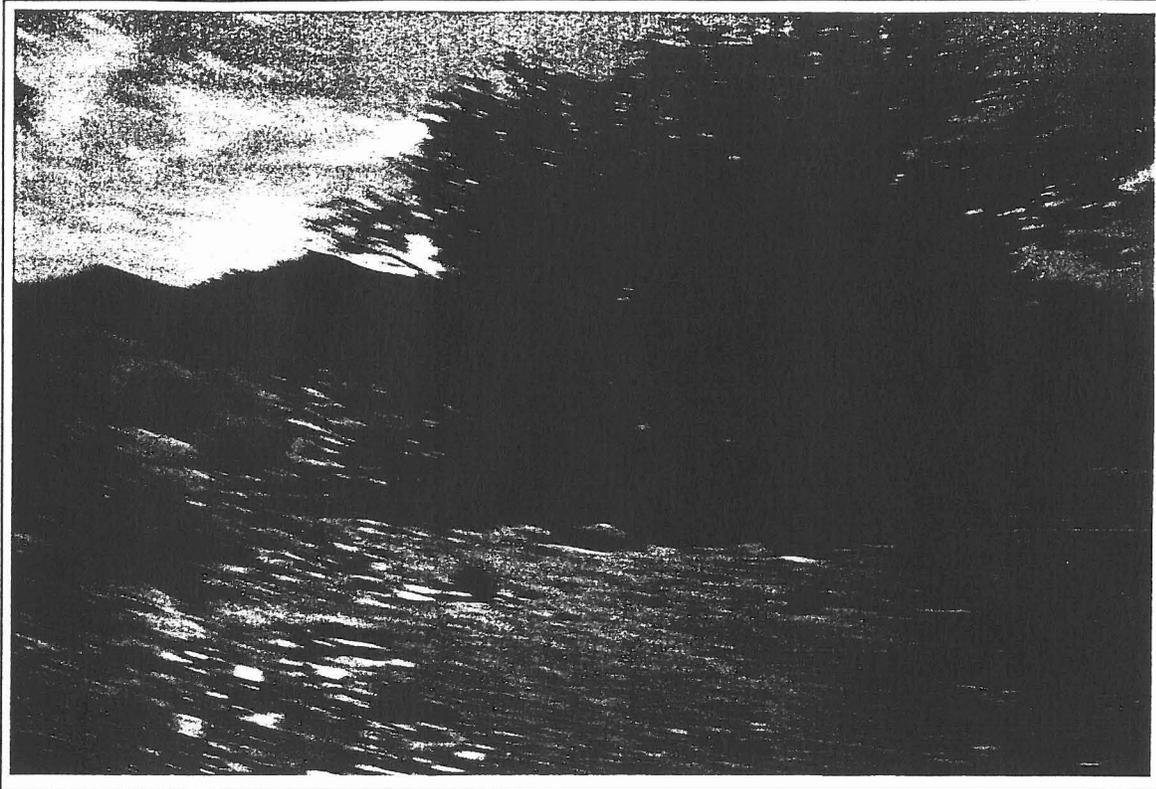
**Figure 20. Reach E. Looking upstream approximately 200 feet north of Carefree Highway bridge.**



