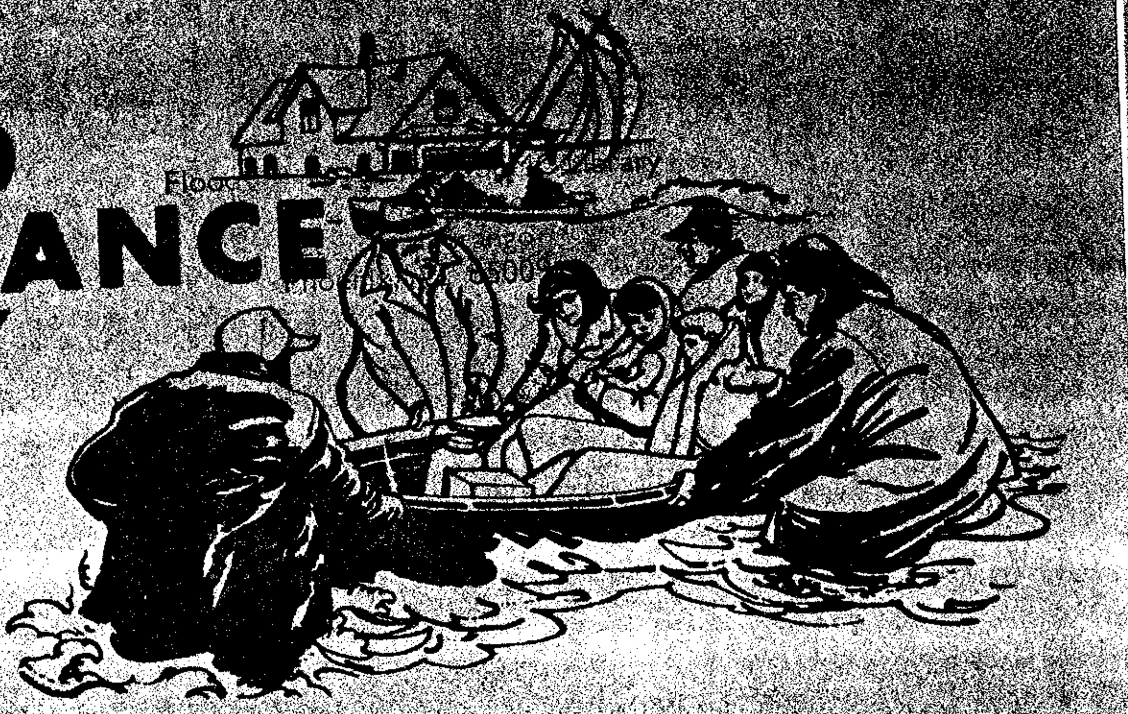
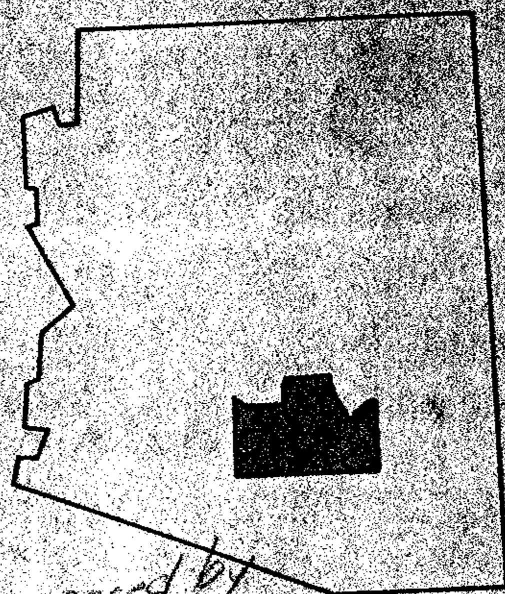
FLOOD INSURANCE STUDY



PINAL COUNTY, ARIZONA
UNINCORPORATED AREAS



Report prepared by Cella-Barr

Federal Emergency Management Agency

COMMUNITY NUMBER - 040077

FEMA

NOTICE TO FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for flood plain 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.

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the unincorporated areas of Pinal County, Arizona. This information will be used by Pinal County to update existing flood plain regulations as part of the regular phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and flood plain development.

