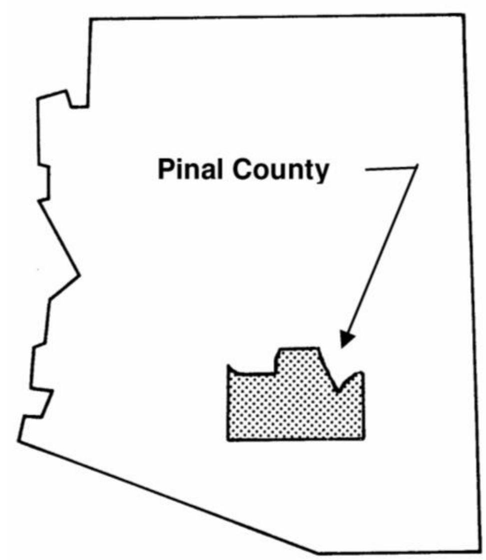
FLOOD INSURANCE STUDY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

VOLUME 1 OF 2



Community Name	Community Number
PINAL COUNTY, UNINCORPORATED AREAS	040077
APACHE JUNCTION, CITY OF	040120
CASA GRANDE, CITY OF	040080
COOLIDGE, CITY OF	040082
ELOY, CITY OF	040083
FLORENCE, TOWN OF	040084
HAYDEN, TOWN OF	040104
KEARNY, TOWN OF	040085
MAMMOTH, TOWN OF	040086
MARICOPA, CITY OF	040052
QUEEN CREEK, TOWN OF	040132
SUPERIOR, TOWN OF	040119
WINKELMAN, TOWN OF	040031

REVISED:

Federal Emergency Management Agency
FLOOD INSURANCE STUDY NUMBER
04021CV001B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This publication incorporates revisions to the original Flood Insurance Study. These revisions are presented in Section 10.0.

This preliminary revised Flood Insurance Study contains only profiles added or revised as part of the restudy. These profiles are presented in a reduced scale to minimize reproduction costs. All profiles will be included and printed at full scale in the final published report.

This Preliminary Flood Insurance Study report does not include unrevised Floodway Data Tables or unrevised Flood Profiles. These unrevised components will appear in the final Flood Insurance Study report.

Part or all of this Flood Insurance Study may be revised and republished at any time. In addition, part of this Flood Insurance Study may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the Flood Insurance Study. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current Flood Insurance Study components.

Initial Countywide FIS Effective Date: December 4, 2007
Revision Dates: TBD

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1

- 1.1 Purpose of Study 1
- 1.2 Authority and Acknowledgments 1
- 1.3 Coordination 2

2.0 AREA STUDIED 5

- 2.1 Scope of Study 5
- 2.2 Community Description 10
- 2.3 Principal Flood Problems 14
- 2.4 Flood Protection Measures 22

3.0 ENGINEERING METHODS 25

- 3.1 Hydrologic Analyses 25
- 3.2 Hydraulic Analyses 39
- 3.3 Vertical Datum 46

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS 46

- 4.1 Flood Boundaries 46
- 4.2 Floodways 51

5.0 INSURANCE APPLICATION 69

6.0 FLOOD INSURANCE RATE MAP 69

7.0 OTHER STUDIES 72

8.0 LOCATION OF DATA 72

9.0 BIBLIOGRAPHY AND REFERENCES 72

10.0 REVISION DESCRIPTIONS 77

- 10.1 First Revision 77

TABLE OF CONTENTS (Cont'd)

Page

FIGURES

Figure 1 - Floodway Schematic 52

TABLES

Table 1 – Initial and Final CCO Meetings 4
Table 2 – Flooding Sources Studied by Detailed Methods 5
Table 3 – Flooding Sources Studied by Approximate Methods 6
Table 4 – Scope of Revision 8
Table 5 – Areas Studied using Shallow Flow Techniques 8
Table 6 – Letters of Map Change 9
Table 7 – Historical Flood Data 15
Table 8 – Summary of Peak Discharges 32
Table 9 – Manning's "n" Values 45
Table 10 – Stream Conversion Factors 45
Table 11 – Floodway Data 54
Table 12 – Community Map History 71

EXHIBITS

Exhibit 1 - Flood Profiles

Arizola Drain	01P – 05P
Gila River at Florence	06P – 07P
Gila River at Hayden and Winkelman	08P – 11P
Gila River at Kearney	12P – 14P
Gila River at Riverside	15P
McClellan Wash	16P – 28P
McClellan Wash Split	29P – 30P
North Branch Santa Cruz Wash	31P – 35P
Queen Creek	36P
Queen Creek at Superior	37P – 42P
San Pedro River at Dudleyville	43P – 45P
San Pedro River at Mammoth	46P – 48P
Santa Cruz Wash	49P – 53P
Santa Cruz Wash	53(a)P – 53(a)P
Santa Cruz Wash Near I-8	54P – 58P
Santa Rosa Canal	59P – 63P
Steamboat Wash	64P – 65P
Weekes Wash	66P – 67P
West Branch	69P
Vekol Wash Tributary	70P – 72P
Vekol Wash Channel	73P – 73P
Vekol Wash Tributary Split	75P

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
PINAL COUNTY, ARIZONA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide FIS investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Pinal County, Arizona, including the Cities of Apache Junction, Casa Grande, Coolidge, and Eloy, Towns of Florence, Hayden (in both Pinal and Gila Counties), Kearny, Mammoth, and Maricopa (in both Pinal and Maricopa Counties), Towns of Superior (in both Pinal and Maricopa Counties), Queen Creek (in both Pinal and Maricopa Counties), and Winkelman (in both Pinal and Gila Counties), Arizona, and all unincorporated areas of Pinal County (referred to collectively herein as Pinal County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood hazard data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

Hydrologic and hydraulic analyses for Pinal County were performed by Cella, Barr, Evans, and Associates, for the Federal Insurance Administration, under Contract No. H-4607. This work was completed in March 1981 for Unincorporated Areas of Pinal County, July 1981 for the City of Apache Junction, July 1980 for Town of Florence, July 1980 for the Town of Kearny, March 1981 for the Town of Mammoth, and July 1980 for the Town of Superior.

Hydrologic and hydraulic analyses for the initial study for the City of Casa Grande, dated August 1, 1977, were performed by the U.S. Geological Survey (USGS) for the Federal Insurance Administration, U.S. Department of Housing and Urban Development. Authority and financing are contained in Inter-Agency Agreement No. IAA-H-19-74, Project Order No. 16 and Inter-Agency Agreement No. IAA-H-17-75, Project Order No.1, Amendment No.1.

Hydrologic and hydraulic analyses for the reach of the North Branch of Santa Cruz Wash which passes through the City of Casa Grande were conducted by Cella, Barr, Evans, and Associates of Tucson, Arizona (Cella, Barr, Evans, and Associates, December 1, 1987). The portion reanalyzed extends from a point 600 feet upstream of Burris Road to a point 2,800 feet upstream of Trekell Road. These reanalyzes were completed in December 1987.

Hydrologic and hydraulic analyses for the Gila River at Hayden and Winkelman and for the North

Branch Santa Cruz Wash were performed by the U.S. Geological Survey (USGS) for FEMA, under Inter-Agency Agreement No. IAA-H-9-77, Project Order No.10; and under Inter-Agency Nos. IAA-H-19-74, Project Order No. 16 and IAA-H-17-75, Project Order Nos. 10, 16, and 1 (with Amendment No. 1), respectively.

Hydrologic and hydraulic analyses for the revised study of Vekol Wash, Vekol Wash Tributary, and portions of the Santa Rosa Wash were performed by CBA, for FEMA, under Contract No. EMW-C-1185. This study was completed in September 1985.

For Apache Junction, information regarding the Buckhorn-Mesa Watershed project was submitted by the Flood Control District of Maricopa County (FCDMC) in cooperation with the U.S. Soil Conservation Service (NRCS (formerly SCS)).

In December 2007, HDR Engineering Inc. completed a countywide DFIRM and FIS for the County of Pinal, Arizona. HDR Engineering Inc. was hired as an IDIQ study contractor for FEMA Region XI under contract number EMF-2003-CO-0045, Task Order Number 4. The DFIRM process included digitizing floodplain boundaries from the effective paper FIRMs and fitting them to a digital base map, thus converting the existing manually produced FIRMs to digitally produced FIRMs, referred to as DFIRMs. Individual community effective FIS reports were also combined into one report for the entire county.

On selected FIRM panels, planimetric base map information was provided in digital format. Additional information was derived from U.S. Geological Survey (USGS) Digital Line Graphs. Digital Orthophotographic Quarter Quadragles (DOQQ) were provided by USGS. Additional information may have been derived from other sources. Users of this FIRM should be aware that minor adjustments may have been made to specific base map features.

The coordinate system used for the production of this FIRM is Universal Transverse Mercator (UTM), North American Datum of 1983 (NAD 83), and GRS 1980 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the UTM projection, NAD 83. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

Consultation Coordination Officer’s (CCO) meetings may be held for each jurisdiction covered under this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

Streams requiring study by detailed methods were identified at a meeting attended by representatives of the study contractors, FEMA, local and Federal governmental agencies, flood-control districts, the County of Pinal, City of Casa Grande, Towns of Florence, Kearny, Mammoth, and Superior on August 10, 1977. At that time, Apache Junction was not yet an incorporated community. After incorporation, a community meeting, held on November 27, 1979, was organized by the CCO to explain the nature and purpose of the Flood Insurance Study to residents and city officials of Apache Junction. The Arizona Department of Water Resources served as the State coordinating agency for this study.

Results of the hydrological analyses were coordinated with the USGS, the U.S. Soil Conservation Service (NRCS (formerly SCS)), and the U.S. Army Corps of Engineers (COE). The U.S. Soil Conservation Service provided some information regarding crop areas that had previously flooded in the past. Aerial photographs were also provided by the NRCS and were used to facilitate field surveys. Additional information was obtained from the Pinal County Flood Control Board.

On December 2, 1979, the final consultation and coordination meeting for the initial study for the City of Casa Grande was held. Previous progress meetings were held with the City Manager, the Consultation Coordination Officer of the Federal Insurance Administration, a representative of the Arizona State Land Department, which was the State coordinating agency at the time, and interested local parties.

On December 5, 1979, the results of the study for the Town of Florence were reviewed at the intermediate/final meeting which was attended by representatives of the study contractor, the Federal Insurance Administration, and Town of Florence officials. The study was acceptable to the community.

On December 6, 1979, the results of the Flood Insurance Study for the Town of Kearny were explained at the intermediate/final meeting attended by the Town Manager, the Federal Insurance Administration, and the study contractor. No problems were raised at this meeting.

On December 6, 1979, an intermediate meeting for the Town of Superior was held and attended by the study contractor, the Federal Insurance Administration, the Arizona Department of Water Resources, and the community.

On July 21, 1980, the initial results of the Flood Insurance Study for the City of Apache Junction were explained at the intermediate/final meeting attended by representatives of the City of Apache Junction, FEMA, and the study contractor. At this meeting, City of Apache Junction officials requested additional areas to be studied in their community. These requests were met and a second intermediate/final meeting was held on June 17, 1981. At this second meeting, the study was found acceptable to the city officials.

On July 22, 1980, the final community coordination meeting for the Town of Mammoth was held. At this meeting the representatives of FEMA Region IX proposed a special conversion of Mammoth to the Regular Flood Insurance Program. This proposal was acceptable to the community. This study was revised in 1984 to incorporate data used to prepare the 1983 Flood Insurance Study for Pinal County, Arizona (Federal Emergency Management Agency, April 1983).

On November 3, 1980, the results of the study for the Unincorporated Areas of Pinal County were reviewed at an intermediate meeting attended by representatives of the study contractors, FEMA, and Pinal County and was approved and accepted.

On December 6, 1980, the results of this study for the Town of Superior were reviewed at the final community coordination meeting. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, the Arizona Department of Water Resources, and the town. No problems were raised at the meeting.

On May 4, 1983, streams requiring revised shallow flooding analysis in the Unincorporated Areas of Pinal County were identified at a meeting attended by representatives of the study contractor, FEMA, and Pinal County. Results of the hydrologic analyses were coordinated with Pinal County, Flood Control District of Maricopa County (FCDMC), Arizona Department of Water Resources, USGS, NRCS (formerly SCS), the Arizona Department of Transportation, and the COE.

On March 11, 1985, the results of the shallow flooding analysis for the Unincorporated Areas of Pinal County were reviewed at the final meeting attended by representatives of the study contractor, FEMA, and community officials; at which time the study was approved by the community.

On November 10, 1986, a final coordination meeting for the City of Casa Grande was held with representatives of Cella Barr Associates, Arizona Department of Water Resources (ADWR), and Pinal County for the reanalysis of the North Branch of Santa Cruz Wash hydrology issues. Cella Barr Associates consulted with both the Arizona Department of Water Resources (ADWR) and the City of Casa Grande in order to obtain information and concurrence regarding the new analysis.

The dates of the initial and final CCO meetings held for Pinal County and the incorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings."

Table 1 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Pinal County (Unincorporated Areas)	August 10, 1977	March 11, 1985
Apache Junction, City of	August 10, 1977	June 17, 1981
Casa Grande, City of	August 10, 1977	November 10, 1986
Coolidge, City of	N/A	N/A
Florence, Town of	August 10, 1977	December 5, 1979
Hayden, Town of	N/A	N/A
Kearny, Town of	August 10, 1977	December 6, 1979
Mammoth, Town of	August 10, 1977	July 22, 1980
Maricopa, City of	N/A	N/A
Queen Creek, Town of	N/A	N/A
Superior, Town of	August 10, 1977	December 6, 1980
Winkelman, Town of	N/A	N/A

N/A – not applicable

On August 25, 2004, the initial CCO meeting for the Pinal countywide DFIRM and FIS was held. Attending the meeting were representatives of FEMA Region IX, MAPIX- URS, HDR Engineering Inc. the study contractor, Pinal County, Cities of Apache Junction, Casa Grande, and Florence.

On August 10, 2005, the final CCO meeting for the Pinal countywide DFIRM and FIS was held. Attending the meeting were representatives of FEMA Region IX, ADWR, HDR Engineering Inc. the study contractor, Michael Baker Jr. Inc., Pinal County, Cities of Apache Junction, Casa Grande, Coolidge, Florence, Maricopa, and Towns of Kearny, Mammoth and Superior.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Pinal County, Arizona. Those areas within the County, but excluded from this study include the Papago, and San Carlos Indian Reservations; the Casa Grande and Florence Military Reservations; and the Rittenhouse U.S. Air Force Auxiliary Field. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM.

Table 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Arizola Drain	Queen Creek at Superior
Gila River at Florence	San Pedro River at Dudleyville
Gila Riverat Hayden and Winkelman	San Pedro River at Mammoth
Gila Riverat Kearny	Santa Cruz Wash
Gila River at Riverside	Santa Cruz Wash near I-8
McClellan Wash	Santa Rosa Canal
McClellan Wash Split	Steamboat Wash
North Branch Santa Cruz Wash	Weekes Wash
Queen Creek	West Branch

All or portions of the flooding sources listed in Table 3, “Flooding Sources Studied by Approximate Methods,” were studied by approximate methods. Approximate analyses were used to study only those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Pinal County.

Table 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Alder Wash	Dripping Spring Wash	Peppersauce Wash
Antelope Ravine	Dry Camp Canyon Creek	Picacho Reservoir
Apache Wash	Durham Wash	Polo Tank
Aravaipa Creek	Eagle Wash	Putnam Wash
Ash Creek	El Molino Tank	Rawhide Canyon Creek
Bear Springs Canyon Creek	Eskiminzin Wash	Ray Springs Wash
Bee Tank	Faraway Wash	Repecita Tank
Big Wash	Flag Wash	Rhodes Canyon Creek
Bloodsucker Wash	Florence Canal	Ripsey Wash
Bonito Canyon Creek	Florence-Casa Grande Canal	Roach Wash
Booger Canyon Creek	Forman Wash	Romero Wash
Box Canyon Creek	Gato Tank	Sample Wash
Box O Wash	Goldfield Wash	Santa Cruz River
Box Wash	Green Lantern Wash	Santa Rosa Wash
Brady Wash	Greene Canal	Scanlon Wash
Brandenburg Wash	Greene Wash	School Wash
Bright Angel Canyon Creek	Hackberry Gulch	Smelter Wash
Bull Dog Wash	Hackberry Wash	Smith Wash
Bulldog Mine Wash	Hagen Canyon Creek	South Wash
Buzan Canyon Creek	Hells Half Acre Canyon Creek	Statton Wash
Camp Grant Wash	Holy Joe Canyon Creek	Suffering Wash
Canada Del Oro	Horse Camp Canyon Creek	Swingle Wash
Capgage Wash	Hot Tamale Wash	Syphon Draw
Carpas Wash	Indian Camp Wash	Tar Wash
Cat Hills Tank	James Wash	Tascal Ravine
Catalina Wash	Javelina Canyon Creek	Threeway Wash
Cave Canyon Creek	Jim Thomas Wash	Tom Mix Wash
Cement Dam Canyon	Kannally Wash	Tovera Tank
Char Tank	Keystone Canyon Wash	Tacson Wash
Cherry Valley Wash	Kilberg Canyon	Tule Canyon Creek
China Wash	Lambing Camp Wash	Twentynine Wash
Chirreones Arroyo	Lyons Fork	Vekol Wash
Cienega Wash	Mammoth Wash	Vekol Wash Tributary
Circle Wash	Martinez Canyon Creek	Virgus Canyon Creek
Clark Wash	Myer Wash	Walnut Canyon Creek
Copper Canyon Creek	Middle Mountain Tank	White Canyon Creek
Copper Creek	Middle Tank	Whitewash Canyon Creek
Coronade Wash	Milk Ranch Creek	Whitlock Wash
Cottonwood Canyon Creek	Mine Wash	Whitlow Canyon Creek
Cottonwood Wash	Mineral Creek	Yle Canyon Creek
Cronley Wash	Muddy Tank Ravine	Zapata Wash
Cross Canyon Creek	Mulberry Wash	Zelleweger Wash

Table 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Cruz Wash	New Tank
Deer Creek	North Side Canal
Derrio Canyon	Oak Spring Canyon Creek
Devils Canyon Creek	Old Deer Creek
Dodge Tank Wash	Olsen Wash
Dodson Wash	Paisano Wash
Donnelly Wash	Palmer Wash
Double Tank	Parsons Canyon Creek

The following flooding sources were studied by detailed methods:

Gila River at Riverside from 185.74 river miles above Painted Rock Dam upstream to River Mile (RM) 186.97.

San Pedro River at Dudleyville from 2.27 river miles above its confluence with the Gila River upstream of RM 21.96.