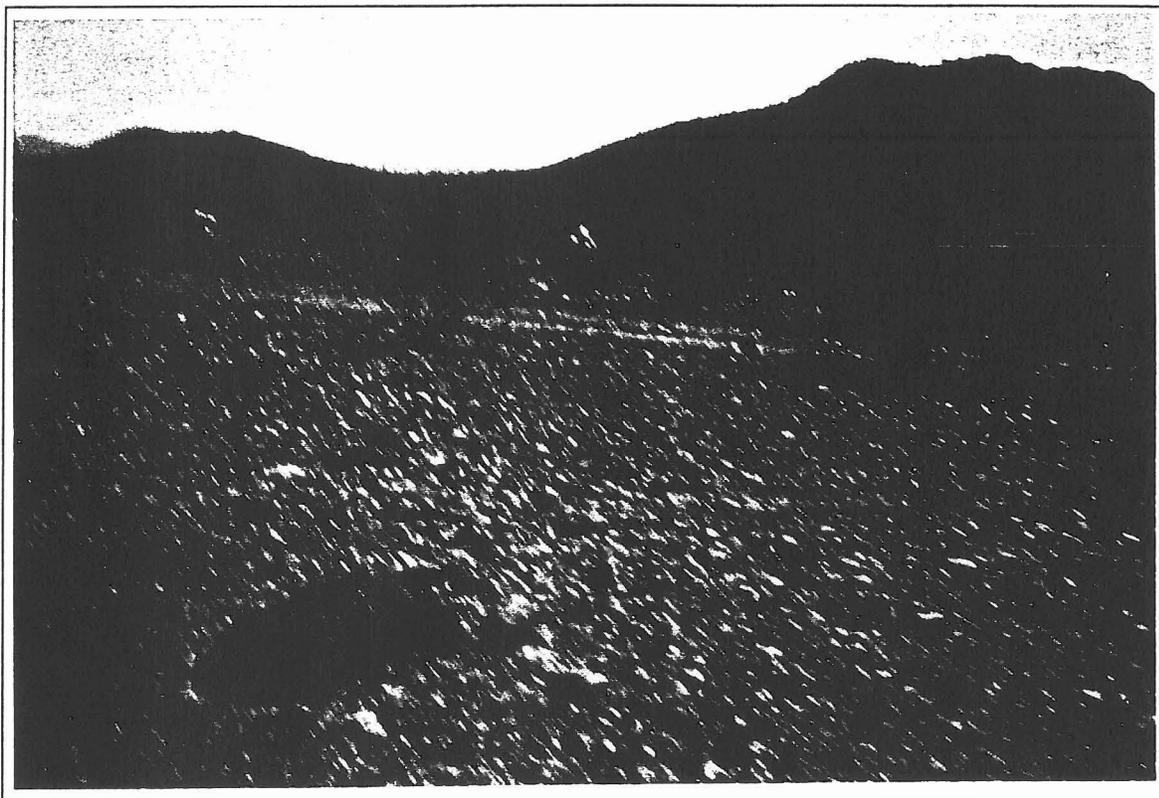


**Figure 21. Reach F. Looking upstream from Cross-Section Y, main channel.**





**Figure 22. Reach F. Looking upstream from Cross-Section Y, left overbank.**



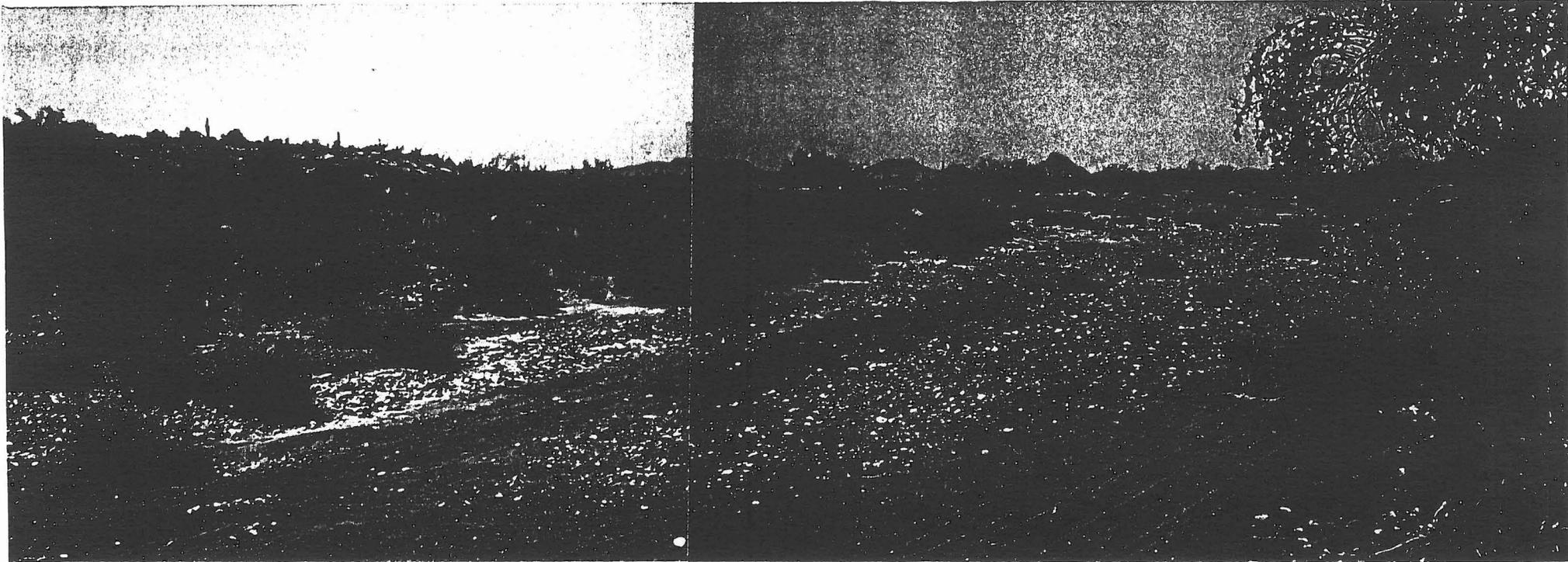