In some states or communities, flood plain 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 Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Cella Barr Associates (CBA), for the Federal Emergency Management Agency (FEMA), under Contract No. 11-4607. This work was completed in March 1981. Excluded from these analyses were the Gila River at Hayden and Winkelman, and North Branch Santa Cruz Wash.

The hydrologic and hydraulic analyses for the Gila River at Hayden and Winkelman and for 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.

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

1.3 Coordination

Streams requiring study by detailed methods were identified at a meeting attended by representatives of the study contractors, FEMA, and Pinal County in August 1977.

Results of the hydrological analyses were coordinated with the USGS, the U.S. Soil Conservation Service (SCS), and the U.S. Army Corps of Engineers (COE). Additional information was obtained from the Pinal County Flood Control Board.

On November 3, 1980, the results of the study were reviewed at an intermediate meeting attended by representatives of the study contractors, FEMA, and the county. The study was acceptable to the county.

Streams requiring revised shallow flooding analysis were identified at a meeting attended by representatives of the study contractor, FEMA, and Pinal County on May 4, 1983.

Results of the hydrologic anlayses were coordinated with Pinal County, Maricopa County Flood Control District (MCFCD), Arizona Department of Water Resources (ADWR), USGS, SCS, the Arizona Department of Transportation (ADOT), and the COE.

On March 11, 1985, the results of the shallow flooding analysis 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.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Pinal County, Arizona. The area of study is shown on the Vicinity Map (Figure 1).

Those areas within the county but excluded from this study include the Cities of Apache Junction, Casa Grande, Coolidge, and Eloy; the Towns of Florence, Hayden, Kearny, Mammoth, and Superior; 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 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 to 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