Queen Creek – from 29.17 river miles above Roosevelt Canal upstream to RM 30.33, in the vicinity of Queen Valley. The upstream 0.14 mile of this reach lies along a tributary valley to the north of Queen Creek and is indicated on the flood profiles and maps by a profile base line. For the purposes of this study, Queen Creek and the tributary valley were analyzed as a single unit.

West Branch – from its confluence with Queen Creek upsteam to RM 0.76, in the vicinity of Queen Valley.

Santa Cruz Wash – 1,000 feet below its confluence with Santa Rosa Wash upstream of RM 2.99, in the vicinity of Stanfield.

In the southern portion of Casa Grande, inadequate drainage for run-off originating in or near the city results in localized ponding. These flood hazard areas were delineated using approximate methods. There may be additional areas subject to ponding south of Kortsen Road, but they were not studied in detail because the hazard in these areas is not great enough to justify the costly small-interval contour maps necessary to delineate the additional areas or to establish depth-frequency relations for those areas.

In the City of Casa Grande lying to the north of North Branch of Santa Cruz Wash is subject to sheetflow flooding. This area, which is traversed by several small gravelly channels, was studied by approximate methods.

Small washes southeast of Florence were not studied due to the existence of a U.S. Soil Conservation Service flood control structure in this area. This structure was designed to protect against the 1 percent frequency (100-year) flood (Pinal County and Florence- Coolidge Soil Conservation District, October 1961).

Table 4, "Scope of Revision," lists streams that have names in this countywide FIS other than those used in the previously printed FISs for the communities in which they are located.

Table 4 - SCOPE OF REVISION

Stream	Limits of Revised or New Detailed Study
Arizola Drain	I-10/SR-84 Interchange to confluence with North Santa Cruz Wash
McClellan Wash	1.5 miles downstream of the main channel crossing of the CAP Canal to Gila River Reservation
North Santa Cruz Wash	Burris Road to 2800' East of Trekkel Road
Santa Cruz Wash near I-8	Rivermile 7.532 to 12.669 upstream of the confluence with North Branch Santa Cruz Wash
Santa Rosa Canal	Rivermile 4.979 to 10.155 upstream of the confluence with Santa Cruz Wash (Overchute on the Santa Rosa Canal)

Streams studied using the shallow flooding analyses are shown in Table 5, "Areas Studied Using Shallow Flooding Techniques" below. These streams were evaluated using detailed/shallow flooding techniques due to the type of historical flood problems experienced in Pinal County.

Table 5 - AREAS STUDIED USING SHALLOW FLOODING TECHNIQUES

Stream	Limits of Study
Santa Rosa Wash	3 mile southeast of the City of Maricopa to the Gila River Indian Reservation
Vekol Wash Tributary	From the Maricopa Indian Reservation boundary to the Gila River Indian Reservation boundary, approximately 3.0 miles
Vekol Wash	From the Maricopa Indian Reservation boundary to the Gila River boundary approximately 0.8 miles

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision - based on Fill [LOMR-F], and Letter of Map Amendment [LOMA], as shown in Table 6, "Letters of Map Change."

Table 6 - LETTERS OF MAP CHANGE

Community	Project Identifier Type	Date Issued	Type	Case No
Pinal County	Gila River at Florence	12/12/1989	102	---
Pinal County	Gila River	04/04/1995	LOMR	95-09-003P
Pinal County	Unnamed Wash – 200’ Upstream of Delaware Drive to 450’ South of 16th Avenue	6/26/198	102	97-09-1211P
Pinal County	Unnamed Wash – Downstream of the intersection of South Delaware Drive and Primrose Lane to just upstream of East Southern Avenue	8/22/2001	102	01-09-864P
Pinal County	Santa Rosa Wash downstream of Honeycut Road	04/19/2002	LOMR	02-09-249P
Pinal County	Gila River at Kearny – 1500’ downstream of Ford Road to 500’ Upstream of the Confluence with Steamboat Wash	09/11/2002	LOMR	01-09-283P
Pinal County	Canada Del Oro Wash	10/31/2002	LOMR	02-09-1101P
Pinal County	Santa Cruz River – 6,900’ downstream of Trico Road to 1,600’ downstream of Sanders Road	03/10/2005	102	03-09-1071P
Pinal County	Unnamed Wash – Downstream of Kenworth Road to 3,800’ upstream of Skousen Road	12/02/2005	102	05-09-1106P
Pinal County	Santa Rosa Wash – just upstream of Maricopa Road to just upstream of Parter Road & Vekol Wash Tributary – 6,500’ upstream of McDavid Road to just upstream of the Southern Pacific Railroad	01/30/2006	LOMR	05-9-A319P
Pinal County	Santa Rosa Wash	07/17/2006	LOMR	06-09-BB74X
Pinal County	Greene Wash	09/25/2006	LOMR	06-09-BE33P
Pinal County	North Branch Santa Cruz Wash and Arizola Drain	04/25/2008	LOMR	08-09-0418P
Pinal County	Unnamed Wash – from Hunt Highway to approximately 1,150’ south of Hunt Highway	05/11/2007	LOMR	06-09-B902P

2.2 Community Description

Pinal County

Pinal County is located in south-central Arizona, and encompasses an area of approximately 5,386 square miles. It is bordered by Graham County to the east, Pima County to the south, Gila County to the north, and Maricopa County to the west and north. The population of Pinal County was 90,918 in 1980, approximately 111,100 in 1990, and 179,727 in 2000.

Topography, as well as vegetation, is extremely diverse, varying from high, rugged mountains scattered throughout the County, to the Sonoran Desert Lowlands. Red-flowered ocotillo and green-barked palo verde inhabit the higher slopes due to the abundance of moisture. Jatrophos, brittle brush, acacia, saguaro cactus, and similar vegetation are well-suited for the plains regions, while smoke trees and similar vegetation survive well in low washes.

Due to competition for moisture, growth densities are low and plants are widely-spaced. This leaves the soil unprotected and open to the agents of erosion. Alluvial fans extend from eroded, angular peaks, coalescing to form wide expanses of alluvium, or bajadas. The fans eventually level out to form low, flat basins called playas. As runoff rushes down the sparsely-vegetated slopes, a braided, or distributary pattern of channels is formed, which is characteristic of the drainage pattern in much of Pinal County.

The average annual rainfall in Pinal County ranges from a minimum of 4 inches in the low desert to a maximum of 25 inches in the high mountains. At an elevation of 5,500 feet, the average annual air temperature is 57°F; while in the low desert areas it is 71°F (U.S. Department of Agriculture, April 1972).

The three primary watercourses in Pinal County are the San Pedro River, the Gila River, and the Santa Cruz River system. The San Pedro River enters the county from the southeast, flowing north northeasterly for roughly 35 miles before joining the Gila River at Winkelman. The San Pedro River is characterized by a sandy bottom that shifts during major flows. A small low-flow channel generally remains open, while a dense growth of phreatophytes dominates the remainder of the channel.

The Gila River forms the far northeastern border of Pinal County until it reaches Winkelman, at which point it traverses westerly across the County to meet the Santa Cruz River system. Between Kelvin and Winkelman, the Gila River has channel characteristics similar to those of the San Pedro River. Approximately 6 miles downstream of Kelvin, the Gila River forms a wide floodplain. By the time it exits at the northwestern corner of Pinal County, the Gila River floodplain is several miles wide.

The Santa Cruz River, up to this point near Read Rock, has been referred to as a system due to man-made and natural diversions that cause its floodwaters to separate and become distinct, unique floodflows, then recombine at a point many miles downstream.

In the vicinity of the shallow flooding study area, the Santa Cruz River system is composed of two major drainage ways, Santa Cruz Wash and Santa Rosa Wash. The Santa Cruz River originates in the San Rafael Valley, approximately 20 miles east of Nogales, Arizona, and flows southward into Mexico before re-entering the United States about 3 miles east of Nogales. From here, it flows northward about 70 miles to Tucson and then north-westward approximately 42 miles to the junction with Greene Canal. A majority of the flow is directed north-westerly in

Greene Canal to Greene Wash (Halpenny and Greene, November 1968). At Chuichu, the flow is traversed by Highway 84 and at this point much of the flow is diverted back into the Santa Cruz Wash and the remainder continues in Greene Wash.

Greene Wash continues northwestward and is channelized by a system of dikes from a point just south of Interstate 8 to its confluence with Santa Rosa Wash, about 1 mile northeast of Stanfield, Arizona. From here, the flow continues northward and crosses the Union Pacific (former Southern Pacific) Railroad approximately 1 mile east of Maricopa. Santa Cruz Wash crosses the railroad approximately 7.5 miles southeast of Maricopa and is joined by Santa Rosa Wash about 9 miles downstream, before it eventually flows into the Gila River, near Laveen. It is this sequence of diversions and channels which limits the use of the term "Santa Cruz River" to simply describe the complex linkage of flood hazards along the Santa Cruz River system.

Vekol Wash is a tributary to the Santa Cruz River and joins it approximately 8 miles north of the Union Pacific Railroad (formerly Southern Pacific Railroad) crossing. At Maricopa, it drains an area of approximately 297 square miles, extending up into the Vekol Valley. Elevations range from 1,160 feet at the railroad to 4,084 feet at the peak of the Maricopa Mountains. The average slope through the Vekol Valley is 0.55 percent, but steepens to over 29 percent in the mountains. Vekol Wash Tributary, with a drainage area of approximately 156 square miles, drains to Vekol Wash near Maricopa. This drainage area is less defined than that of Vekol Wash, as many of the alluvial plains are presently under cultivation, and grading and channelization have altered the natural drainage pattern.

City of Apache Junction

The City of Apache Junction lies astride the boundaries of north-central Pina1 County and northeastern Maricopa County, in south-central Arizona, approximately 30 miles east of Phoenix, Arizona. The population of the City was approximately 31,814 in 2000. The total land area contained within the corporate limits is approximately 16.5 square miles. It is bordered by unincorporated areas of Maricopa County on the west and unincorporated areas of Pinal County elsewhere.

Apache Junction is a suburb of Metropolitan Phoenix. Residential development is found throughout the community, with commercial development located along U.S. Highway 60/89.

The City of Apache Junction is located on an alluvial fan at the base of the Superstition and Goldfield Mountains. The alluvial fan is characterized by the presence of many intermingling washes, generally flowing southwesterly.

Terrain is hilly on the eastern side of the community, while relatively flat on the western side. Natural vegetation consists of creosote bush, mesquite, palo verde, cacti, and native grasses. The climate in the study area is semiarid, with a mean annual temperature of 70°F. Total annual precipitation ranges from 6 to 10 inches.

Weekes Wash is the largest wash in the community with a drainage area of 10.6 square miles at U.S. Highway 60/89. The major portion of its drainage area is in the Goldfield and Superstition Mountains. Bulldog, Apache, Goldfield, and Superstition Washes all flow southwesterly through the city and have drainage areas of 3.8, 3.2, 6.2, and 2.2 square miles, respectively.

City of Casa Grande

The City of Casa Grande is located on the southwest side of a large agricultural area in western Pinal County. The city, which was incorporated in 1915, is basically residential, having such businesses and light industry as needed to support the local residents and the agricultural and mining operations in the surrounding rural area. The population of the City was estimated at 25,224 in 2000.

The older, developed portion of the City of Casa Grande straddles a very low divide between two arms of a gently sloping valley constituting the former floodplain of the Santa Cruz River and its tributaries. The Santa Cruz River at the City of Casa Grande drains an area of several thousand square miles. The valley floor is nearly flat in cross section and is rimmed by alluvial fans near the mountains.

Drainage is to the northwest, with a slope of about 12 feet per mile. The Santa Cruz River and one tributary, Santa Cruz Wash, follow the western arm of the valley. Formerly, another tributary of the Santa Cruz River followed the eastern arm, but that arm now carries only local runoff from an indeterminate amount of flat farmland to the southeast of the City. Drainage divides are poorly-defined; divides and watercourses have been obliterated by land leveling, and several canals connect and divert water from the natural watercourses; therefore, it is impractical to determine the contributing drainage area for this arm of the valley. Water that does follow the natural drainage course and excess flow from some canals drains to the North Branch of Santa Cruz Wash (hereafter referred to as the North Branch). The North Branch flows westerly through the northern part of the city and empties into Santa Cruz Wash about 8 miles west of State Highway 93. All streams in the vicinity of Casa Grande are ephemeral, flowing occasionally in response to large amounts of rainfall in short intervals of time.

Casa Grande has a hot, dry climate with a normal annual precipitation of 8.11 inches (period 1941-70). Winter and summer precipitation falls as intense rains from thunderstorms whereas winter precipitation generally results from low intensity storms lasting from one to three days. The maximum rainfall recorded in a single day between 1899 and 1962 was 4.50 inches on July 26, 1936. The National Weather Service estimates the 100-year, 6-hour rainfall as 3.4 inches. Casa Grande does not have a recording rain gauge.

City of Coolidge

Results of the mapping study were not previously summarized in an effective FIS report for the City of Coolidge; therefore, no community description is provided.

City of Eloy

Results of the mapping study were not previously summarized in an effective FIS report for the City of Eloy; therefore, no community description is provided.

Town of Florence

The Town of Florence, the county seat, is centrally located in Pinal County, in south- central Arizona. Unincorporated areas of Pinal County surround Florence. Coolidge is the nearest city, located approximately 8 miles to the west-southwest, while the Town of Superior is approximately 28 miles to the northeast.

Florence encompasses an area of approximately 2.25 square miles (The Arizona Association of Counties and The League of Arizona Cities and Towns, January 1977). The population of the Town of Florence was estimated at approximately 17,054 in 2000. The Gila River, divides the Town of Florence into northern and southern areas, with much of the population concentrated in the southern portion of the community. A thin strip of the town runs across the Gila River floodplain; however, very little development has taken place in this strip, and it is mainly used for agricultural purposes.

The Gila River at Florence has developed a gently-sloping floodplain consisting of alluvium derived from mixed sources. The average annual rainfall of 6 to 10 inches supports a sparse vegetative cover of annual grasses, creosotebush, mesquite, paloverde, and cactus. Mean annual air temperature is 68°F to 71°F.

Town of Hayden

Results of the mapping study were not previously summarized in an effective FIS report for the City of Eloy; therefore, no community description is provided.

Town of Kearny

The Town of Kearny is located in eastern Pinal County, in south-central Arizona. It is situated approximately 80 miles southeast of Phoenix, Arizona, and 76 miles north of Tucson, Arizona. The total land area contained within the corporate limits is 2.75 square miles. It is bordered by Unincorporated Areas of Pinal County. The Town of Kearny has an estimated population of 2,479 in 2003. The main industry in Kearny is copper mining.

The majority of development in Kearny is located outside flood hazard areas, although some single-family residences, a few private businesses, and the Kearny Airport are located in the Gila River floodplain.

The Gila River, which flows westerly and northwesterly through the community, is one of the principal rivers in Arizona. It originates in New Mexico and flows westerly through Arizona to Colorado River near Yuma, Arizona. Its drainage area encompasses 57,950 square miles. Steamboat Wash, a tributary flowing southwesterly through Kearny to a confluence with the Gila River, has a drainage area of approximately 8.64 square miles. Danbury Wash and Cemetery Wash, also tributaries flowing southwesterly through the town to confluences with the Gila River, have drainage areas of approximately 0.50 and 0.23 square miles, respectively.

Terrain of the area surrounding the Town of Kearny is quite mountainous, with a sparse vegetative cover consisting of desert grasses, mesquite, catclaw, and white horn trees. Soils in and around Kearny are generally deep, gravelly, and fine- textured.

The climate in the study area is semi-arid with a mean annual temperature which varies from 62°F to 65°F. Average annual precipitation varies from 10 to 16 inches over the community.

Town of Mammoth

The Town of Mammoth is located in eastern Pinal County. The estimated population of the community was approximately 1,762 in 2000.

The San Pedro River flows northwesterly along the eastern corporate limits of Mammoth to its confluence with the Gila River, 19.5 miles downstream of the State Highway 17 crossing at Mammoth. The San Pedro River is characterized by a sandy bottom that shifts during major flows. A narrow low-flow channel usually remains, open, while a dense growth of phreatophytes dominates the remainder of the channel.

City of Maricopa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Maricopa; therefore, no community description is provided.

Town of Queen Creek

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Queen Creek; therefore, no community description is provided. Town of Superior

The Town of Superior is in the northeastern portion of Pinal County, in south-central Arizona. It is situated approximately 15 miles northwest of Kelvin, Arizona, and 20 miles northeast of Florence, Arizona. The total land area contained within the corporate limits is 2.1 miles. Superior is surrounded by unincorporated areas of Pinal County. The estimated population of the community was approximately 3,254 in 2000.

Queen Creek is the principal watercourse in the Town of Superior, flowing south- westerly through the community. Development within the flood plain is primarily residential. The drainage area of Queen Creek at Superior is approximately 14 square miles.

Mine Wash and School Wash are tributaries to Queen Creek within the community, and both having drainage areas slightly greater than 1 square mile. Cross Canyon Creek is a tributary to School Wash, having a drainage area of less than 1 square mile.

The Town of Superior, primarily a mining community, is located at a point where mountainous portions of the watershed give way to flat land below. The mountainous area consists primarily of andesite, basalt, and tuff agglomerate, and the flatter area is a moderately dissected alluvial fan overlain by alluvium. An annual precipitation ranging from 14 to 25 inches supports sparse vegetative cover consisting of whitehorn, catclaw, cactus, and some mesquite and oak. The mean annual temperature fluctuates between 60°F and 65°F (U.S. Department of Agriculture, Soil Conservation Service, April 1972).

Town of Winkelman

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Winkelman; therefore, no community description is provided.

2.3 Principal Flood Problems

Pinal County

Records of historical flooding in Pinal County indicate that large portions of the County are subject to highly-destructive flood events. The principal flood hazard results from overflow of major rivers during large flood events. This overflow results in the inundation of generally wide, flat floodplains, encompassing any residential, commercial, or agricultural development located within them. In addition, the region is subject to intense, short-duration rainfall, resulting in "flash" floods, which rise quickly, and cause high-velocity flood flows carrying large amounts of debris and sediment. Erosion of natural and newly-created earthen drainage channels, adds to the potential hazard from flooding.

Records indicate that annual peak discharges in the County occur most often during the period of August through January. Although most destructive flood events occur as the result of smaller, but high-intensity summer rainfall events, general winter storms may result in large-scale flooding on the major river systems, which may last many weeks in duration.

The table below summarizes historical flood data and the associated peak discharges.