**Figure 23. Reach F. Looking upstream from Cross-Section Y, right overbank.**



**Figure 24. Reach G. Looking upstream toward 3-60" cmp culvert crossing of Cloud Road.**



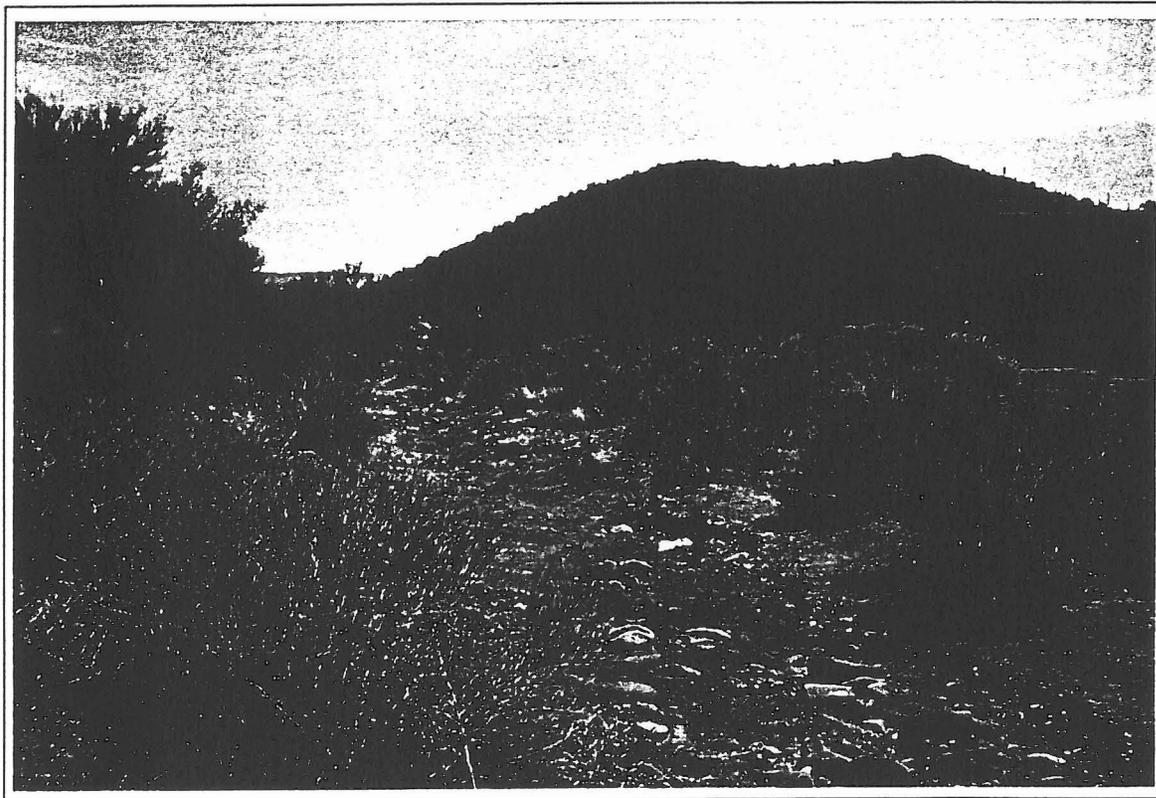
**Figure 25. Reach G. Looking downstream from Cloud Road culvert crossing.**