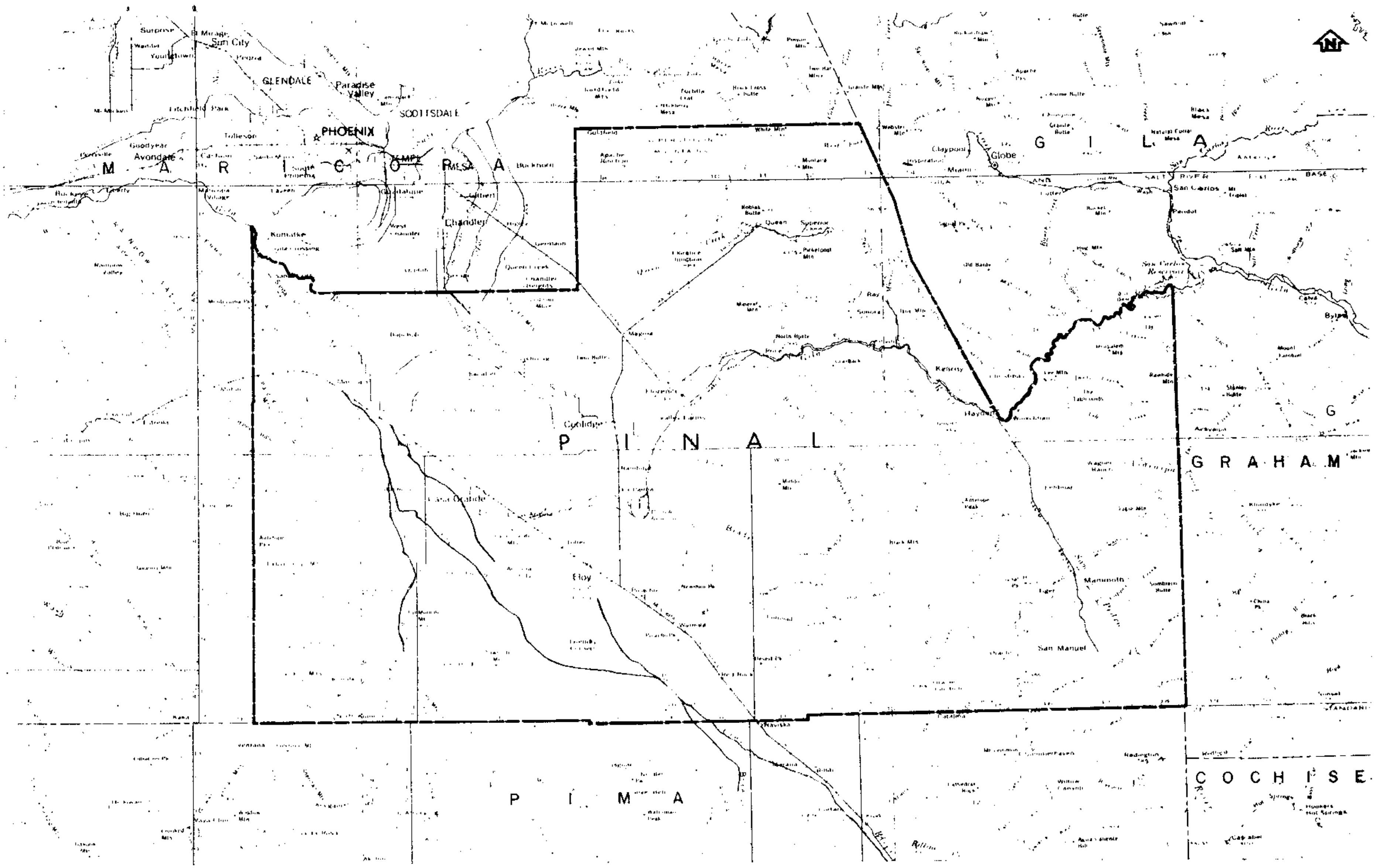

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

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 upstream to RM 0.76, in the vicinity of Queen Valley

Santa Cruz Wash - from 38.00 river miles above its confluence with the Gila River upstream to RM 42.4, in the vicinity of Desert Carmel

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

Data presented in this study for the following detailed-study areas were taken from their respective Flood Insurance Studies:

Flooding Source	Flood Insurance Study
Gila River at Florence	Town of Florence (Reference 1)
Gila River at Kearny	Town of Kearny (Reference 2)
Gila River at Hayden and Winkelman	Towns of Hayden (Reference 3) and Winkelman (Reference 4)
North Branch Santa Cruz Wash	City of Casa Grande (Reference 5)
Weekes Wash	City of Apache Junction (Reference 6)

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through March 1990.

Streams studied using the shallow flooding analyses are listed below. These streams were evaluated using detailed/shallow flooding techniques due to the type of historical flood problems experienced in the area.

Areas Studied Using Shallow Flooding Techniques

Drainage	Limit of Study
Santa Rosa Wash	3 miles southeast of the Town of Maricopa to the Gila River Indian Reservation boundary.
Vekol Wash Tributary	From the Maricopa Indian Reservation Boundary to the Gila River Indian Reservation boundary, approximately 3.0 miles.

Drainage	Limit of Study
Vekol Wash	From the Maricopa Indian Reservation boundary to the Gila River Indian Reservation boundary, approximately 0.8 mile.

The areas studied by detailed shallow flooding methods were selected with priority given to all known flood hazard areas and areas of projected development through September 1990.

The following flooding sources were studied by approximate methods in the following areas: the Santa Cruz Wash, in the vicinity of Maricopa; Queen Creek, between Queen Valley and Whitlow Ranch Dam; McClellan Wash, in the vicinity of Pichacho; Big and South Washes, in the vicinity of San Manuel; and two unnamed washes west of Mammoth. Flooding occurring in areas without defined watercourses was also studied by approximate methods for the following areas: Arizona Childrens Colony, Colina del Sol, Lake in the Desert, Randolph, and Twilight Trails.

Approximate analyses were used to study 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.

2.2 Community Description

Pinal County, encompassing a total area of 5,386 square miles, is located in south-central Arizona. 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 Pinal County population was 90,918 in 1980, and is projected to reach 111,100 by 1990 (Reference 7).

The topography as well as vegetation in the area is extremely diverse, varying from 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 the low washes.

Due to the 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 pattern of washes 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 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 (Reference 8).

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 flood plain. By the time it exits at the northwestern corner of Pinal County, the Gila River flood plain is several miles wide.