Table 7 - HISTORICAL FLOOD DATA

Flooding Source	Study Site	Peak Discharges (cfs)	Flood Date	Recurrence Interval (Years)
Gila River	Riverside	82,000	09/28/1926	---
	Riverside	42,800	08/08/1930	22
	Riverside	28,600	08/30/1931	---
	Riverside	38,200	08/14/1940	19
	Riverside	28,000	08/09/1944	---
	Riverside	26,300	12/23/1965	10
	Riverside	27,700	12/20/1967	12
	Riverside	27,000	12/19/1978	11
	Riverside	100,000	10/02/1983	---
Green Wash	Stanfield	4,300	09/25/1962	6
	Stanfield	6,200	12/22/1967	25
	Stanfield	1,700	10/09/1977	2
	State Highway 84	4,300	09/26/1962	6
	State Highway 84	6,200	12/22/1967	25
	State Highway 84	1,700	10/09/1977	2
	State Highway 84	---	108/14/1983	300
San Pedro River	Dudleyville	20,000	08/13/1919	10
San Pedro River	Dudleyville	85,000	09/28/1926	600
	Dudleyville	25,000	08/08/1930	18
	Dudleyville	20,000	08/28/1935	10
	Dudleyville	45,000	08/14/1940	75
	Dudleyville	16,800	12/22/1965	---
	Dudleyville	16,000	10/11/1977	8
	Dudleyville	18,000	12/18/1978	---
	Mammoth	90,000	09/28/1926	---
	Mammoth	50,000	08/14/1940	---
	Mammoth	22,000	10/11/1977	10
Santa Cruz Wash	Desert Carmel	3,060	09/25/1962	7
	Desert Carmel	2,000	12/2/1967	3
	Desert Carmel	3,000	10/09/1977	6.5
	State Highway 84	3,060	09/26/1962	7
	State Highway 84	8,430	09/26/1962	6
	State Highway 84	2,000	12/22/1967	3
	State Highway 84	3,000	10/09/1977	6.5
Santa Rosa Wash	State Highway 84	---	10/04/1983	300

Table 7 - HISTORICAL FLOOD DATA

Flooding Source	Study Site	Peak Discharges (cfs)	Flood Date	Recurrence Interval (Years)
Santa Rosa Wash (Maricopa)	Union Pacific Railroad (formerly Southern Pacific Railroad)	---	09/26/1962	---
	Union Pacific Railroad (formerly Southern Pacific Railroad)	15,400	10/04/1983	300
Santa Rosa Wash and Santa Cruz Wash	Union Pacific Railroad (formerly Southern Pacific Railroad)36,400	36,400	10/04/1983	300

Flooding characteristics at Maricopa, Stanfield, and Desert Carmel are essentially the same as at State Highway 84 (Cella Bar Associates, November 1979). As flood flows exceed the capacity of the existing well-defined, man-made channels, breakout results in a general sheetflow condition in the overbank area. Typically, flood depths for a 1- percent chance flood event average approximately 2 feet across the floodplain, but may be deeper in isolated pockets.

Numerous larger floods occurred prior to the construction of the Coolidge Dam in 1929. Of the 18,011-square-mile area contributing to the flood hazard at Riverside, approximately 12,900 square miles of the watershed is controlled by Coolidge Dam. Thus, Coolidge Dam plays an important role in the flooding problems of Riverside. The majority of Riverside is located in the low floodplain immediately adjacent to the Gila River. The result of this is that even small, frequent floods have a destructive effect. Furthermore, there is a bridge approximately 1 mile downstream that creates a backwater condition. Assuming the reservoir to be at capacity, three types of events could lead to severe flooding on Gila River: (1) a widespread frontal-type storm of large magnitude and long duration, (2) a warm air mass moving in on a large snow accumulation, or (3) a frontal-type storm falling on snow (U.S. Department of the Interior, Geological Survey,
1970).

An examination of the Gila River discharge records collected at Kelvin, USGS gage No. 09474000, (just downstream of Riverside) show that the annual peak discharge occurs most often during the period of August through January (U.S. Department of the Interior, Geological Survey, 1966).

The San Pedro River near Dudleyville experienced five major floods between 1919 and 1940. The major floods on the San Pedro River usually occur during the fall months. The most severe flood on record for the San Pedro River at Mammoth was in September 1926. The discharge associated with that flood was estimated by the USGS to be 90,000 cfs at Mammoth, which is an extremely rare event. The most recent large flood on the San Pedro River at Mammoth occurred in October 1977. The estimated discharge (USGS estimate) for this flood was 22,000 cfs, which is an approximately 10-year event.

Homes and businesses along Main Street in Mammoth experienced severe inundation damage as a result of this relatively small flood.

In August 1970, the COE constructed Whitlow Ranch Dam just upstream of Queen Valley. Based on a USGS crest stage gage (Station No. 09478600) that monitors a tributary to Queen Creek, no significant flood flows have occurred on Queen Creek near Queen Valley since existence of the dam.

There is no documented history of a major flood having occurred on North Branch Santa Cruz Wash. Until recent years, the area was completely undeveloped and flooding could have passed unnoticed. There are reports by local residents of water encroaching upon fields, but no dates could be put on these reports.

Flooding on the complex Greene Wash and Santa Cruz Wash systems occurs quite frequently. South of Greene Reservoir, flood flows on the Santa Cruz River system may break out and flow northward down Greene Wash. At Chuichu, the capacity of Greene Wash is inadequate to contain large flood flows within the banks of the wash, and a portion of the flow is diverted northeasterly into Santa Cruz Wash. At this point, two distinct watercourses may carry flood flow that originates from a single watercourse. North of State Highway 84, Greene Wash then joins Santa Rosa Wash and continues north to the City of Maricopa. In addition, north of State Highway 84, Santa Cruz Wash is also joined by the North Branch of Santa Cruz Wash. Continuing further north; Santa Cruz Wash is met by Santa Rosa Wash just north of Maricopa. Finally, Santa Cruz Wash is joined by Vekol Wash, approximately 8 miles north of Maricopa, just before it flows into the Gila River.

Flooding on the Santa Rosa Wash has occurred frequently and, according to the COE, (U.S. Department of the Army, Corps of Engineers, 1963-1) large floods have occurred in 1914, 1926, 1929, 1931, 1935, 1938, 1940, 1945, 1950, 1954, 1957, and 1962. In 1957, flooding of the adjacent fields occurred in the Maricopa area as a result of the failure of dikes along the Santa Rosa Wash. The discharge at Vaiva Vo (6.5 miles downstream of the present site of Tat Momolikot Dam) was estimated at 10,000 cfs.

The largest flood of record on the Santa Rosa Wash occurred on September 27, 1962, when a discharge of 53,000 cfs was recorded at Vaiva Vo. Approximately 12,800 cfs were estimated at Stanfield with an additional 3,000 cfs contributed from the Santa Cruz Wash by the time the floodwaters reached the Union Pacific (former Southern Pacific) Railroad, near Maricopa (Arizona State Land Development, April 1963).

In October, 1983, the watersheds contributing runoff to the Santa Cruz River and tributary watersheds were subject to a record storm estimated to be a 0.33 percent-chance (approximately 300-year) event. This flood event caused widespread flooding and flood damage in the vicinity of Maricopa, peaking on October 4, 1983. Estimates from the gages at Cortaro and Laveen indicate a peak discharge, from the Santa Cruz River system near Maricopa, of about 36,400 cfs (Cella Bar Associates, July 1984).

Later investigation of aerial photographs (Cella Bar Associates, October 4, 1983 and Cooper Aerial Mapping Company, October 3, 1983) and on-site field reconnaissance indicated that the flooding in Maricopa resulted from break out of flow from both Santa Cruz Wash and Santa Rosa Wash. Flow in Santa Cruz Wash exceeded the capacity of several bridges along the Union Pacific Railroad (formerly Southern Pacific Railroad) and backed up, causing water to flow around the railroad embankment. A drainage channel, paralleling the railroad, helped carry some flow toward Maricopa, while discharging some portion of the flow through numerous culverts that pass beneath the railroad. As the drainage channel capacity was exceeded, flow from Santa Cruz Wash combined with flow from Santa Rosa Wash and caused overland flow in the direction of the Santa Rosa Wash bridge crossing.

Debris build-up on the bridge piers of the Santa Rosa Wash Bridge restricted the conveyance capacity to approximately 8,500 cfs. Additional flow being added from Santa Cruz Wash caused the channel capacity to be exceeded and resulted in a breach of the banks. Approximately 15,400 cfs of discharge was then diverted as overland flow along the south side of the railroad through the City of Maricopa. These flood waters then passed beneath the railroad through culverts and continued to flow along the path of

Vekol Wash prior to recombining with Santa Cruz Wash further downstream.

City of Apache Junction

The City of Apache Junction is subject to the effects of both summer flash flooding, and also general winter storm flooding. Floods typically occur in the Apache Junction area during late summer (July to September) or during the winter storm months (December to March). The NRCS (former NRCS (formerly SCS)) has reported the occurrence of an estimated 40 floods in the area since 1910. Of these 40 flood events, 13 occurred during the winter and 27 occurred during the summer. The most severe of these floods occurred in 1926, 1930, 1941, 1943, 1954, 1959, 1966, and 1971 (U.S. Department of Agriculture, June 1976). Due to the potential severity of flooding, the area was selected for study by detailed analysis.

City of Casa Grande

The City of Casa Grande is subject to several different types of flooding. The area of the City adjacent to the North Branch of Santa Cruz Wash is subject to normal riverine flooding and was studied by detailed analyses. That part of the City of Casa Grande lying to the north of the North Branch of Santa Cruz Wash is subject to sheet flow flooding. This area, which is traversed by several small channels, was studied by approximate methods.

Intense rainfall of short duration, 2 to 3 inches in less than an hour, creates severe drainage problems in the City of Casa Grande owing to the lack of well-defined stream channels. It is difficult to distinguish drainage problems from true flood problems. Shallow sheet runoff occurs over much of the city, and City streets serve as drainage channels. Shallow ponding occurs in many areas. Following large amounts of rain, the small irrigation ditches that flow through and around the city frequently overflow. The central business district has experienced frequent minor flooding from this lack of adequate drainage. Following the 4.50 inch rainfall on July 26, 1936, the Casa Grande Dispatch reported that the entire city was a lake and that there was minor damage to businesses. Similar flooding has been experienced several times. The problem has been somewhat reduced by the construction of numerous small diversion channels and streets designed to convey runoff. A low area near Florence Boulevard and Brown Avenue fills with water on each heavy rainfall. The city has installed pumps to relieve this situation.

The primary outlet for floodwaters from the city is via the North Branch Santa Cruz Wash. The North Branch Santa Cruz Wash has no well-defined channel in the study area. Small channels meander through a zone of dense mesquite and other desert shrubs; the zone is approximately flat in cross section and is from 300 to 1,000 feet wide. Major floods will inundate an area of as much as 4,600 feet wide. Maximum water depths near the center of the flooded area will be about 3 feet. Drainage from the southern part of the city flows directly to Santa Cruz Wash. The Santa

Cruz River and Santa Cruz Wash pose no flood threat to the City of Casa Grande.

There is no documented history of a major flood having occurred on the North Branch. Until recent years the area was completely undeveloped and flooding could have passed unnoticed. There are reports by local residents of water being well up in the fields, but no dates could be put on these reports.

Two sub-divisions within the City are also subject to frequent flooding. The subdivision east of Trekell Road along Bisnaga Street, Yucca Street, and Pueblo Drive, in the NW-1/4 of section 9, T. 6 S., R. 6 E., is in a low area near the center of the natural flood channel. A small man-made channel bounded by low dirt dikes diverts minor flows around the subdivision but does not provide protection against large floods. The channel follows the northern edge of the floodplain and has the capacity to carry only a few hundred cubic feet per second of flood water. A search of newspaper articles on floods during the period 1964-1975 revealed that floods were reported in this development twice in that 12-year period. The development was flooded on August 12, 1964 and August 19-20, 1971 from minor flows in the North Branch Santa Cruz Wash. The trailer park on the west side of Trekell Road, in the NE-1/4 SE-1/4 of section 8, T. 6 S., R. 6 E., is also in the area subject to frequent flooding.

Drainage characteristics on the north side of the North Branch differ greatly from those of the south side. The north side is an alluvial fan which slopes up to the Sacaton Mountains, 4 to 6 miles to the north, at a rate of about 26 feet per mile. The fan is dissected by a network of small channels that diverge and reconverge. Areas between channels are subject to sheet flow with depths that are generally less than 1 foot. Flood flows within the channels generally have maximum depths of two to three feet and velocities of six to eight feet per second. Two highways and a number of cross-slope dikes, drainage channels, low road embankments, and streets have altered the natural sheet flow pattern.

Minor flood flows do not reach the North Branch Santa Cruz Wash because they are dissipated on the fan; however, during major floods, large amounts of water flow down the fan, contributing most of the flow in the North Branch Santa Cruz Wash. Shallow flooding occurred on during minor flood events on August 12, 1964 and August 19-20, 1971 in the development located east of Trekell Road and north of Rodeo Road. The probability of the type of flooding described above – combining sheetflow in the small channels – is at least 10 percent in the year, but the probability of such flooding at a particular place with the area may be considered lower.

The main valley floor lying to the south of the North Branch Santa Cruz Wash is primarily farmland. Streets, roads, canals, dikes, and land leveling have substantially altered the natural sheet flow regime in this area. Flooding is mainly caused by ponding behind dikes and embankments, or by concentrations of runoff in small drainage ditches. The ditch that parallels Interstate 10 is the principal source of minor flooding along the North Branch Santa Cruz Wash in this area. The capacities of canals feeding this ditch are limited, and the flat cultivated fields have a large infiltration capacity. The south side of the valley will contribute only a minor amount of flow to the North Branch Santa Cruz Wash during major floods, and flow from the south will reach the main channel much later than that from the north. Extensive areas on the south side of the wash are covered with dense growths of either crops or weeds during the principal flood season – July to October. Average flood velocities are estimated to be about twice that for the same depth of flow on the north side.

City of Coolidge

Results of the mapping study were not previously summarized in an effective FIS report for the City of Coolidge; therefore, no principal flood problems are provided.

City of Eloy

Results of the mapping study were not previously summarized in an effective FIS report for the City of Eloy; therefore, no principal flood problems are provided.

Town of Florence

The Town of Florence is subject to flooding during large events. Although the existence of Coolidge Dam has considerably lessened the threat of flooding from large flood events, some threat still exists due to localized flooding, and the potential for flooding originating from events centered over the watershed downstream of Coolidge Dam. Assuming the reservoir to be at capacity, there are three types of events which would lead to severe flooding on Gila River: (1) a widespread frontal type storm of large magnitude and long duration, (2) a warm air mass moving in on a large snow accumulation, or (3) a frontal type storm falling on snow (U.S. Department of the Interior, Geological Survey, 1970).

An examination of Gila River discharge records collected at Kelvin, gage No. 94740, (approximately 25 miles upstream from Florence) show that the annual peak discharge occurs most often during the months of August through January (U.S. Department of the Interior, Geological Survey, 1966).

The estimated maximum discharge at Kelvin, downstream of Coolidge Dam, is 190,000 cubic feet per second (cfs), occurring on November 28, 1905. Based on newspaper accounts, the Gila River swelled to 1 mile wide, cutting the Town of Florence off from communication with other communities and washing out three railroad bridges between Florence and Kelvin. Based on current discharge-frequency relationships, a flood of this magnitude has a chance of occurring at Florence on the average of once every 285 years, and at Kearny on the average of once every 220 years.

The second-largest flood of record at Kelvin was estimated at 132,000 cfs, and occurred on January 20, 1916. According to the January 22, 1916, edition of the Arizona Blade- Tribune, both the north and south approaches to a bridge in the vicinity of the existing U.S. Highway 89 Bridge were washed away, and the river cut a new channel to the south of the bridge. According to the current discharge-frequency relationships, a flood of this magnitude has a chance of occurring at Florence on the average of once every 120 years.

The more recent flood occurred on December 20, 1967. The peak discharge of this flood was 27,700 cfs, recorded at Kelvin. A flood of this magnitude has a change of occurring at Florence on the average of once every 21 years.

The bridge on U.S. Highway 80/89 is the only structure in the vicinity of Florence which significantly affects the flow of floodwater. Both the bridge and the south approach ramp to the bridge create a backwater condition. Small washes southeast of Florence were not studied due to the existence of a flood control structure in this area. This structure was designed to protect against the 1 percent frequency (100-year) flood. Detailed study of the Town of Florence focused on the area of the City adjacent to the 1.19 miles of Gila River extending from U.S. Highway

80/89 on the east, to the extreme western City corporate limit.

Town of Hayden

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Hayden; therefore, no principal flood problems are provided.

Town of Kearny

The Town of Kearny is subject to flooding during almost any season of the year. Rainfall is the main cause of flooding. The worst flood on Gila River in recent history occurred in November 1905. The discharge associated with that flood was estimated to be approximately 190,000 cfs at Kearny, which is an approximately 0.45-percent chance (approx. 220-year) flood event.

The three previous floods occurred in December in 1965, 1967, and 1968. U.S. Geological Survey gage No. 09474000, located approximately 6 miles downstream of Kearny, recorded discharges of 26,300 cfs, 27,700 cfs, respectively, for these floods. All three of these floods have a return period of approximately 10 years.

Because of community awareness of the flood hazards that exist in Kearny, no major damage has occurred as a result of recent floods.

Town of Mammoth

In the Town of Mammoth, major floods on the San Pedro River usually occur during the fall months. The most severe flood on record for the Town of Mammoth occurred in September 1926, with an estimated discharge of 90,000 cfs. The most recent large flood occurred in October 1977, with an estimated discharge of 22,000 cfs and an approximate recurrence interval of 10 years (Federal Emergency Management Agency, April 1983).

Flooding from Tucson Wash affects a small portion of the northern part of the Town of Mammoth. Additionally, several un-named washes cause shallow flooding, with average depths of less than 1.0 foot.

City of Maricopa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Maricopa; therefore, no principal flood problems are provided.

Town of Queen Creek

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Queen Creek; therefore, no principal flood problems are provided.

Town of Superior

Flooding in the Town of Superior may occur at any time of the year, although summer thunderstorms will produce floods of the greatest magnitude. As is characteristic of floods emanating from small mountainous watersheds, runoff within the Town of Superior concentrates rapidly, peaks, and recedes in a matter of hours. Due to the close proximity of Mine Wash, School Wash, and Cross Canyon Creek to Queen Creek and the Town center, it is likely that all four flooding sources would flood concurrently.

Documentation of flooding in the Town of Superior is scarce. However, through discussion with the town historian, it is known that during floods in the 1950s, Queen Creek at Church Avenue was sufficiently deep to cause one car to be washed downstream.

The protection bridge over Queen Creek located just downstream of Western Avenue is assumed to be destroyed in any low-frequency flood.

Town of Winkelman

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Winkelman; therefore, no principal flood problems are provided.

2.4 Flood Protection Measures

Pinal County

As discussed previously, Coolidge Dam regulates flow on the Gila River, and thus, provides flood protection to many communities downstream of this facility. Regulation of the dam reduces the effects of more frequent floods, but would not eliminate the effects of larger events, such as the 1-percent chance or larger flood events.