**Figure 26. Reach G. Looking downstream from Cross-Section HH approximately 300 feet south of Cloud Road alignment, main channel.**



**Figure 27. Reach G. Looking downstream approximately 150 feet south of Cloud Road alignment, right overbank.**



**Figure 28. Reach G. Looking upstream approximately 150 feet south of Cloud Road alignment, right overbank.**



**Figure 29. Reach G. Looking upstream adjacent to Cloud Road.**



**Figure 30. Reach H. Looking upstream at Cross Section #3  
(FEMA Cross Section "BJ").**

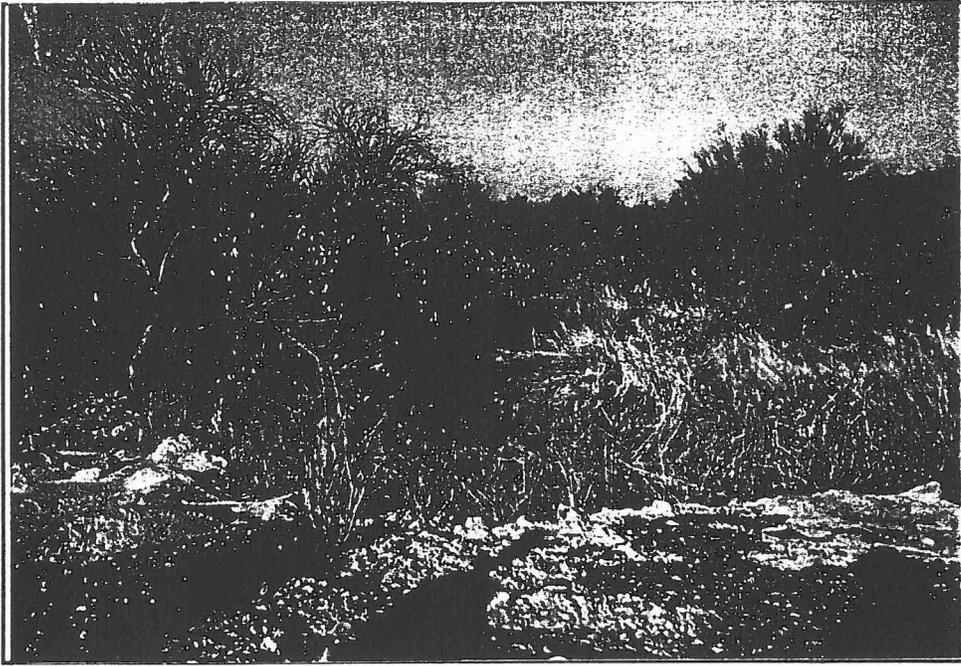


Figure 31. Reach H. Looking downstream at right overbank of tributary under Cloud Road.



Figure 32. Reach I. Looking downstream at Cross Section #4.