The Santa Cruz River, up to this point, has been referred to as a system due to the manmade and natural diversions that cause its floodwaters to separate, and become distinct, unique floodflows, then recombine at a point many miles downstream. As is shown in Figure 2, the main stem of the Santa Cruz River flows undivided to a point near Red Rock.

In the vicinity of the shallow flooding study area, the Santa Cruz River system is composed of two major drainageways, the Santa Cruz Wash and the Santa Rosa Wash. The Santa Cruz River originates in the San Rafael Valley, approximately 20 miles east of Nogales, and flows southward into Mexico before reentering the United States about 3 miles east of Nogales. From here, it flows northward about 70 miles to Tucson and then northwestward 42 miles to the junction with Greene Canal. Halpenny (Reference 9) notes that a majority of the flow is directed northwesterly in Greene Canal to Greene Wash. 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 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 Southern

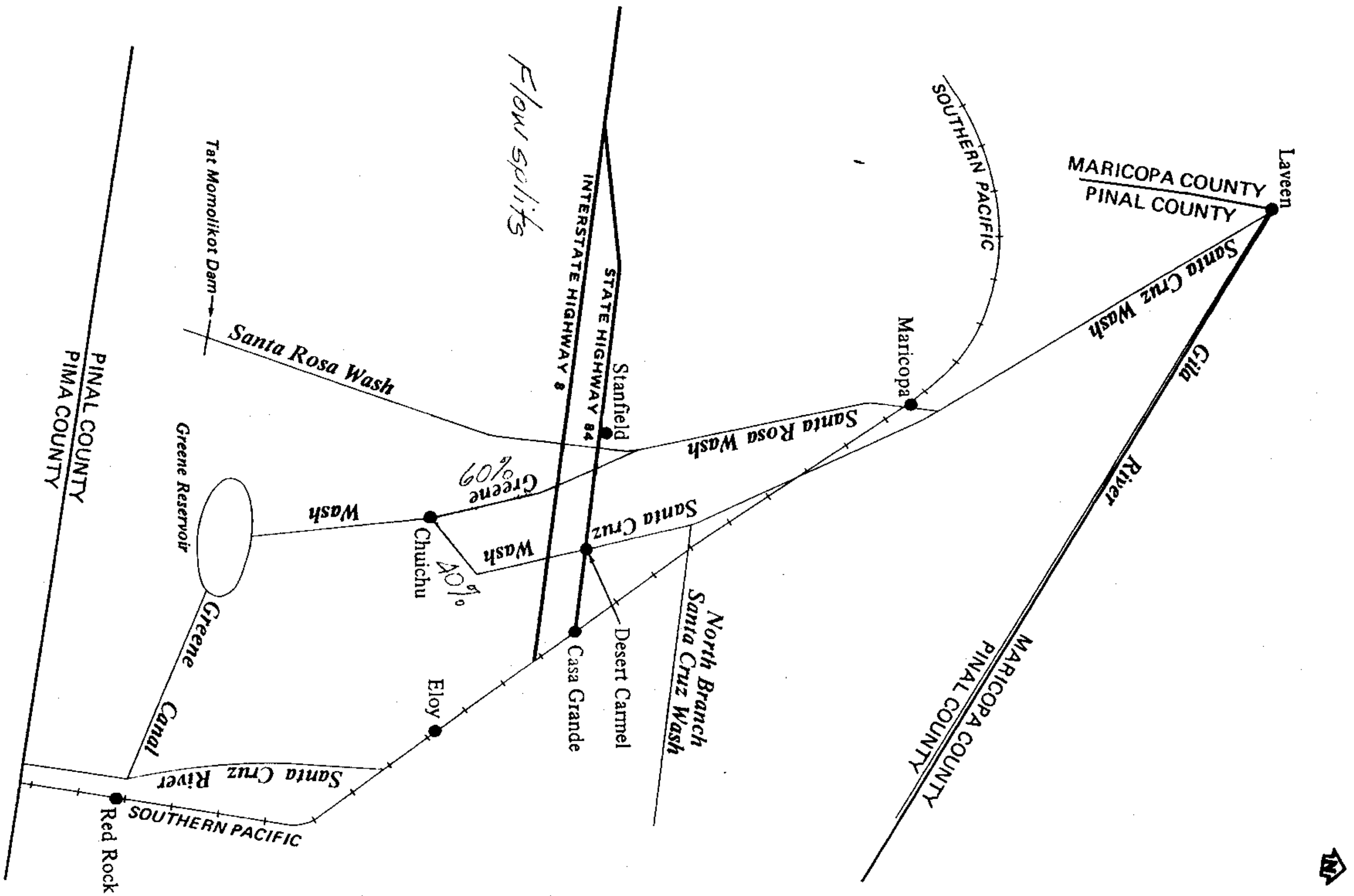

FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

SCHEMATIC DIAGRAM

LOWER SANTA CRUZ RIVER SYSTEM

Pacific Railroad approximately 1 mile east of Maricopa. Santa Cruz Wash crosses the Southern Pacific 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 prevents the use of the term "Santa Cruz River" to describe the flood hazards in the Santa Cruz River system. Elements of the Santa Cruz River system referenced in this study are shown in Figure 2.

Vekol Wash is a tributary to the Santa Cruz River and joins it approximately 8 miles north of the Southern Pacific Railroad crossing. At Maricopa, it drains an area of 297 square miles extending up into the Vekol Valley. Elevations range from 1,160 feet at the Southern Pacific 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 for Vekol Wash, as many of the alluvial plains are presently under cultivation, and grading and channelization have altered the natural drainage characteristics.

2.3 Principal Flood Problems

Past flooding of Pinal County indicates that large portions of the county are subject to destructive floods. The principal flood hazard results from overflow of the major rivers. The overflow results in the inundation of the wide, flat flood plains, including any residential, commercial, or agricultural developments located within them. Erosion combined with the development of new channels adds to the potential hazard from flooding.