For Queen Valley, Whitlow Ranch Dam provides protection from flooding on Queen Creek. The dam and the Whitlow Ranch Flood Control Basin behind it were designed to contain floods of a 1-percent chance magnitude.

A small water-supply dam and reservoir at the upstream end of the detailed-study reach on West Branch has no effect on the 10-percent chance or larger flood events. Therefore, it was not considered in the analysis for West Branch.

The NRCS (formerly SCS), in cooperation with the FCDMC, the East Maricopa Natural Resource Conservation District, and the Pinal County Board of Supervisors, has completed the Buckhorn-Mesa Watershed Project, which includes five flood-retarding structures that were designed to contain flood flows resulting from a 1-percent chance flood event. Two of the structures included in this project, Apache Junction Dam and Weekes Wash Dam, significantly reduce the flood hazard in Apache Junction.

Green Reservoir is no longer a reservoir. It was constructed privately, along with Green Canal, in the early 1900s as part of an irrigation project. Approximately 1 year later it was destroyed by severe flooding and never rebuilt.

Large dikes have been constructed that effectively divert runoff around the northern and southern sides of the community of San Manuel. It is unknown to what percent chance flood these dikes will prevent damages, but they were assumed to be ineffective in the event of a 1-percent chance flood event.

In the past, Santa Rosa Wash has been the primary flood hazard to the City of Maricopa and Town of Stanfield. In 1974, however, the COE constructed Tat Momolikot Dam, which effectively diminished the threat of Santa Rosa Wash as a flooding source. Today, the Santa Cruz River system represents the major flood hazard to the City of Maricopa, while Greene Wash represents the major hazard to Stanfield. Although many dikes have been constructed and channels dredged to divert floodwater away from the communities of Stanfield, Desert Carmel, and Maricopa, most of these structures are capable of conveying only small recurrence interval flood events, and would be ineffective against a 1-percent chance or greater flood.

Immediately after the destructive floods of October 1983, the NRCS (formerly SCS) began reconstructing the dikes that were breached on the Santa Rosa Wash near the Union Pacific Railroad (formerly Southern Pacific Railroad) crossing. The construction included re-channelization and erosion protection on the west bank of the channel. In view of the effects of the October 1983 flood event, it is assumed these improvements will not provide protection from the 1-percent chance flood, due to the restricted capacity of the railroad bridge. It is therefore assumed that portions of this dike would be breached during a flood of that magnitude or larger.

City of Apache Junction

As mentioned in the discussion about County flood measures above, the City of Apache Junction is partially protected by the Buckhorn-Mesa Watershed Project, which includes five flood-retarding structures capable of controlling a 1-percent chance flood event. Two of these structures, the Apache Junction Flood Retarding Structure (FRS) and Weekes Wash Dam, significantly reduce the flood hazard to the City of Apache Junction. The Apache Junction FRS was completed in December 1988 and was designed as a single purpose flood control dam that will collect all water from its own uncontrolled watershed along with water carried to it by the Apache Junction Floodway. Flooding from Bulldog Wash would flow into the Apache Junction FRS, and thus decrease the threat of flooding downstream in the City.

There are no other known Federal, State, County, or local efforts toward flood protection that would affect the City of Apache Junction.

City of Casa Grande

There is no coordinated flood protection system in the City of Casa Grande. Several channels have been constructed to divert low flows, and in the area north of the North Branch cross-slope dikes provide limited protection from small floods. The dikes and channels will not provide reliable flood protection for high floods because of the small channel capacities and large amounts of sediment carried by floodwaters. It is possible for a channel along the up-slope side of a dike to be completely filled with sediment over a period of a few years or even during one flood event. The City of Casa Grande has a "Master Drainage Plan," which was completed in June 1985 by Carter and Associates.

There are no other known Federal, State, County, or local efforts toward flood protection that would significantly affect the City of Casa Grande.

City of Coolidge

Results of the mapping study were not previously summarized in an effective FIS report for the City of Coolidge; therefore, no flood protection measures were provided.

City of Eloy

Results of the mapping study were not previously summarized in an effective FIS report for the City of Eloy; therefore, no flood protection measures were provided.

Town of Florence

There are no flood protection structures for the Gila River at Florence. As mentioned earlier, an NRCS (formerly SCS) flood-control structure southeast of Florence protects that community against 1-percent chance flooding in that area.
There are no other known Federal, State, County, or local efforts toward flood protection that would significantly affect the Town of Florence.

Town of Hayden

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Hayden; therefore, no flood protection measures were provided.

Town of Kearny

As mentioned above, Coolidge Dam, located on Gila River approximately 40 miles upstream from Kearny, provides regulation of more frequent flood events on the River. It does not significantly affect flooding resulting from larger events, such as the 1-percent chance or larger floods.

In August 1979, Kennecott Copper Co. has constructed an earthen dike adjacent to the landing strip at Kearny in an attempt to protect the landing strip from the effects of floods. Although this measure may help convey smaller floods, it will not have a significant effect on the 1-percent chance of larger floods.

There have been no other known Federal, State, county, or local efforts toward flood protection that would significantly affect the Town of Kearny.

Town of Mammoth

The Town of Mammoth has adopted an ordinance which restricts development of the San Pedro River flood plain.

There have been no other known Federal, State, county, or local efforts toward flood protection measures that would significantly effect the Town of Mammoth.
City of Maricopa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Maricopa; therefore, no flood protection measures were provided.

Town of Queen Creek

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Queen Creek; therefore, no flood protection measures were provided.

Town of Superior

Non-structural measures for flood protection are being utilized in the Town of Superior to aid in the prevention of future flood damage. These take the form of land-use regulations adopted from the Code of Federal Regulations, which control building within areas that have a high risk of flooding (U.S. Department of Housing and Urban Development, Federal Insurance

Administration, 1976).

No structural measures of flood protection exist in the Town of Superior. There are no other known Federal, State, County, or local efforts toward flood protection that would significantly affect the Town of Superior.

Town of Winkelman

Results of the mapping study were not previously summarized in an effective FIS report for the Town of Winkelman; therefore, no flood protection measures were provided.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2- percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedance) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge frequency relationships for the flooding sources studied in detail affecting Pinal County. Each incorporated community within, and the unincorporated areas of, Pinal County, with the exceptions of the Maricopa, Papago, and San Carlos Indian Reservations; the Casa Grande and Florence Military Reservations; and the Rittenhouse U.S. Air Force Auxiliary Field, has a previously printed FIS report. The hydrologic analyses described in those reports have been compiled and are summarized below.

Gila River

Peak discharge values for the Gila River at Riverside (U.S. Department of the Interior, Geological Survey, September 1978, were developed by the USGS using the Log- Pearson Type III Method, using data from the USGS gage 09474000 (Gila River at Kelvin) with a period of record from 1911 to 1978.

Peak discharge data for the Gila River at Florence, the Gila River at Kearny, and the Gila River at Hayden and Winkelman were taken from the appropriate Flood Insurance Study for each study area.

The attenuation of peak discharges for the Gila River between Florence and Kearny and for the

Santa Cruz River system is due to overbank storage in the floodplain. The differences in peak discharge values between the Gila River at Florence through Kearny and the Gila River at Hayden and Winkelman are attributable to differences in the stream gages and number of years of stream gage data was used for those study areas. This is also true for the decrease in the 10-percent chance discharge on the San Pedro River from Mammoth to Dudleyville.

Peak discharge values for the Town of Florence were developed by the U.S. Geological Survey, using a log-Pearson Type III distribution. Frequency-discharge data were based on records from several U.S. Geological Survey gaging stations on the Gila River. The gage information was adjusted to reflect the regulating effect of Coolidge Dam by assuming low recurrence interval floods to be a result of inflow below the dam, assuming intermediate floods to be the sum of inflow below the dam and controlled releases from the dam, and assuming large floods (1-percent chance or greater) would be caused by uncontrolled releases from the dam.

Discharges for the Gila River at Kearny were developed by the U.S. Geological Survey using a log-Pearson Type III distribution. Frequency-discharge data were based on records from several U.S. Geological Survey gaging stations including stations No. 09474000 and No. 09470000. Records covering the period from 1913 to 1975 were used from gage No. 09474000, located approximately 6 miles downstream of Kearny. Records covering the period from 1942 to 1975 were used from gage No. 0947000, located approximately 10 miles upstream of Kearny. This analysis considered regulation by Coolidge Dam, which was built in 1928, by assuming low recurrence interval floods to be a result of inflow below the dam, assuming intermediate floods to be the sum of inflow below the dam and controlled releases from the dam, and assuming large floods (1- percent chance or greater) to be the result of uncontrolled releases from the dam.

North Branch Santa Cruz Wash

No stream flow data were available for washes in or near the City of Casa Grande. The NRCS TR-20 program was used to develop peak discharge frequency relationships for the North Branch Santa Cruz Wash. The 0.2-percent chance flood was determined by a straight line extrapolation of a single-leg graph of flood discharges computed for frequencies up to the 1-percent chance flood event.

Queen Creek

Stream gage data were not available for Queen Creek and West Branch at Queen Valley and for Big Wash at San Manuel. The NRCS (formerly SCS) TR-20 program was used to develop peak discharge data in these cases (U.S. Department of Agriculture, Soil Conservation Service, May 1965). When given the correct basin characteristics and rainfall data, the TR-20 program computes the corresponding discharge. The more important basin characteristics used are drainage area, average slope, soil type, and percent of vegetative cover. Rainfall data are computed from information compiled by the National Oceanic and Atmospheric Administration.

Peak discharge values are then calculated from an empirical equation relating the time lapse from the start of rainfall to peak discharge.

Santa Cruz Wash and Santa Rosa Wash

Peak discharge values for the Santa Cruz, Santa Rosa, and Greene Washes were taken from an unpublished planning study of the Lower Santa Cruz River by the COE, Los Angeles District. These values were determined by a routing model using stream gage data from the USGS gages 09486500 (Santa Cruz River at Cortaro) with a period of record from 1939 to 1947, and 1950 to 1978, and 09489000 (Santa Cruz Wash near Laveen) with a period of record from 1940 to 1978.

The two major flooding sources that affect the City of Maricopa are Vekol Wash and its tributaries, and the Santa Cruz River system. The drainage area for the Santa Cruz River system extends southward into Mexico and has a time of concentration of several days while that for Vekol Wash is in terms of hours. For this reason, it was assumed that the storm runoff from these two drainage systems would result from independent events, and thus they were analyzed separately.

Stream gaging stations are not present on the Santa Cruz River system near the City of Maricopa. The closest upstream and downstream gages are located at Cortaro and Laveen, respectively. Using available data, including estimates from the October 1983 flood, a log-Pearson Type III discharge-frequency relationship was determined for these gaging stations. The peak discharges from the Laveen station were adjusted to eliminate major events that originated on the Santa Rosa Wash, prior to construction of the Tat Momolikot Dam.

It is assumed that discharges within the Santa Cruz River system have the potential to increase up to Red Rock, located downstream of the confluence with Los Robles Wash and Brawley Wash. From this point northward, the tributary inflow is negligible and the Santa Cruz River is considered an effluent (water-losing) stream with respect to runoff.

As there is still major tributary inflow to the Santa Cruz River up to Red Rock, with the closest gaging station located at Cortaro, the discharge-frequency relationship for Cortaro was adjusted to account for the increase in drainage area utilizing the USGS regression equations (U.S. Department of the Interior, Geological Survey, September 1978). Assuming that the flow losses occur linearly between Red Rock and Laveen, a discharge- frequency relationship for Maricopa was determined using river miles as the basis. Additional information from the aerial photographs and field reconnaissance of the October 1983 flooding was used to serve as a guide in determining the flow distribution and 1-percent chance flood limits in the vicinity of Maricopa (Cella Bar Associates, October 4, 1983).

San Pedro River

Peak discharge data for floods of selected recurrence intervals for the San Pedro River at Mammoth were developed by application of the Log-Pearson Type III Method (U.S. Water Resources Council, September 1981), employing records from the USGS gage 09472500 at Mammoth with a period of record from 1926, 1931 to 1940 which also includes historic information dating back to 1906.

Peak discharge values for the San Pedro River at Dudleyville (U.S. Department of the Interior, Geological Survey) was developed by the USGS using the Log-Pearson Type III Method, using data from the USGS gage 09473500 with a period of record from 1966 to 1978 which also includes historic information dating back to 1890.

Steamboat Wash

For the detailed study of Steamboat Wash, the hydrologic analysis was carried out using the NRCS TR-20 program.

Vekol Wash and Tributaries

There is no streamflow data available for either Vekol Wash or Vekol Wash Tributary, so the

USGS regression analysis was utilized to determine peak discharges. These regression equations may be used to determine the flood magnitudes of selected recurrence intervals for five different regions of Arizona. They are based on annual peak discharge information collected at USGS gaging stations with over 10 years of records.

Vekol Wash and its tributaries are a major flooding source that affects the City of Maricopa. The drainage area extends southward into Mexico and has a time of concentration in terms of hours while the Santa Cruz River system has a time of concentration of several days. Although close in location to the Santa Cruz River System, these two drainage systems were analyzed separately due to the assumption that independent storm events would occur.

Weekes Wash

Peak discharge data for Weekes Wash were taken from the appropriate Flood Insurance Study for each study area.

Peak discharges on Weekes Wash attenuate due to overbank storage and the diversion of floodwaters away from the main channel south of East Scenic Street. Floodwaters are also diverted from Bulldog Wash near North Cactus Road, and some of this flow joins Goldfield Wash flows near the intersection of North Idaho Road and North Apache Trail. Hydrologic analyses were carried out using the NRCS' (formerly SCS) Computer Program for Project Formulation-Hydrology, commonly known as TR-20. This procedure considers drainage area size, shape, and slope; vegetation type and density; soil type; and rainfall frequency, duration, and distribution. All parameters were evaluated by the study contractor for that area, with the exception of rainfall data, which were obtained from the National Oceanic and Atmospheric Administration.

Except for Weekes Wash, only 1-percent chance peak discharges were calculated for the washes because they were identified as shallow flooding areas.

Arizola Drain

HEC-2 modeling was completed for the Arizola Drain to determine the distribution of flow conveyed just upstream and under the I-10/SR-84 interchange. The upstream discharge used in the analysis was 4000 cfs, and is consistent with that reported in the approximate study completed by Wood-Patel in 1999. The objective of the analysis was to estimate the portion of the 4000 cfs that is conveyed through the interchange, and to the head of the Arizola Drain, which represents the upstream extent of the detailed study. The area upstream of the interchange and north of SR-84 was mapped by McGovern, McVittie, Lodge & Associates by approximate methods to tie into the work completed by Wood-Patel. The distribution analysis utilized the split flow option in HEC-2 to estimate the portion of the 4000 cfs that breaks over SR-84, and is conveyed to the north, away from the interchange. The flow that remains after the split and goes through the interchange was tracked in the reach downstream of the interchange to estimate the portion of flow that reaches the Arizola Drain at the Tanger Mall, and the portion that is conveyed west, on the south side of SR-84. Bank stations were set approximately to determine the flow distribution in the downstream cross-section.

McClellan Wash

The downstream detailed study limits are the Union Pacific Railroad (former Southern Pacific Railroad) on the west and the Battaglia Road on the north. The Union Pacific Railroad alignment is elevated above existing grace and consistently drops in elevation as it approaches Battaglia Road. Likewise, Battaglia Road is elevated above existing grade and consistently drops in elevation as it approaches the Union Pacific Railroad. The Battaglia Road embankment also acts as the right channel bank for the McClellan Wash channel between River Station (RS) 4814.772 and the Union Pacific Railroad; it also acts as a levee by preventing flow form inundating the land north of the road alignment. The Union Pacific Railroad alignment is located at the edge of the leftover bank of the main channel bank, and acts as a levee by containing the flow on the east side of the alignment, and preventing flow from inundating the land on the west. The left elevated channel bank of the McClellan Wash channel begins approximately 300 feet upstream of the Union Pacific Railroad. The right elevated channel bank begins on the right side of the channel at approximately RS 5535.958. The elevated channel bank begins on the right side of the channel at ground near RS28437.91. The top elevations of the elevated channel banks can vary significiantly for each side of the channel between each hydraulic cross section. Prior to elevating the impacts of the elevated channel banks to the 1% annual chance floodplain, an analysis was performed that reflects the failure of the elevated channel banks, and this analysis is henceforth referred to as the "channel levee failed" scenario.

North Branch Santa Cruz Wash

Watershed delineation was completed using USGS quadrangles as well as 1" = 600' aerial photography date September 9, 1994 for the North Branch Santa Cruz Wash. The watersheds and associated flow patterns shown on the map are generally consistent with those presented in the Master Drainage Study for the City of Casa Grande, completed by Carter Associates in 1985. Based on the field investigations and discussions with representatives of Casa Grande, very little has changed since that study was completed, with the exception of some localized development primarily along Florence Boulevard. 100-year peak discharges were calculated using the HEC-1 computer program and the methodology outlined in the "Highway Drainage Design Manual" published by Arizona Department of Transportation (ADOT). This approach was taken because the ADOT manual provides a method that has been adapted to the various hydrologic conditions encountered in Arizona, and it provides defendable results for areas, such as Casa Grande, which have not developed their own set of peak discharge procedures. The 100- year precipitation depth was taken from the NOAA atlas value provided in the manual. Precipitation losses were modeled using the Green-Ampt method and the associated parameters provided in the ADOT manual. The soils within the watersheds were determined from the SCS soil survey of Pinal County, and consist of primarily sandy loam north of the NBSCW, and primarily clayey loam to the south. The Clark Unit Hydrograph method was utilized and the parameters of time of concentration (Tc) and storage coefficients (R) used in the method were calculated using the equations provided in the ADOT manual. The manual provides Tc equations for urban, desert/mountain, and agricultural conditions. The manual also provides input data for the synthetic time-area curve for urban and desert conditions. Flood routing was completed using the Kinematic Wave methodology with an NSTPS value based on average flood velocities through the routing reaches.

Santa Cruz Wash

Hydrologic analyses of Santa Cruz Wash were performed by Wood, Patel & Associates, Inc. (WPA) for all washes in the areas. Hydrology for the detailed study areas was prepared using Log Pearson Type III method.

After reviewing all of the studies available in this area, the approach of using recorded data from two USGS gaging stations and applying the interpolation method is adopted, which was recommended by U.S. Water Resources Council and has been accepted by all agencies, including

FEMA, per the regulatory FIS.

Santa Cruz River at Cortaro and Laveen USGS Gaging Stations

In order to estimate the flood magnitudes for selected recurrence intervals for both the detailed and approximate study areas, initially, the Log Pearson Type III distribution for the USGS gages along the Santa Cruz River at Cortaro (Gage No. 09486500) and Laveen (Gage No. 09489000) were updated to include all streamflow data through 1996. The flow frequency analysis program developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers (Hagen, 1989) was used to fit the Log-Pearson Type III distribution. The estimated 1% annual chance flows are 52,300 cfs at Cortaro and 19,040 cfs at Laveen.