Figure 33. Reach J. Looking downstream at Cross Section #6



Figure 34. Reach J. Left overbank at Cross Section #6



Figure 35. Reach J. Right overbank at Cross Section #6



Figure 36. Reach K. Looking upstream at Cross Section #9.



Figure 37. Reach K. Right overbank looking downstream at Cross Section #9.



**Figure 38. Reach L. Looking upstream at Cross Section #12  
(FEMA Cross Section "BN").**



**Figure 39. Reach M. Looking upstream at Cross Section #19  
(FEMA Cross Section "BQ").**



Figure 40. Reach N. Looking upstream at Cross Section #31 (FEMA Cross Section "CE").



Figure 41. Reach H. Looking upstream at Cross Section #42 (FEMA Cross Section "CJ").

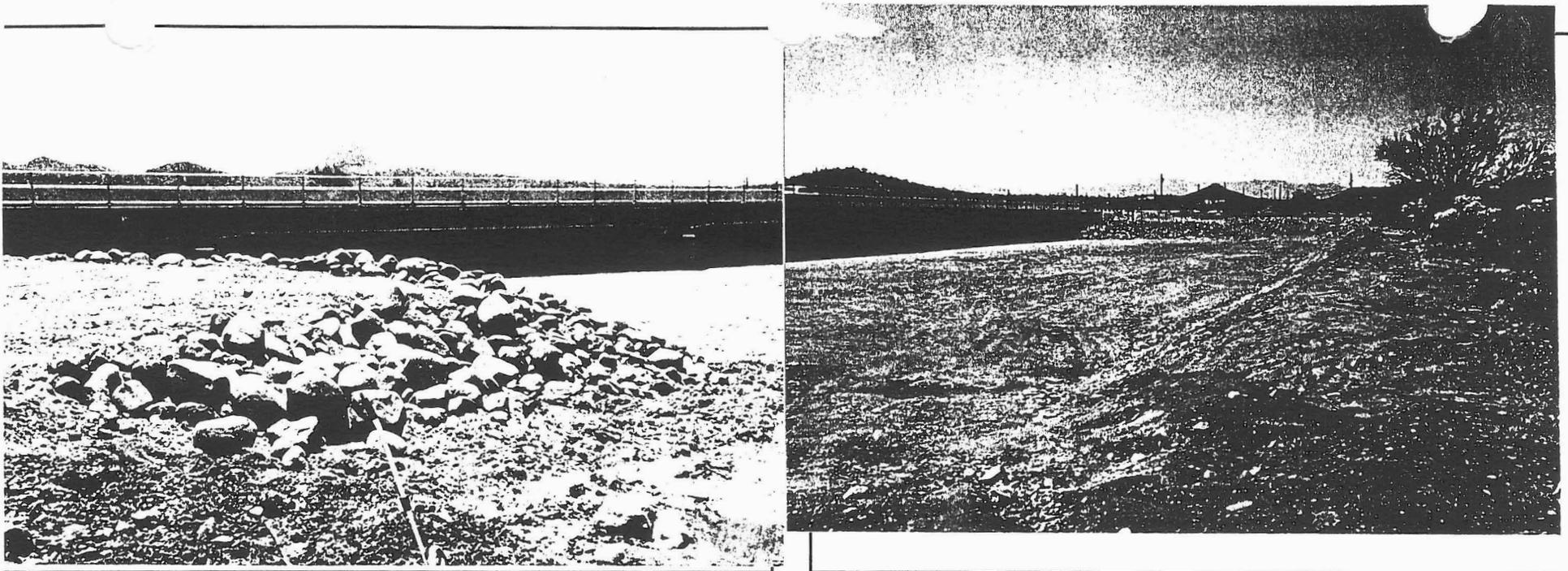


Figure 42. Reach P. Looking downstream at face of New River Bridge, Cross Section #49.



Figure 43. Reach O. Looking upstream at Cross Section #51 (FEMA Cross Section "CM")