Santa Cruz River at Intermediate Locations Between Cortaro and Laveen

Following the procedure utilized by Cella Bar Associates and assuming that there is still major tributary inflow to the Santa Cruz River up to Red Rock, the discharge-frequency relationship at Cortaro was adjusted to account for the increase in drainage area using Roeske regression equation (Roeske, September 1978). Note that the Roeske regression equations were used in the Cella Bar Associates' studies. The flow losses were assumed to occur linearly between Red Rock and Laveen. The 100-year discharges at other locations Red Rock and Laveen were estimated using river mile and flow rate as the basis.

Note that the Santa Cruz River splits twice before it reaches the State Highway 84: one near Red Rock between Santa Cruz Wash and Greene Wash, and the other at Chuichu between Santa Cruz River and Greene Wash.

A field investigation of November 17, 1997, indicated that the breakout elevation of the Santa Cruz Wash is 10 feet higher than the Greene Wash inverts. There are three major breakout areas to the Santa Cruz Wash. Normal depth calculations (Appendix F) indicate that approximately 2,000 cfs will break out into Santa Cruz Wash from the largest breakout area, and for the 1% annual chance flow of 62, 500 cfs, 4,000 cfs may breakout into the Santa Cruz Wash from all of the breakout areas. At Chuichu, the 60% to 40% flow split as previously estimated at Green Wash and Santa Cruz Wash (Study No. 3) was also assumed to determine the flow distribution within the same two washes.

Santa Cruz Wash Flow Split at Chuichu

The hydrology report for this study has concluded the flow in Greene Wash south of Chuichu Road is 43,460 cfs for the 1% annual chance flood. There is a ridge line located between Santa Cruz Wash and Green Wash. Once flow overtops this ridge from the Santa Cruz Wash into Greene Wash, it can not return to the Santa Cruz Wash. Cross section 10000 is set at the ridge line and the right of Greene Wash is also set at station 10000 for each cross section. Thus, the flow distribution capacilities of HEC-RAS yield the flow split values. Flow in the right bank represents flow in the Santa Cruz Wash upstream of the Santa Rosa Canal. At cross section 0.36 of the split at Chuichu model, flow in the Santa Cruz Wash is 16,227 cfs. Section 0.36 is approximately 1,400 feet upstream of the Santa Cruz Wash detailed study rivermile 12.669. Thus, the flow in the Santa Cruz Wash upstream of the Santa Rosa Canal is 16,000 cfs.

Santa Rosa Canal

Santa Rosa Canal is one of the detailed re-study areas which are comprised of several shallow washes with wide overbanks in a very active subsidence area. No base flood was estimated for this are from previous studies. The base flood from Santa Cruz Wash split at Red Rock is about 3,300 cfs without accounting for local flow contributions because of the significant differences between the time of concentration.

After watershed delineation of the local drainage basins for this study and peak flow estimating using USGS regression equations, it was found that the local 1% annual chance may be the critical flow for this study area.

A summary of the drainage area peak discharge relationships for all the streams studied by detailed methods is shown in Table 8, "Summary of Peak Discharges."

Table 8 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Arizola Drain	---	---	---	4,000	---
Apache Wash					
At North Meridian Road	3.25	N/A	N/A	1,275	N/A
Big Wash					
At San Manual	2.65	745	1,325	1,605	2,290
Bulldog Wash					
At U.S. Highway 60/89	3.30	N/A	N/A	1,355	N/A
Casa Blanca Canal					
At upstream limit of study	4.99	---	---	1,680	----
Culvert Flows					
Between Santa Cruz and Santa Rosa Washes	N/A	---	---	2,200	---
Gila River at Hayden and Winkelman					
Downstream of San Pedro River	17,757	28,000	67,000	140,000	250,000
Upstream of San Pedro River	13,270	22,000	64,000	120,000	210,000

Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Gila River					
At Florence	17,239	19,000[1]	37,000[1]	66,300[1]	136,000[1]
At Kearny	18,000	28,000[1]	68,000[1]	140,000[1]	240,000[1]
At Riverside	18,011	26,000[1]	66,000[1]	140,000[1]	240,000[1]
Goldfield Wash					
At U.S. Highway 60/89	2.45	N/A	N/A	850	N/A
Green Wash					
At Stanfield	5,961[2]	5,300[1]	9,500[1]	11,800[1]	18,500[1]
North Branch Santa Cruz Wash					
At Burris Road	57.4	3,389	6,999	8,969	15,000
At Pinal Avenue	48,9	2,910	5,999	7,679	13,000
At Trekkel Road	32.4	1,534	3,235	4,177	7,400
1500’ downstream of Peart Road	30.9	---	---	4,075	---
1500’ upstream of Trekkel Road	20.5	---	---	3,001	---
One mile east Peart Road	14.8	---	---	2,205	---
McClellan Wash					
At Wymola	357.7	---	---	12,750	---
At Pipeline Road	368.4	---	---	12,800	---
Approximately 14,000 ft upstream of Central Arizona Project Canal	---	---	---	12,900	---

Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 12,800 ft upstream of Central Arizona Project Canal (upstream confluence with McClellan Wash Split)	---	---	---	11,930	---
At Central Arizona Project Canal	---	---	---	12,960[3]	---
McClellan Wash Split					
Approximately 10,000 ft upstream of Central Arizona Project Canal (upstream confluence with McClellan Wash)	---	---	---	990	---
Queen Creek					
At Mary Drive	13.42	4,600	9,800	11,400	14,200
Upstream of West Branch	1.79	900	1,885	2,215	2,920
San Pedro River					
At Dudleyville	4,471	20,000	38,800	49,600	2,600
At Mammoth	3,610	23,200[1]	38,300[1]	46,800[1]	72,400[1]
Santa Cruz Wash					
At Maricopa	6,100[2]	2,900[1]	5,900[1]	7,600[1]	12,700[1]
At Desert Carmel	5,961	5,300[1]	9,950[1]	12,600[1]	21,350[1]
At Union Pacific Railroad (formerly Southern Pacific Railroad)	N/A	---	---	9,800	---
Downstream of Union Pacific Railroad (formerly Southern Pacific Railroad)	N/A	---	---	7,600	---

Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
At Smith Enke Road	---	---	---	6,193	---
At Interstate Highway 8	---	---	---	16,340	---
Santa Cruz Wash					
Upstream Limit of Detailed Study	---	---	---	16,000	---
Approximately 1,500 ft upstream of Santa Rosa Canal	---	---	---	15,700	---
Approximately 700 ft upstream of Santa Rosa Canal	---	---	---	15,500	---
At Santa Rosa Canal	---	---	---	14,600	---
Downstream Limit of Detailed Study	---	---	---	14,400	---
Santa Rosa Canal					
At Toltec Highway	---	---	---	2,170	---
At Toltec Butte Road	---	---	---	620	---
At Overfield Road	---	---	---	9,030	---
At Sunland Gin Road	---	---	---	6,050	---
At Lamb Road	---	---	---	3,880	---
At Henness Road	---	---	---	3,040	---
Santa Rosa and Santa Cruz Wash					
Upstream of Union Pacific Railroad (formerly Southern Pacific Railroad)	6,159	---	---	24,600	---

Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Santa Rosa Wash					
At Maricopa	8,100[2]	2,150[1]	4,400[1]	5,800[1]	11,200[1]
Santa Rosa Wash (Greene Wash)					
At Union Pacific Railroad (formerly Southern Pacific Railroad)	N/A	---	---	14,800	---
Downstream of Union Pacific Railroad (formerly Southern Pacific Railroad)	N/A	---	---	8,500	---
Through Maricopa	N/A	---	---	6,300	---
South Wash					
At San Manuel	2.05	690	1,160	1,380	1,915
South Side Canal 1					
At upstream limit of study	N/A	---	---	887	---
Downstream of East Main Canal	N/A	---	---	954	---
Downstream of Murphy Road	N/A	---	---	257	---
Overflow from Southside Canal 1/Farrell Road					
At Overflow	N/A	---	---	854	---
Downstream of Murphy Road	N/A	---	---	1,111	---
South Side Canal 2					
At upstream limit of study	N/A	---	---	3,659	---

Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Downstream of East Main Canal	N/A	---	---	2,799	---
Downstream of Murphy Road	N/A	---	---	2,806	---
Overflow from South Side Canal 2 along East Main Canal	N/A	---	---	417	---
Steamboat Wash					
At confluence with Gila River	8,64	1,645	3,89	4,690	7,240
Vekol Wash					
Downstream of Union Pacific Railroad (formerly Southern Pacific Railroad)	453	---	---	23,300	---
At Union Pacific Railroad (formerly Southern Pacific Railroad)	---	297	---	18,850	---
Vekol Wash Tributary					
Approximately 1 mile upstream of Farrell Road (Steen Road Alignment)	114	---	---	1,686	---
At Farrell Road	116	---	---	1,627	---
At Bowlin Road	117	---	---	1,597	---
Downstream of split with Vekol Channel (north of Bowlin Road)	N/A	---	---	756	
Confluence with Vekol Channel	119			904	
Vekol Channel					
At divergence from Vekol Wash Tributary	N/A	---	---	841	---

Flooding Source and Location	Drainage Area (sq mi)	Peak Discharges 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
West Branch					
At Queen Valley Drive	1.60	530	1,065	1,250	1,630

1 Total peak discharge includes channel, left overbank and right overbank

2 Includes combined drainage areas for Santa Cruze Wash and Green Wash and right overbank flow

3 Discharges increase with decreasing drainage area due to overbank storage

--- Data unknown

N/A Not applicable

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this countywide FIS in conjunction with the data shown on the FIRM.

Cross sections were determined from topographic maps and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed, selected cross section locations are also shown on the FIRM.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National American Vertical Datum of 1988 (NAVD88). Elevation reference marks (ERMs) used in this study, and their descriptions, are shown on the FIRM. ERMs shown on the FIRM represent those used during the preparation of this and previous FISs. The elevations associated with each ERM were obtained and/or developed during FIS production to establish vertical control for determination of flood elevations and floodplain boundaries shown on the FIRM. Users should be aware that these ERM elevations may have changed since the publication of this FIS. To obtain up-to-date elevation information on National Geodetic Survey (NGS) ERMs shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

All qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g.,

concrete monument below frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

Each incorporated community within, and the unincorporated areas of, Pinal County, with the exceptions of the Maricopa, Papago, and San Carlos Indian Reservations; the Casa Grande and Florence Military Reservations; and the Rittenhouse U.S. Air Force Auxiliary Field, has a previously printed FIS report. The hydraulic analyses described in those reports have been compiled and are summarized below.

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Gila River

Hydraulic analyses for the Gila River at Florence, the Gila River at Kearny, the Gila River at Hayden and Winkelman, the North Branch Santa Cruz Wash, and Weekes Wash were taken from the appropriate Flood Insurance Study for each study area.

Cross-sections for the backwater analysis of the Gila River were obtained using topographic maps at a scale of 1:2400, with a contour interval of 2 feet (Cooper Aerial Surveys, 1979). These topographic maps were developed from aerial photographs flown in January 1979. Flight altitude was 4200 feet, and the aerial photographs were taken at a scale of 1:8400. Vertical control was adjusted (+1.5 feet) to coincide with the National Geodetic Vertical Datum (NGVD) of 1929.

Water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program.

North Branch Santa Cruz Wash

In the case of the North Branch Santa Cruz Wash, distances are also measured along the centerline of the 1-percent chance flood flow path. However, a Profile Base Line was not established for the wash in the Flood Insurance Study for the City of Casa Grande; therefore, none is presented in this study.

For the re-analysis along North Branch Santa Cruz Wash, flood profiles were computed using the COE HEC-2 step- backwater computer program.

For the 2001 study for North Branch Santa Cruz Wash, HEC-RAS was used to develop the detailed hydraulic analysis. The North Branch Santa Cruz Wash floodplain consists primarily of agricultural land that has been leveled and differentially graded as part of the historic farming activities, and in some cases in an attempt to control the flow path for more frequent events. As a result, the cross-sectional geometry of the floodplain can change abruptly over a short distance.

McClellan Wash

For the McClellan Wash and Split, water-surface elevations for 100-Year recurrence interval were computed through a combination of the HEC-RAS 3.1.1 computer program and normal-depth calculations. The study area was approximately studied formerly by Wood Patel and Associated (WPA) under FIS Contract EMW-97-CO-0108. This study used the same cross-sections placed at 500-foot intervals. The 1-percent annual chance flood was the only recurrence interval calculated. No floodway analysis was conducted.

Five physical features within the McClellan Wash study area act as levees and were modeled to determine the impact upon base flood elevations with ‘levee in place’ and ‘levee failed’ scenarios. The five structures include the Union Pacific Railroad (UPRR), Interstate 10 (I-10), State Route 87 (SR-87), Battaglia Road and McClellan Wash Elevated Channel Banks.

McClellan Wash Split reach was modeled as a junction split in HEC-RAS 3.1.1. Approximately 1,000 cfs splits right due to natural topography and stays separate from the main reach for approximately 10,000 feet. Modeling of this split was necessary as the main reach and split reach have different profiles.

Queen Creek

For approximate analyses of Big Wash, South Wash at San Manuel, Queen Creek at Queen Valley, the Santa Rosa Wash at
Stanfield, and the Santa Rosa Wash at Maricopa, flooding depths were determined by normal-depth calculations.

The hydraulic analyses described above revealed that in San Manuel, Stanfield, Desert Carmel, and Maricopa, a sheetflow flooding condition exists. A sheetflow condition may be described as the broad, relatively unconfined down-slope movement of floodwater across gently sloping terrain. In Stanfield and Desert Carmel, the average flooding depth is approximately 2 feet and these areas are so designated. In San Manuel and Maricopa, average depth of flooding was determined to be less than 1 foot.

Cross sections for the backwater analyses of Queen Creek were taken from topographic maps obtained from aerial photographs flown in February 1979 at a negative scale of 1:8,400 enlarged to 1:2,400 (Cooper Aerial Surveys). Flight altitude was 4,200 feet. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry.

Water-surface elevations of floods of the selected recurrence intervals were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program.

Starting water-surface elevations for Queen Creek were calculated using the slope-area method.

Normal-depth calculations were used for the approximate analyses of Mine Wash, School Wash, Cross Canyon Creek, and the upstream portion of Queens Creek.

Santa Cruz River

Detailed shallow flooding methods were used on Vekol Wash and Tributaries as well as on the Santa Cruz River system, to determine the flooding depths for the 100-year flood using the COE HEC-2 step-backwater computer program and normal- depth calculations. Average depths of flow without base flood elevations were generally considered to be the best approach to representing these shallow flooding conditions. Base flood elevations have been determined only at specific locations where extensive backwater ponding upstream of the Union (former Southern) Pacific Railroad permitted a reasonable estimate.

Cross section data for the backwater analyses were obtained from topographic maps at a scale of 1:4,800 with a contour interval of 2 feet, prepared specifically for this project by Cooper Aerial Mapping Co., compiled in November 1983. Additional topography of the area, prepared by Kenney Aerial Mapping Co. at a scale of 1:2,400 with a contour interval of 2 feet was also used (Kenney Aerial Mapping Company, November 30, 1983).Information relating to the geometry and hydraulic character of all culverts and bridges was obtained from topographic maps and were field-checked to verify structural geometry for the Vekol and Santa Rosa Wash areas. Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment based on field observations of the rivers and floodplain areas.

Flow across the floodplain, in the vicinity of Maricopa, is restricted by culverts and bridge crossings along the Union Pacific Railroad (formerly Southern Pacific Railroad). A backwater effect thus results and the culvert capacities were calculated using hydraulic charts published by the Bureau of Public Works. Where flow exceeded the culvert capacity, flow across the railway was calculated by weir flow equations.

The COE, in an earlier analysis of the Santa Cruz River system, determined that flow within Greene Wash and the Santa Cruz Wash is divided approximately 60 percent to 40 percent. The same assumption was made in this analysis to determine the flow that occurs down the Santa Rosa Wash channel and the resultant flow through Maricopa.

The hydraulic analyses for this study were based, in part, on observations made of the flooding that resulted from the October 1983 floods. The bridge structure on the Santa Rosa Wash was considered to be restricted with debris load as it occurred in October
1983. The remaining hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Santa Cruz Wash

For the Santa Cruz Wash at Desert Carmel and Greene Wash at Stanfield, water-surface elevations for floods of the selected recurrence intervals were computed through a combination of the HEC-2 computer program and normal-depth calculations. Cross sections for the HEC-2 analysis were taken from topographic maps at a scale of 1:24,000, with a contour interval of 5 feet (U.S. Department of the Interior, Geological Survey, 1952, 1965, and 1981). Cross sections for the normal-depth calculations were taken from topographic maps developed from aerial photographs taken on March 25 and May 5, 1979, for Desert Carmel and Stanfield, respectively, at a negative scale of 1:8,400. The topographic maps were drafted at a scale of 1:4,800, with a contour interval of 2 feet (Cooper Aerial Surveys, March and May 1979).

Desert watercourses often exhibit a meandering nature, lacking a well-defined stream channel. Floodflows often occur in frequently shifting, braided channels. In certain cases, this necessitated the use of distances measured along the centerline of the 1-percent chance flood flow path as opposed to the centerline of the channel. These flow lines, used to establish respective distances that correspond to distances on the flood profiles, are delineated and labeled as Profile Base Lines on the maps.

San Pedro River

For the San Pedro River at Mammoth, the San Pedro River at Dudleyville, the Gila River at Riverside, Queen Valley, and West Branch at Queen Valley, water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program).

Cross-sections for the backwater analyses were obtained from topographic maps developed from aerial photographs flown on February 8 and March 4, 6, and 25, 1979, for Mammoth, Dudleyville, Riverside, and Queen Valley, respectively. The aerial photographs were taken from a flight height of 4,200 feet in order to obtain an original negative scale of 1:8,400. These topographic maps were drafted at a scale of 1:2,400, with a contour interval of 2 feet (Cooper Aerial Surveys, February and March 1979). Water-surface elevations for floods of the selected recurrence intervals on the San Pedro River were computed using the COE HEC-2 computer program.

Cross section data were obtained from topographic maps, which were developed from aerial photographs taken on February 8, 1979 (Cooper Aerial Surveys).

Starting water-surface elevations on the San Pedro River were computed using the slope-area method. Approximate 1-percent chance flood water-surface elevations for several unnamed washes at Mammoth were determined on the basis of flooding history, field inspection, and engineering judgment. Flooding was determined to be shallow, with average depths of less than 1 foot.

Flooding along Tucson Wash was taken from the 1981 Flood Insurance Rate Map for the Town of Mammoth (FEMA).

Santa Rosa Canal and Santa Cruz Wash

Topographic mapping for the detailed study areas was provided by Aerial Mapping Company Inc. as part of the FIS contract EMW 97-CO-0108, dated April 29, 1998. HEC-RAS version 2.1 was used to generate the water surface profiles for detailed study areas. The starting water surface elevations were determined using slope area method.

Steamboat Wash

Backwater analysis of Steamboat Wash assumes critical depth. Therefore, supercritical flow probably exists. For purposes of this study, critical depth was used to determine flood elevations and boundaries. Cross- sections were determined from topographic mapping at a scale of 1:2400, with a contour interval of 2 feet (Cooper Aerial Surveys, 1979). After field reconnaissance, the below-water cross-sections were determined to be insignificant in conveying the larger flows. The low-flow water-surface elevation was used as the ground elevation across the channel. The railroad bridge on Steamboat Wash was field studied to obtain elevation data and structural geometry. The acceptability of all assumed hydraulic factors for the Gila River was checked by computations that duplicated the December 1978 flood on the Gila River.

Starting water-surface elevations for Gila River were calculated using the slope-area method. Critical depth was used for the starting water-surface elevations for Steamboat Wash.

Weekes Wash

Water-surface elevations of floods of the selected recurrence intervals on the upper portion of Weekes Wash, the primary stream affecting the City, were computed through use of the COE HEC-2 step-backwater computer program. Cross-sections for the step-backwater analysis were determined from topographic mapping at a scale of 1:4,800, with a contour interval of 4 feet. Normal depth was used for the starting water- surface elevations on Weekes Wash. Flood profiles for Weekes Wash were drawn showing computed water surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Desert watercourses often exhibit a meandering nature, lacking a well-defined stream channel. Flood flows often occur in frequently shifting, braided channels. For certain lengths of the detailed study reach of Weekes Wash, a Profile Base Line was delineated to establish respective distances between the maps and flood profiles.

Approximate hydraulic analyses for Bulldog, Apache, and Goldfield Washes and the downstream reach of Weekes Wash were carried out using approximate flow velocities and normal depth calculations. These analyses revealed that the channels have very little capacity relative to the 1-percent chance flood and, in some cases, the channels are non- existent. Furthermore, the overbank flow is not confined to a well-defined floodplain, causing a shallow flooding condition.

Areas of ponding on the upstream side of U.S. Highway 60/89 were also studied. Water- surface elevations for these areas were based on the elevation of the highway grade with shallow flows over the highway of less than 1 foot. This results in average shallow flooding depths behind the highway between 1 and 3 feet.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Roughness factors (Manning's "n") used in the hydraulic computations conducted in this countywide FIS, were chosen by engineering judgment based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 9, "Manning's "n" Values."

Table 9 - MANNING'S "n" VALUES

Stream	Left Overbank "n"	Channel "n"	Right Overbank "n"
Arizola Drain	0.050	0.035	0.050
Gila River at Florence	0.040 – 0.060	0.030 – 0.040	0.040 – 0.060
Gila River at Hayden and Winkelman	0.040 – 0.060	0.030 – 0.040	0.040 – 0.060
Gila River at Kearny	0.035 – 0.150	0.035	0.035 – 0.150
Gila River at Riverside	0.035 – 0.120	0.025 – 0.100	0.035 – 0.120
North Branch Santa	0.055	0.035	0.055
Queen River	0.035 – 0.060	0.030 – 0.050	0.035 – 0.060
San Pedro River at Dudleyville	0.035 – 0.120	0.025 – 0.100	0.035 – 0.120
San Pedro River at Mammoth	0.035 – 0.120	0.025 – 0.100	0.035 – 0.120
Santa Cruz Wash	0.035 – 0.120	0.025 – 0.100	0.035 – 0.120
Santa Rosa Canal	0.055	0.055	0.055
Steamboat Wash	0.045	0.035	0.045
West Branch	0.035 – 0.120	0.025 – 0.100	0.035 – 0.120
Weekes Wash	0.040 – 0.060	0.030 – 0.040	0.040 – 0.060

The conversion factors, from NGVD 29 to NAVD 88, for all the streams studied in this FIS are listed below in Table 10, "Stream Conversion Factors."

Table 10 - STREAM CONVERSION FACTORS

Stream Name	Elevation (feet NAVD above NGVD)
Arizola Drain	+1.7
Gila at Florence	+1.9
Gila at Hayden and Winkelman	+2.0
Gila at Kearny	+2.0
Gila at Riverside	+2.0
McClellan Wash	+1.8
North Branch Santa Cruz Wash	+1.9
Queen Creek	+1.9
Queen Creek at Superior	+2.2
San Pedro River at Dudleyville	+2.0
San Pedro River at Mammoth	+2.1
Santa Cruz Wash	+2.0
Santa Rosa Canal	+1.9
Steamboat Wash	+2.0
Weekes Wash	+1.9
West Branch	+1.9

3.3 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this countywide FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities.

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov), or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282 (301)
713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook (TSDN) associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county.

For the streams studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross-section.

Pinal County

For the Gila River at Riverside, the San Pedro River at Dudleyville, the San Pedro River at Mammoth, Queen Creek, and West Branch, the boundaries of the 100-and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic maps developed from aerial photographs at a scale of 1:2,400, with a contour interval of 2 feet (Cooper Aerial Surveys, February and March 1979).

For the flooding sources studied by approximate methods, the boundaries of the 1 percent annual chance floodplains were delineated using topographic maps taken from the previously printed FIS reports, FHBMs, and/or FIRMs for all of the incorporated and unincorporated jurisdictions within Pinal County with the exception of the Gila River, Maricopa, Papago, and San Carlos Indian Reservations; the Casa Grande and Florence Military Reservations; and the Rittenhouse U.S. Air Force Auxiliary Field.

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1 percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1 percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1 percent annual chance floodplain boundary is shown on the FIRM.
Boundaries of the 100- and 500-year floods for the Gila River at Florence, the Gila River at Kearny, the Gila River at Hayden and Winkelman, the North Branch Santa Cruz Wash, and Weekes Wash were taken from the appropriate Flood Insurance Study for each study area.

For the Santa Cruz Wash at Desert Carmel and Greene Wash at Stanfield, 1-percent chance event flooding boundaries were delineated using elevations determined at each cross section used for the hydraulic analyses; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 5 feet (U.S. Water Resources Council, September 1981). Approximate floodplain boundaries in the immediate vicinity of the shallow flooding described above and for the Santa Rosa Wash in the immediate vicinities of Stanfield and Maricopa, were delineated on topographic maps developed from aerial photographs (original negative scale 1:8,400), at a scale of 1:4,800, with a contour interval of 2 feet (Cooper Aerial Surveys, March and May 1979), based on elevations determined by the methods described in Section 3.2.

For Vekol Wash, Vekol Wash Tributaries, and the Santa Rosa Wash near the Maricopa Indian Reservation, streams studied by detailed shallow methods, the boundary of the 100-year flood has been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 2 feet (Cooper Aerial Mapping Company, May 3, 1979 and November 30, 1983).

The shallow flooding zone south of State Highway 84, between Greene Wash and the Santa Cruz Wash, represents floodwaters that become trapped behind the highway embankment. These floodplain boundaries were delineated on topographic maps referenced previously (7.5-Minute Series Topographic Maps, U.S. Department of the Interior, 1952,1965, 1967, and 1981) , and are based on flood depths determined by the elevations of embankments causing the entrapment and ground immediately south of the highway, and from accounts of historic flooding.

Approximate floodplain boundaries for Big Wash and South Wash in the vicinity of San Manuel were delineated on topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (Cooper Aerial Surveys, May 1979), based on the depths determined by the methods described in Section 3.2.

Approximate 1-percent chance floodplain boundaries for the two unnamed washes west of Mammoth were determined on the basis of previous flooding history, field examination, and engineering judgment, and were delineated on a topographic map at a scale of 1:24,000, with a contour interval of 40 feet (7.5-Minute Series Topographic Maps, U.S. Department of the Interior, 1948 and 1972).

Floodplain boundaries for the approximate study areas of Arizona Children's Colony, Colina del Sol, Lake in the Desert, Randolph, and Twilight Trails were delineated on topographic maps at a scale of 1:24,000, with contour intervals of 5 and 10 feet (7.5- Minute Series Topographic Maps, U.S. Department of the Interior, 1948), based on average flooding depths as determined by the methods described in Section 3.2.

For the approximate study of McClellan Wash at Picacho, documentation of historic flooding in the area indicates that the floodplain boundaries presented on the Flood Hazard Boundary Map for Pinal County (FEMA February 7, 1981) are adequate and thus, no changes were made.

Approximate 1-percent chance floodplain boundaries for Mine and School Washes were taken from the Flood Insurance Study for the Town of Superior (FEMA 1981). Approximate floodplain boundaries for Weekes Wash, approximately 2,200 feet south of Apache Junction, were taken from the Flood Insurance Study for Apache Junction.

Unpublished work maps for the City of Eloy also presented floodplain boundaries in unincorporated areas of Pinal County (Cella Bar Associates, 1979). These Zone A and Zone B boundaries were added to this study at Eloy in the vicinity of Bataglia Drive, Interstate 10, and the Union (former Southern) Pacific Railroad.

Floodplain boundaries for Vekol Wash, Vekol Wash Tributaries, and the Santa Rosa Wash are indicated on the Flood Insurance Rate Map (published separately). On this map, the 1-percent chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and A0). Areas with flooding depths greater than 3 feet are denoted as Zone A and depths less than 3 feet as Zone AO with approximate average flooding depths.

Floodplain boundaries for the 1-percent chance and 0.2-percent chance floods are shown on the Flood Insurance Rate Map. In cases where the 1-percent chance and 0.2-percent chance floodplain boundaries are close together, only the1-percent chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

Approximate floodplain boundaries in some portions of the study area were taken from the Flood Insurance Rate Map (FIRM).

City of Apache Junction

Between cross sections, the boundaries were interpolated using topographic maps, developed from aerial photographs (Cooper Aerial Survey, February 1979), at a scale of 1:4,800, with a contour interval of 4 feet. Areas of shallow flooding were delineated on the topographic maps reference above. Approximate flood boundaries were delineated using the stream banks of the washes studied if definable, on the same topographic maps.

Floodplain boundaries for the 100-year ponding area behind the Apache Junction FIS were delineated on a topographic map at a scale of 1:4,800, with a contour interval of 4 feet (Drawing No. 86002-AZ-CH, U.S. Department of Agriculture, March 25, 1986). The 1-percent chance and 0.2-percent chance floodplain boundaries for the City of Apache Junction are shown on the Flood Insurance Rate Map. On this map, the 1-percent chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone A, AE, and AH); and the 0.2-percent chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- percent chance and 0.2-percent chance floodplain boundaries are close together, only then 1-percent chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

City of Casa Grande

Between cross sections, the boundaries were interpolated using topographic maps, developed from aerial photographs (Cooper Aerial Survey, December 1, 1987), at a scale of 1:4,800, with a contour interval of 4 feet.

Flooding in or near the southern part of the City of Casa Grande is caused by inadequate drainage. The flood boundaries of these areas of local ponding and concentrated flow in shallow channels have been delineated for the 1-percent chance flood by approximate methods on the basis of information provided by D.M. Childes, Director of Planning for the City of Casa Grande; Henningson, Durham, and Richardson, Inc., of Arizona; the NRCS; and limited reconnaissance by the study contractor.

The 1-percent chance and 0.2-percent chance floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 1-percent chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 0.2-percent chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent chance and 0.2-percent chance floodplain boundaries are close together, only the 1-percent chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

In and near downtown Casa Grande, there are numerous such cases of areas of minimal flooding outside the flood boundaries shown. The streets in this area are depressed, and are subject to occurrences of curb-deep water in the streets, and are used as conveyance channels for storm runoff.

Approximate 1-percent chance floodplain boundaries in some portions of the study were taken directly from the 1983 Flood Insurance Rate Map.

Town of Florence

Between cross sections, the boundaries were interpolated using topographic maps, developed from aerial photographs (Cooper Aerial Survey, 1979), at a scale of 1:2,400, with a contour interval of 2 feet.

The 1-percent chance and 0.2-percent chance floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 1-percent chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 0.2-percent chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent chance and 0.2-percent chance floodplain boundaries are close together, only the 1-percent chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Town of Kearny

Between cross sections, the boundaries were interpolated using topographic maps, developed from aerial photographs (Cooper Aerial Survey, 1979), at a scale of 1:2,400, with a contour interval of 2 feet.
Appropriate flood boundaries for Steamboat Wash and Cemetery Wash were delineated on the reference topographic maps and on a U.S. Geological Survey topographic map, which was enlarged from a scale of 1:24,000 to a scale of 1:12,000, with a contour interval of 40 feet (U.S. Department of the Interior, 1964).

The 1-percent chance and 0.2-percent chance floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 1-percent chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 0.2-percent chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent chance and 0.2-percent chance floodplain boundaries are close together, only the 1-percent chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Approximate flood boundaries in some portions of the study area were taken from the Federal Insurance Administration Flood Hazard Boundary Map (U.S. Department of Housing and Urban Development, 1976).

Town of Mammoth

Between cross sections, the boundaries were interpolated using topographic maps, developed from aerial photographs (Cooper Aerial Survey, February 8, 1979), at a scale of 1:2,400, with a contour interval of 2 feet.

The 1-percent chance and 0.2-percent chance floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 1-percent chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 0.2-percent chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent chance and 0.2-percent chance floodplain boundaries are close together, only the 1-percent chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For streams studied by approximate methods, only the 1-percent chance flood plain boundary is shown.

Approximate 1-perecent chance floodplain boundaries for the unnamed washes at Mammoth were determined on the basis of past flooding, field inspection, and engineering judgment. Boundaries were delineated using topographic maps.

Approximate 1-percent chance floodplain boundaries for Tucson Wash were taken directly from the Flood Insurance Rate Map.

Town of Superior

Between cross sections, the boundaries were interpolated using topographic maps, developed from aerial photographs (Cooper Aerial Survey, j1979), at a scale of 1:2,400, with a contour interval of 2 feet.

Approximate flood boundaries on the downstream portion of Queen Creek were taken from the Federal Insurance Administration Flood Hazard Boundary Map. Approximate flood boundaries for Cross Canyon Creek, School Wash, Mine Wash, and the upstream portion of Queen Creek were developed using normal-depth calculations and the topographic maps referenced previously.

The 1-percent chance and 0.2-percent chance floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 1-percent chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 0.2-percent chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent chance and 0.2-percent chance floodplain boundaries are close together, only the 1-percent chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1 percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1 percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain.

Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations were tabulated for selected cross sections. The computed floodways are shown on the FIRM. In cases where the floodway and 1 percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Portions of the floodways for Pinal County extend beyond the county boundary.

No floodways were computed for the Gila River, Maricopa, Papago, and San Carlos Indian Reservations; the Casa Grande and Florence Military Reservations; and the Rittenhouse U.S. Air Force Auxiliary Field.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations for certain downstream cross-sections are lower than the regulatory flood elevations in that area, which must take into account the 1 percent annual chance flooding due to backwater from other sources. Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 10, "Floodway Data Tables." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

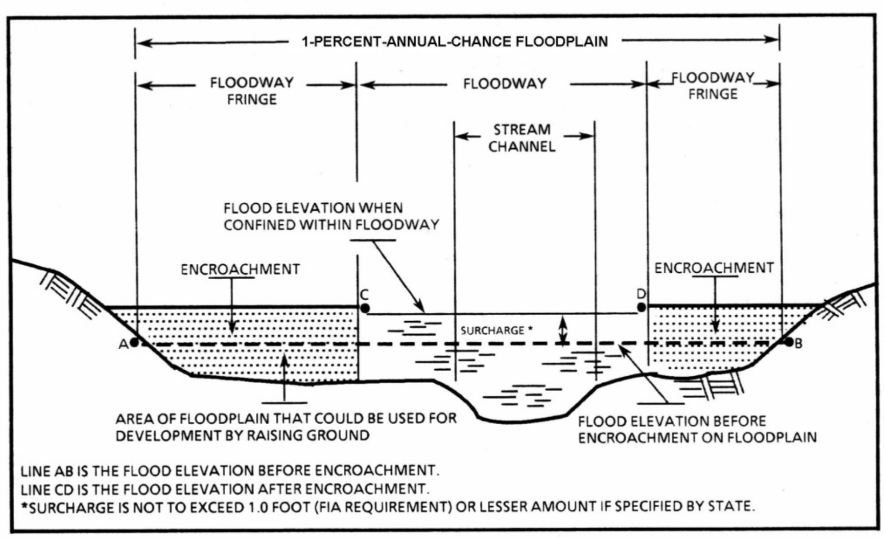


Figure 1 FLOODWAY SCHEMATIC

The area between the floodway and 1 percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water surface elevation of the 1 percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

For Vekol Wash, Vekol Wash Tributaries, and the Santa Rosa Wash it was considered inappropriate to define floodways due to the relatively low relief. Shallow flooding methods were thus employed and areas of flooding defined as Zone AO. Small areas within the floodplain boundaries may lie above the flood elevations, but cannot be shown due to the limitations of the map scale and/or lack of detailed topographic data.

The floodways and floodway data presented in this study for the Gila River at Florence, the Gila River at Kearny, the Gila River at Hayden and Winkelman, North Branch Santa Cruz Wash, and Weekes Wash were taken from the appropriate FIS study for each study area. For the Gila River at Hayden and Winkelman, no floodway is presented downstream of cross section F as no floodway was developed for this reach in the FIS.

As shown on the FIRM, the floodway boundaries were computed at cross sections. Between the cross sections, the boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Gila River at Florence								
A	156.66	2,402	10,665	6.2	1,466.2	1,466.2	1,466.5	0.3
B	156.79	2,525	10,824	6.1	1,467.4	1,467.4	1,467.6	0.2
C	156.87	2,484	10,370	6.4	1,468.1	1,468.1	1,468.3	0.2
D	156.95	2,548	10,737	6.2	1,468.9	1,468.9	1,469.2	0.3
E	157.01	2,708	11,398	5.8	1,469.6	1,469.6	1,469.8	0.2
F	157.16	2,283	8,993	7.4	1,470.9	1,470.9	1,471.1	0.2
G	157.37	1,835	7,759	8.5	1,473.8	1,473.8	1,474.2	0.4
H	157.58	2,008	10,419	6.4	1,476.5	1,476.5	1,476.9	0.4
I	157.74	2,104	12,074	5.5	1,477.5	1,477.5	1,478.0	0.5
J	157.90	2,485	12,498	5.3	1,478.3	1,478.3	1,478.8	0.5
K	157.99	1,485	8,310	8.0	1,478.5	1,478.5	1,479.2	0.7
L	158.08	3140 [2]	15,980	4.1	1,481.7	1,481.7	1,481.7	0.0
M	158.13	3410 [2]	14,538	4.6	1,481.8	1,481.8	1,481.8	0.0

[1] Miles Above Painted Rock Dam

[2] Floodway Lies Entirely Outside Town of Florence

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA AND INCORPORATED AREAS

FLOODWAY DATA

GILA RIVER AT FLORENCE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Gila River at Hayden and Winkelman								
F	4,040	1,719 / 1,560	20,307	5.19	1,930.9	1,930.9	1,931.9	1.0
G	4,855	1,120 / 970	15,710	7.64	1,932.8	1,932.8	1,933.8	1.0
H	5,215	960 / 770	13,413	8.95	1,934.1	1,934.1	1,934.9	0.8
I	5,715	716 / 290	11,641	10.31	1,935.3	1,935.3	1,936.2	0.9
J	6,230	1,120 / 255	18,442	6.51	1,938.2	1,938.2	1,938.8	0.6
K	6,675	1,195 / 135	19,609	6.12	1,938.7	1,938.7	1,939.6	0.9
L	7,535	1,439 / 160	20,956	5.73	1,940.2	1,940.2	1,941.1	0.9
M	8,160	1,636 / 480	24,311	4.94	1,941.7	1,941.7	1,942.7	1.0
N	8,500	1,905 / 610	27,512	4.36	1,942.2	1,942.2	1,943.2	1.0
O	9,320	2,144 / 525	28,538	4.20	1,943.0	1,943.0	1,944.0	1.0

[1] Feet Above San Manuel Arizona Railroad
[2] Width/Width Within Study Area

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY
PINAL COUNTY, ARIZONA
AND INCORPORATED AREAS

FLOODWAY DATA

GILA RIVER AT HAYDEN AND WINKELMAN

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Gila River at Kearny								
A	190.75	2,549	35,332	4.2	1,814.8	1,814.8	1,815.8	1.0
B	191.05	3,560 / 330[3]	16,187	9.3	1,816.6	1,816.6	1,817.0	0.4
C	191.22	2,712 / 142[3]	21,184	7.1	1,821.8	1,821.8	1,822.6	0.8
D	191.38	2,513 / 170[3]	23,853	6.3	1,823.3	1,823.3	1,824.3	1.0
E	191.53	2,244 / 694[3]	21,467	7	1,823.9	1,823.9	1,824.9	1.0
F	191.70	1,231 / 150[3]	11,846	12.7	1,825.2	1,825.2	1,625.7	0.5
G	191.78	1,591	15,415	9.7	1,827.4	1,827.4	1,828.3	0.9
H	191.99	1,444 / 1,044[3]	17,032	8.8	1,831.3	1,831.3	1,831.7	0.4
I	192.21	1,673 / 233[3]	24,394	6.2	1,833.7	1,833.7	1,834.5	0.8
J	192.45	1,571	17,835	8.4	1,834.0	1,834.0	1,834.8	0.8
K	192.86	1,273	21,319	7	1,836.4	1,836.4	1,837.4	1.0
L	193.05	1,639	23,636	6.4	1,837.7	1,837.7	1,838.6	0.9
M	193.36	1,873	27,528	5.5	1,840.1	1,840.1	1,841.0	0.9
N	193.49	2,458	28,794	5.2	1,840.9	1,840.9	1,841.9	1.0
O	193.64	1,950	24,081	6.2	1,841.8	1,841.8	1,842.8	1.0
P	193.75	1,456	17,528	8.6	1,842.8	1,842.8	1,843.7	0.9

[1] Miles Above Painted Rock Dam

[2] Width/Width Within the Town of Kearny Corporate Limits

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

GILA RIVER AT KEARNY

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Gila River at Riverside								
A	185.733	821	24,354	5.7	1,795.4	1,795.4	1,796.3	0.9
B	185.824	817	25,510	5.5	1,795.7	1,795.7	1,796.6	0.9
C	185.899	776	24,163	5.8	1,795.8	1,795.8	1,796.7	0.9
D	186.000	699	20,978	6.7	1,796.0	1,796.0	1,796.9	0.9
E	186.143	748	19,646	7.1	1,796.8	1,796.8	1,797.6	0.8
F	186.276	813	21,581	6.5	1,797.9	1,797.9	1,798.7	0.8
G	186.376	865	21,944	6.4	1,798.5	1,798.5	1,799.3	0.8
H	186.490	917	23,534	5.9	1,799.3	1,799.3	1,800.1	0.8
I	186.630	821	20,877	6.7	1,800.0	1,800.0	1,800.7	0.7
J	186.721	837	22,536	6.2	1,800.9	1,800.9	1,801.6	0.7
K	186.802	836	22,722	6.2	1,801.4	1,801.4	1,802.1	0.7
L	186.902	783	22,870	6.1	1,802.0	1,802.0	1,802.7	0.7
M	186.974	710	20,720	6.8	1,802.3	1,802.3	1,803.0	0.7

[1] Miles Above Painted Rock Dam

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA
AND INCORPORATED AREAS

FLOODWAY DATA

GILA RIVER AT RIVERSIDE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
North Branch Santa Cruz Branch								
A	1,970	950	3,323	2.7	1,365.9	1,365.9	1,366.8	0.9
B	2,945	950	4,204	2.1	1,367.1	1,367.1	1,368.1	1.0
C	3,965	850	2860	2.7	1,368.3	1,368.3	1,369.3	1.0
D	5,115	900	3,187	2.4	1,370.8	1,370.8	1,371.2	0.4
E	6,130	697	2494	3.1	1,372.7	1,372.7	1,373.2	0.5
F	7,400	460	1,877	4.1	1,376.3	1,376.3	1,377.0	0.7
G	8,560	500	1631	4.7	1,379.4	1,379.4	1,380.2	0.8
H	9,770	500	2,158	3.6	1,381.4	1,381.4	1,382.3	0.9
I	10,600	605	--	--	1,385.4	1,385.4	--	--
J	11,283	705	--	--	1,386.0	1,386.0	--	--
K	11,994	755	--	--	1,386.5	1,386.5	--	--
L	12,419	600	--	--	1,387.1	1,387.1	--	--
M	13,002	550	--	--	1,387.8	1,387.8	--	--
N	13,578	600	--	--	1,388.9	1,388.9	--	--
O	14,117	500	--	--	1,389.6	1,389.6	--	--
P	14,656	490	--	--	1,390.1	1,390.1	--	--
Q	15,449	350	--	--	1,392.1	1,392.1	--	--
R	16,329	500	--	--	1393.39	1,393.4	--	--
S	16,877	1000	--	--	1393.75	1,393.8	--	--
T	17,425	1000	--	--	1393.96	1,394.0	--	--
U	17,851	908	--	--	1394.14	1,394.1	--	--
V	18,142	916	--	--	1394.56	1,394.6	--	--
W	18,892	800	--	--	1395.26	1,395.3	--	--
X	19,446	750	--	--	1395.77	1,395.8	--	--
Y	19,956	800	--	--	1,396.2	1,396.2	--	--

[1] Feet above Burris Road

-- Data unavailable

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH BRANCH SANTA CRUZ WASH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
North Branch Santa Cruz Branch								
Z	20,457	700	--	--	1,396.2	1,396.2	--	--
AA	21,458	825	--	--	1,397.7	1,397.7	--	--
AB	22,528	930	2,114	1.4	1,397.9	1,397.9	1,398.0	0.1
AC	23,468	415	820	3.4	1,398.6	1,398.6	1,399.2	0.6
AD	24,208	200	590	3.4	1,399.8	1,399.8	1,399.9	0.1
AE	25,180	310	1,816	1.1	1,400.2	1,400.2	1,400.3	0.1
AF	27,500	400	1,016	1.6	1,403.3	1,403.3	1,404.0	0.7
AG	28,980	890	1,866	0.9	1,404.3	1,404.3	1,404.8	0.5
AH	30,810	1,080	1,624	1.0	1,406.2	1,406.2	1,406.3	0.1

[1] Feet above Burris Road
-- Data unavailable

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY
PINAL COUNTY, ARIZONA AND INCORPORATED AREAS

FLOODWAY DATA

NORTH BRANCH SANTA CRUZ WASH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Queen Creek								
A	154,000[1]	100	390	7.9	1,994.3	1,994.3	1,994.9	0.6
B	154,630[1]	106	464	6.7	1,997.5	1,997.5	1,998.0	0.5
C	155,020[1]	68	289	10.7	2,000.1	2,000.1	2,000.1	0.0
D	155,740[1]	62	277	7.4	2,006.6	2,006.6	2,006.6	0.0
E	155,970[1]	41	182	11.3	2,007.4	2,007.4	2,007.4	0.0
F	156,080[1]	86	315	6.5	2,011.6	2,011.6	2,011.6	0.0
G	156,280[1]	106	384	5.4	2,012.6	2,012.6	2,012.6	0.0
H	156,680[1]	85	221	9.3	2,014.7	2,014.7	2,014.7	0.0
I	157,200[1]	95	202	6.4	2,018.4	2,018.4	2,018.4	0.0
J	157,660[1]	78	197	9.5	2,022.6	2,022.6	2,022.6	0.0
K	157,910[1]	98	382	4.9	2,023.8	2,023.8	2,024.5	0.7
L	158,080[1]	120	746	2.5	2,030.2	2,030.2	2,030.2	0.0
M	158,230[1]	74	412	4.5	2,030.2	2,030.2	2,030.2	0.0
N	158,820[1]	81	287	6.5	2,030.2	2,030.2	2,030.9	0.7
O	159,290[1]	107	190	7.1	2,035.2	2,035.2	2,035.2	0.0
P	159,920[1]	205	264	1.9	2,040.4	2,040.4	2,040.7	0.3
Q	160,140[1]	125	99	5.1	2,046.7	2,046.7	2,046.7	0.0
Queen Creek at Superior								
A	3,200[2]	514	2,344	4.9	2,645.5	2,645.5	2,646.4	0.9
B	4,160[2]	392	1,172	9.7	2,661.0	2,661.0	2,661.0	0.0
C	5,030[2]	397	1,212	9.4	2,675.2	2,675.2	2,675.2	0.0
D	5,790[2]	704	1,557	7.3	2,688.8	2,688.8	2,689.0	0.2
E	6,570[2]	565	1,241	9.2	2,706.8	2,706.8	2,706.8	0.0
G	6,640[2]	560	2,632	4.3	2,710.7	2,710.7	2,710.8	0.1
H	7,050[2]	487	1,113	10.2	2,716.2	2,716.2	2,716.2	0.0
I	7,905[2]	410	1,186	9.6	2,736.5	2,736.5	2,736.5	0.0
J	9,015[2]	358	1,213	9.4	2,759.4	2,759.4	2,759.4	0.0
K	9,815[2]	394	1,241	9.2	2,781.5	2,781.5	2,781.5	0.0
L	10,415[2]	416	1,394	8.2	2,795.7	2,795.7	2,795.7	0.0

[1] Feet Above Confluence with Roosevelt Canal
[2] Feet Above Corporate Limits of the City of Superior

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY
PINAL COUNTY, ARIZONA
AND INCORPORATED AREAS

FLOODWAY DATA

QUEEN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
San Pedro River at Dudleyville								
A	12,000	1,602	9,570	5.2	1,953.5	1,953.5	1,954.5	1.0
B	12,870	1,565	9,267	5.4	1,955.8	1,955.8	1,956.8	1.0
C	13,700	1,235	6,447	7.7	1,958.1	1,958.1	1,959.0	0.9
D	15,280	1,170	6,373	7.8	1,963.7	1,963.7	1,964.6	0.9
E	16,150	1,320	7,758	6.4	1,966.5	1,966.5	1,967.3	0.8
F	17,500	1,060	5,466	9.1	1,970.9	1,970.9	1,971.1	0.2
G	18,970	980	6,373	7.8	1,976.5	1,976.5	1,977.1	0.6
H	20,270	980	6,121	8.1	1,981.0	1,981.0	1,981.0	0.0
I	21,140	998	6,798	7.3	1,983.6	1,983.6	1,983.8	0.2
J	21,740	1,140	6,196	8.0	1,985.0	1,985.0	1,985.7	0.7
K	22,760	1,145	7,824	6.3	1,990.7	1,990.7	1,991.0	0.3
L	24,180	1,520	8,370	5.9	1,995.3	1,995.3	1,996.0	0.7
M	25,380	1,230	4,932	10.1	1,999.2	1,999.2	1,999.8	0.6
N	26,980	1,360	8,310	6.0	2,005.4	2,005.4	2,005.9	0.5
O	28,040	1,360	5,731	8.7	2,008.3	2,008.3	2,008.6	0.3
P	29,490	1,010	6,562	7.6	2,016.3	2,016.3	2,016.8	0.5
Q	30,890	1,377	10,667	4.6	2,021.6	2,021.6	2,022.3	0.7
R	32,490	2,001	13,123	3.8	2,026.5	2,026.5	2,027.5	1.0
S	33,530	1460 / 370[2]	7,372	6.7	2,029.2	2,029.2	2,029.8	0.6
T	34,410	1330 / 340[2]	5,149	9.6	2,033.5	2,033.5	2,033.8	0.3
U	35,750	1,885	9,207	5.4	2,041.3	2,041.3	2,042.0	0.7
V	36,970	1715 / 1360[2]	7,103	7.0	2,046.0	2,046.0	2,046.1	0.1
W	38,230	1710 / 1510[2]	8,043	6.2	2,051.2	2,051.2	2,051.5	0.3
X	39,530	1,615	7,352	6.7	2,056.1	2,056.1	2,056.6	0.5
Y	41,230	1,400	7,925	6.3	2,064.4	2,064.4	2,065.2	0.8

[1] Feet Above Mouth Along Profile Base Line

[2] Width / Width Within Study Area

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

SAN PEDRO RIVER AT DUDLEYVILLE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
San Pedro River at Mammoth								
A	100,000	1,960	8,661	5.4	2,313.5	2,313.5	2,314.0	0.5
B	100,650	1,860	7,357	6.4	2,315.8	2,315.8	2,316.4	0.6
C	101,400	1,370	6,408	7.3	2,318.9	2,318.9	2,319.8	0.9
D	102,030	815	5,274	8.9	2,321.8	2,321.8	2,322.7	0.9
E	102,850	340	2,893	16.2	2,325.5	2,325.5	2,325.6	0.1
F	102,890	351	3,664	12.8	2,327.6	2,327.6	2,327.9	0.3
G	103,220	500	5,125	9.1	2,330.6	2,330.6	2,330.6	0.0
H	103,730	740	7,362	6.4	2,331.5	2,331.5	2,331.6	0.1
I	104,420	693	6,016	7.8	2,332.5	2,332.5	2,332.9	0.4
J	104,950	680	5,411	8.6	2,333.8	2,333.8	2,334.4	0.6
K	105,750	783 / 0[2]	7,599	6.2	2,336.4	2,336.4	2,337.3	0.9
L	106,230	850	7,302	6.4	2,337.6	2,337.6	2,338.6	1.0
M	106,630	1,045	8,066	5.8	2,338.8	2,338.8	2,339.7	0.9
N	107,220	1,467	11,255	4.2	2,340.2	2,340.2	2,341.2	1.0
O	107,750	1,763	12,280	3.8	2,341.0	2,341.0	2,341.9	0.9
P	108,440	1940 / 1690[2]	9,075	5.2	2,342.6	2,342.6	2,343.3	0.7
Q	109,360	2000 / 1700[2]	10,456	4.5	2,346.9	2,346.9	2,347.8	0.9
R	110,130	1906 / 1425[2]	10,858	4.3	2,349.3	2,349.3	2,350.2	0.9
S	110,690	1700 / 1330[2]	9,839	4.8	2,350.6	2,350.6	2,351.6	1.0
T	111,320	1341 / 1150[2]	8,303	5.6	2,352.1	2,352.1	2,352.9	0.8
U	111,780	1,122	6,940	6.7	2,353.5	2,353.5	2,354.4	0.9
V	112,480	1,023	7,194	6.5	2,355.8	2,355.8	2,356.5	0.7
W	113,120	1,260	7,764	6.0	2,357.5	2,357.5	2,358.3	0.8

[1] Feet Above Mouth Along Profile Base Line

[2] Width/Width Within Unincorporated Area

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

SAN PEDRO RIVER AT MAMMOTH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
San Pedro River at Mammoth								
X	113,730	1,304	7,834	6.0	2,359.7	2,359.7	2,360.3	0.6
Y	114,370	1,320	7,061	6.6	2,361.2	2,361.2	2,361.9	0.7
Z	115,050	1,495	7,921	5.9	2,363.9	2,363.9	2,364.6	0.7
AA	115,950	1,465	8,828	5.3	2,367.5	2,367.5	2,368.5	1.0

[1] Feet Above Mouth Along Profile Base Line

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY
PINAL COUNTY, ARIZONA
AND INCORPORATED AREAS

FLOODWAY DATA

SAN PEDRO RIVER AT MAMMOTH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Santa Cruz Wash Near I-8								
A	39,769	3,114	8,062	1.8	1,381.81	1,381.81	1,382.81	1.00
B	40,218	3,157	7,540	1.9	1,382.54	1,382.54	1,383.41	0.87
C	41,041	2,827	6,192	2.3	1,384.60	1,384.60	1,385.41	0.81
D	41,928	2,520	6,531	2.2	1,386.46	1,386.46	1,387.36	0.90
E	42,731	2,210	5,305	2.7	1,388.70	1,388.70	1,389.18	0.48
F	43,608	1,860	6,039	2.4	1,390.60	1,390.60	1,391.26	0.66
G	44,553	1,623	5,319	2.7	1,392.21	1,392.21	1,393.01	0.80
H	45,471	1,580	5,173	2.8	1,394.10	1,394.10	1,394.97	0.87
I	46,380	1,480	4,961	2.9	1,396.37	1,396.37	1,397.01	0.64
J	47,008	1,357	4,621	3.1	1,398.19	1,398.19	1,398.53	0.34
K	47,853	800	3,561	4.0	1,400.63	1,400.63	1,400.92	0.29
L	48,428	409	2,123	6.8	1,402.15	1,402.15	1,402.45	0.30
M	48,565	350	2,185	6.6	1,404.85	1,404.85	1,404.25	-0.60
N	48,682	323	2,437	5.9	1,405.51	1,405.51	1,405.35	-0.16
O	49,421	743	4,143	3.5	1,406.47	1,406.47	1,406.55	0.08
P	50,329	1,260	5,832	2.5	1,407.06	1,407.06	1,407.58	0.52
Q	51,211	1,500	5,503	2.6	1,407.80	1,407.80	1,408.75	0.95
R	52,050	1,520	5,074	2.8	1,409.53	1,409.53	1,410.33	0.80
S	52,958	1,520	5,039	2.9	1,411.51	1,411.51	1,412.35	0.84
T	53,919	1,450	5,163	2.8	1,413.57	1,413.57	1,414.36	0.79
U	54,801	1,366	4,580	3.1	1,415.75	1,415.75	1,416.35	0.60
V	55,730	1,314	4,716	3.1	1,418.11	1,418.11	1,418.68	0.57
W	56,612.160	1,209	4,410	3.3	1,420.02	1,420.02	1,420.83	0.81
X	57,488.640	1,180	4,546	3.2	1,422.01	1,422.01	1,423.01	1.00
Y	58,428.480	1,049	4,266	3.4	1,424.24	1,424.24	1,425.24	1.00

[1] Feet above confluence with North Branch Santa Cruz Wash

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

SANTA CRUZ WASH NEAR I-8

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Santa Cruz Wash Near I-8								
Z	59,331	1,090	4,616	3.1	1,426.24	1,426.24	1,427.23	0.99
AA	60,261	1,301	4,597	3.1	1,428.26	1,428.26	1,429.25	0.99
AB	60,931	1,300	4,338	3.3	1,430.16	1,430.16	1,431.06	0.90
AC	61,760	1,460	5,278	2.7	1,432.06	1,432.06	1,433.01	0.95
AD	62,499	1,590	5,878	2.5	1,433.49	1,433.49	1,434.29	0.80
AE	63,402	1,770	6,581	2.2	1,434.72	1,434.72	1,435.45	0.73
AF	63,819	1,807	5,997	2.4	1,435.35	1,435.35	1,436.05	0.70
AG	64,559	2,240	6,038	2.5	1,436.92	1,434.92	1,437.44	0.52
AH	65,361	2,870	7,267	2.2	1,438.49	1,438.49	1,439.02	0.53
AI	66,048	2,930	7,475	2.1	1,439.60	1,439.60	1,440.23	0.63
AJ	66,892	3,300	8,413	1.9	1,440.84	1,440.84	1,441.62	0.78

[1] Feet above confluence with North Branch Santa Cruz Wash

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY
PINAL COUNTY, ARIZONA
AND INCORPORATED AREAS

FLOODWAY DATA

SANTA CRUZ WASH NEAR I-8

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Steamboat Wash								
A	950	140	456	10.3	1,839.6	1,839.6	1,839.6	0.0
B	1,100	165	469	10.0	1,843.6	1,843.6	1,843.6	0.0
C	1,300	233	538	8.7	1,850.8	1,850.8	1,850.8	0.0
D	1,680	194	507	9.3	1,860.2	1,860.2	1,860.2	0.0
E	1,920	153	469	10.0	1,868.1	1,868.1	1,868.1	0.0
F	2,290	151	468	10.0	1,879.5	1,879.5	1,879.5	0.0
G	2,600	120	430	10.9	1,890.0	1,890.0	1,890.0	0.0
H	2,900	135	449	10.4	1,898.7	1,898.7	1,898.7	0.0
I	3,200	169	490	9.6	1,907.9	1,907.9	1,907.9	0.0
J	3,350	134	449	10.5	1,912.5	1,912.5	1,912.5	0.0

[1] Feet Above Confluence with Gila River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

STEAMBOAT WASH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Weekes Wash								
A	5,500	439	807	8.5	1,780.2	1,780.2	1,780.9	0.7
B	6,380	220	818	8.4	1,790.0	1,790.0	1,791.0	1.0
C	7,290	297	867	7.9	1,798.4	1,798.4	1,799.3	0.9
D	8,010	725	1,352	5.1	1,805.8	1,805.8	1,806.1	0.3
E	8,910	793	1,139	6.0	1,816.4	1,816.4	1,817.2	0.8
F	9,660	267	807	8.5	1,825.4	1,825.4	1,826.3	0.9
G	10,460	199	767	8.9	1,833.6	1,833.6	1,834.5	0.9
H	11,140	320	854	8.0	1,842.1	1,842.1	1,842.2	0.1
I	12,090	449	962	7.1	1,853.2	1,853.2	1,854.2	1.0
J	12,990	385	1,046	6.5	1,862.2	1,862.2	1,863.1	0.9
K	13,990	503	1,017	6.7	1,874.7	1,874.7	1,875.7	1.0
L	14,790	439	967	7.1	1,883.5	1,883.5	1,884.4	0.9
M	15,510	400	972	7.0	1,890.9	1,890.9	1,891.3	0.4
N	16,240	260	799	8.6	1,899.7	1,899.7	1,899.7	0.0
O	17,190	492	950	7.2	1,908.7	1,908.7	1,908.7	0.0
P	17,610	884	1,590	4.3	1,915.1	1,915.1	1,915.1	0.0
Q	17,710	780	3,177	2.2	1,918.3	1,918.3	1,918.3	0.0
R	17,940	500	1,670	4.1	1,918.4	1,918.4	1,918.4	0.0
S	18,790	381	825	8.3	1,926.6	1,926.6	1,926.6	0.0
T	19,940	247	786	8.7	1,937.6	1,937.6	1,937.7	0.1
U	20,740	296	751	9.1	1,948.7	1,948.7	1,948.7	0.0
V	21,390	526	1,022	6.7	1,956.2	1,956.2	1,956.2	0.0

[1] Feet Above U.S. Highways 60, 80, and 89.

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY
PINAL COUNTY, ARIZONA
AND INCORPORATED AREAS

FLOODWAY DATA

WEEKES WASH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Branch								
A	70	20	127	9.8	2,001.5	2,001.5	2,001.5	0.0
B	250	20	128	9.7	2,002.5	2,002.5	2,002.5	0.0
C	510	20	137	9.1	2,004.0	2,004.0	2,004.0	0.0
D	800	96	178	7.0	2,007.2	2,007.2	2,007.7	0.5
E	1,330	210	358	3.5	2,009.4	2,009.4	2,010.3	0.9
F	1,860	51	140	8.9	2,014.5	2,014.5	2,014.5	0.0
G	2,220	37	127	9.9	2,019.3	2,019.3	2,019.3	0.0
H	2,440	51	134	9.3	2,021.8	2,021.8	2,021.8	0.0
I	3,060	154	204	6.1	2,028.8	2,028.8	2,028.8	0.0
J	3,334	108	123	3.3	2,031.2	2,031.2	2,031.2	0.0
K	3,880	77	72	5.5	2,038.4	2,038.4	2,038.4	0.0
L	4,330	65	69	5.8	2,046.6	2,046.6	2,046.6	0.0

[1] Feet Above Mouth

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

WEST BRANCH

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1 percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1 percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1 percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1 percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and to areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1- percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Pinal County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs); however, all the information found on the FBFM will now be located on the FIRM where applicable. Historical data relating to the maps prepared for each community, up to and including this countywide FIS, are presented in Table 12, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Apache Junction, City of	June 10, 1980	None	September 30,1982	March 19, 1990
Casa Grande, City of	April 5, 1974	None	August 1, 1977	April 19, 1983 September 29, 1989
Coolidge, City of	December 4, 2007	None	December 4, 2007	None
Eloy, City of	September 18, 1987	None	September 18, 1987	None
Florence, Town of	May 3, 1974	February 20, 1976	August 17, 1981	None
Hayden, Town of	April 23, 1976	None	September 14, 1979	None
Kearny, Town of	November 30, 1973	May 21, 1976	August 17, 1981	None
Mammoth, Town of	December 7, 1973	May 28, 1976 January 14, 1977	September 15, 1981	July 3, 1985

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Maricopa, City of	January 10, 1975	None	August 15, 1983	None
Queen Creek, Town of	September 29, 1989	None	September 29, 1989	September 30, 2005
Superior, Town of	July 31, 1979	None	November 4, 1981	None
Winkelman, Town of	January 23, 1974	December 26, 1975	September 14, 1979	None
Pinal County (Unincorporated Areas)	January 10, 1975	October 25, 1977 February 7, 1978 June 26, 1979	August 15, 1983	May 4, 1987 March 5, 1990

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Pinal County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Pinal County with the exception of the Gila River, Maricopa, Papago, and San Carlos Indian Reservations; the Casa Grande and Florence Military Reservations; and the Rittenhouse U.S. Air Force Auxiliary Field.

Due to differences in the scopes of these studies, Flood Insurance Studies for Apache Junction, Casa Grande, and Maricopa County may not entirely agree with this study.

The Flood Insurance Studies for the Unincorporated Areas of Pinal County, the City of Apache Junction, the City of Casa Grande, the Town of Florence, the Town of Kearny, the Town of Mammoth, the Town of Superior, and the Towns of Hayden and Winkelman, of Gila County, were used as sources of data for detailed study areas in this study.

An unpublished report on the lower Santa Cruz River basin by the COE was used as a source of discharge data and some approximate floodplain boundaries for the Santa Cruz, Santa Rosa, and Greene Washes. Two reports by the USGS were used as sources of peak discharge-¬frequency data on the Gila and San Pedro Rivers for this study; therefore, they are in agreement with this study.

This study is authoritative for the purposes of the NFIP; data presented herein either supersede or are compatible with all previous determinations.

8.0 LOCATION OF DATA

Information concerning the pertinent data regarding the Unincorporated Areas of Pinal County, City of Apache Junction, City of Casa Grande, City of Coolidge, City of Eloy, Town of Florence, Town of Kearny, Town of Mammoth, and the Town of Superior can be obtained by contacting the Federal Emergency Management Agency – Region IX, 1111 Broadway, Suite 1200, Oakland, CA 94607.

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original FIS was printed. Future revisions may be made that do not result in the republishing of the FIS report. To assure that user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data.

10.1 First Revision (TBD)

Authority and Acknowledgements
The countywide study was revised on December 2, 2011, to incorporate new hydrologic and hydraulic analyses for the Vekol Wash Tributary, Casa Blanca/Sacaton Canal, South Side Canal #1 and South Side Canal #2. The new study was performed by Michael Baker Jr., Inc. for FEMA, under Contract No. HSFEHQ-09-D-0368. The study was completed in October 2011.

The City of Maricopa then provided three appeals to update both the hydrologic and hydraulic analyses and the mapping. These studies were performed by Cardno (Casa Blanca/Sacaton Watershed), EPS Group (South Side 2 Canal) and Wood Patel (Vekol Wash Tributary). The studies were completed in August 2012, July 2012, and April 2012, respectively. Additionally, the appeal for the South Side 2 canal provided updated flows that allowed Michael Baker Jr. Inc. to update the hydraulics and mapping for the South Side 1 canal. That study was completed in June 2013.

Coordination
The initial CCO meeting was held on December 8, 2009 and a follow up review meeting was held on August 31, 2011. Both meetings were attended by representatives of the City of Maricopa, Pinal County, FEMA and Michael Baker Jr. Inc. The final CCO meeting was held on December 7, 2011, and was attended by representatives of the City of Maricopa, Pinal County, FEMA, Michael Baker Jr., Inc. and Wood Patel.

Scope of Study
This revision includes detailed study of the Vekol Wash Tributary and approximate study of the Casa Blanca/Sacaton Canal, and South Side Canals 1 and 2 within the city limits of the City of Maricopa. As noted above the original analysis was appealed by the city and new analyses were submitted for the Vekol Wash Tributary, Casa Blanca Canal and South Side Canal #2. The appeal also included a partial update to the South Side Canal 1 hydrology. That information was used by Michael Baker Jr. Inc. to update the South Side 1 hydraulic analysis.

Hydrology
The original hydrologic analysis for the Vekol Wash was conducted by HDR under contract to the City of Maricopa in the "Master Drainage Study" and was submitted to FEMA for this restudy. That study was completed in August 2009 and was accepted by FEMA for use in this restudy. The original hydrologic analysis for the Casa Blanca Canal and the South Side Canals was conducted by Michael Baker Jr. Inc. and utilized the Regional Regression Equations developed by R.H. Roeske for the Arizona Department of Transportation and the US Geological Survey in September 1978.

The appeal for the Vekol Wash was submitted by Wood/Patel and included updates and modifications to the original hydrologic HEC-1 model submitted by HDR. The major changes include additions of some major storage routing and flow splits that changed the flow patterns and the addition of a few minor changes in the channel routing data. Additionally, the landuses, soils data, drainage subbasin delineations and subbasin parameters were all reviewed and updated as necessary.

The appeal for the Casa Blanca Canal was submitted by Cardno. The appeal analysis included a review of the watershed delineation and the creation of a HEC-1 model. Cardno used estimates and equations from the Arizona Department of Transportation's Highway Drainage Design Manual Hydrology. The manual includes the use of the Clark Unit Hydrograph methodology and the Green and Ampt soil loss methodology to estimate the 1% annual chance peak flow. The 100-yr, 24-hr precipitation value was obtained from NOAA Atlas 14.

The appeal for the South Side 2 canal was submitted by EPS Group. The appeal analysis includes a new HEC-HMS model that includes both of the South Side Canals (1 and 2). Similar to above, EPS Group used estimates and equations from the Arizona Department of Transportation's Highway Drainage Design Manual Hydrology. The manual includes the use of the Clark Unit Hydrograph methodology and the Green and Ampt soil loss methodology to estimate the 1% annual chance peak flow. The Muskingum-Cunge method was used for routing. Additionally, diversions were included in the model to account for breakout flows from Steen Road and Farrell Road and flows along the East Main Irrigation Canal. The 100-yr, 24-hr precipitation value was obtained from NOAA Atlas 14.

Further information for all of the appeal models can be found in their respective Technical Data Study Notebooks (TSDNs).

Table 8 has been updated to show the new peak discharges for the Vekol Wash Tributary, Casa Blanca/Sacaton Canal and South Side Canals 1 and 2.

Hydraulic Analysis

The City of Maricopa provided topographic data within the city limits and field cross section surveys for the Vekol Wash Tributary were conducted in 2010. The field cross sections were extended using HEC-GeoRAS and were then imported into HEC-RAS version 4.1.0 for analysis. Cross sections for the Vekol Channel were obtained using HEC-GeoRAS to "cut" the sections from the topographic data. Further information regarding the development of cross sections can be found in the TSDN.

The Manning's "n" values for the Vekol Wash ranged from 0.2 in the channel to 0.5 for residential areas. The downstream boundary condition used for all streams was normal depth.

In the original model it was assumed that a split flow condition would occur from the Vekol Wash Tributary and form the Vekol Wash Tributary Split. The split flowpath was assumed to run west along Honeycutt Boulevard and then turn north to run along Hogenes Boulevard and then confluence with the Vekol Wash Tributary. Additionally, the hydrologic analysis conducted by HDR include flows for the canal (Vekol Channel) that runs just south of Bowlin Road that carries diverted flow from the Vekol Wash Tributary. An analysis was also conducted for this potential flood source.

The appeal for the Vekol Wash Tributary utilized the model built by Michael Baker but several modifications were made to account for the change in hydrology. Specifically, the split flow path was removed and changes were made to the Manning's n values, some cross sections and ineffective flow settings. The Maning's "n" values for the appeal ranged from 0.03 in the channel to 0.45 in the overbanks. Blocked obstructions were used to eliminate areas of residential development. Further information regarding the appeal hydraulic analysis can be found in the Technical Data Study Notebook (TSDN) for the appeal.

The original hydraulic analysis for the Casa Blanca/Sacaton Canal was done using HEC-RAS with cross sections created from the topographic data provided by the City of Maricopa; no field survey work was done for this stream. The cross sections were cut using best engineering judgment to approximate the floodplain and Manning's n values of 0.05 for the overbank and 0.035 for the channel were used. The topography provided by the City of Maricopa stopped at the city boundary along the north side of the canal and as a result there was some uncertainty regarding potential flow leaving the system to the north. The original model assumed that no flow would leave the system.

The appeal model utilized the above described new hydrology and also more detailed ground elevation data obtained from field visits to the site. The model also included a culvert at Hartman Road previously not modeled. Additionally, water was allowed to leave the system and flow north out of the City of Maricopa and onto the Gila River Indian Community (currently a non-participating community). The floodplain that was mapped only reflects the flooding in the City of Maricopa, no floodplain was generated for the portion of the flow leaving the system and flooding across the Gila River Indian Community lands.

The original hydraulic analysis for the South Side 1 canal was done using HEC-RAS with cross sections created from the topographic data provided by the City of Maricopa; no field survey work was done for this stream. The original topographic data did not show the exact dimensions of the channel very precisely so a channel was created using best engineering judgment from the best available data. Also based on the topography it was assumed that water could leave the channel at the upstream end of the reach and form a separate flowpath. Two models were created to reflect these assumptions.

The appeal model utilized the above noted hydrology and also more detailed ground elevation information obtained from field visits to the site included as part of the appeal for the South Side 2 canal. That appeal showed that some flow would remain in the South Side 1 channel and some would sheet flow north. A new HEC-RAS model was created to map the overflow from the South Side 1 canal.

The original hydraulic analysis for the South Side 2 canal was done using HEC-RAS with cross sections created from the topographic data provided by the City of Maricopa; no field survey work was done for this stream.

The appeal model utilized the above noted hydrology and also more detailed ground information obtained from field visits to the site. The new HEC-RAS model takes into account diversions from the South Side 2 canal north along the East Main Canal and also flow leaving the canal and sheet flowing to the northwest.

Floodplain Boundaries
The two foot topographic data provided by the City of Maricopa was used to delineate the floodplain boundaries. The appeals redelineated the floodplains for Vekol Wash Tributary and the Zone A delineations for Sacaton/Casa Blanca Canal and the South Side Canals.

Floodways
No floodways were calculated for any of the flood sources.

This revision also incorporated the following Letters of Map Revision cases.

13-09-0781P – changes to the Santa Rosa Wash from approximately 260 feet upstream to approximately 6,280 feet upstream of Portor Road in the Santa Rosa Springs neighborhood.

13-09-0917P – changes to hydraulic analysis for the Santa Cruz Wash (Campus Channel) from the confluence with to the divergence from Santa Cruz Wash (W-P channel) and the Santa Cruz Wash (W-P Channel) from Honeycutt Road to approximately 6,400 feet upstream

10-09-2020P – changes to hydrologic and hydraulic analysis for the Santa Cruz Wash from approximately 270 feet downstream of Smith Enke Road to approximately 1,000 feet upstream of Honeycutt Road

07-09-1819P (reissued as 09-09-0127P) – changes to hydrologic and hydraulic analysis for the Santa Cruz Wash from approximately 960 feet downstream of Honeycutt Road to approximately 2,000 feet downstream of Farrell Road

07-09-1532P – changes to hydrologic and hydraulic analysis for Santa Rosa Wash from just downstream of Honeycutt Road to just upstream of the Southern Pacific Railroad and to Casa Grande Ditch from the confluence with Santa Rosa Wash to approximately 2,830 feet upstream.

03-09-0634A – This was a LOMR based on fill and it removed the Acacia Crossing neighborhood from the floodplain.