Table 1 summarizes major known flooding events that have occurred in the county.

The Gila River near Riverside has experienced many floods. Table 1 identifies only those major floodflows that have occurred on the Gila River since 1929, which marks the construction of Coolidge Dam. Of the 18,011-square-mile area contributing to the flood hazard at Riverside, approximately 12,900 square miles are controlled by Coolidge Dam. Thus, Coolidge Dam plays an important role in the flooding problems of Riverside. Assuming the reservoir to be at capacity, three types of events could lead to severe flooding on the Gila River: (1) a widespread frontal-type storm of large magnitude and long duration, (2) a warm airmass moving in on a large snow accumulation, or (3) a frontal-type storm falling on snow (Reference 10).

An examination of the Gila River discharge records collected at Kelvin, USGS gage No. 09474000, (just downstream of Riverside),

Table 1. Historic Flood Information

Study Site	Flooding Source	Peak Discharges (cfs)	Flood Date	Recurrence Interval (Years)
Riverside	Gila River	42,800	08/08/30	22
		38,200	08/14/40	19
		26,300	12/23/65	10
		27,700	12/20/67	12
		27,000	12/19/78	11
Dudleyville	San Pedro River	85,000	09/28/26	600
		45,000	08/14/40	75
		25,000	08/08/30	18
		20,000	08/13/19	10
		20,000	08/28/35	10
		18,500	10/11/77	8
Mammoth	San Pedro River	90,000	09/28/26	Unknown
		22,000	10/11/77	10
Stanfield	Greene Wash	6,200	12/22/67	25
		4,300	09/25/62	6
		1,700	10/09/77	2
Desert Carmel	Santa Cruz Wash	3,060	09/25/62	7
		3,000	10/09/77	6.5
		2,000	12/22/67	3
State Highway 84	Santa Cruz Wash	3,060	09/26/62	7
		3,000	10/09/77	6.5
		2,000	12/22/67	3
		Unknown	10/04/83	300

Table 1. Historic Flood Information (Cont'd)

Study Site	Flooding Source	Peak Discharges (cfs)	Flood Date	Recurrence Interval (Years)
State Highway 84	Greene Wash	6,200	12/22/67	25
		4,300	09/26/62	6
		1,700	10/09/77	2
		Unknown	10/14/83	300
State Highway 84	Santa Rosa Wash	8,430	09/26/62	6
Southern Pacific Railroad	Santa Cruz and Santa Rosa Wash	36,400	10/04/83	300
Southern Pacific Railroad	Maricopa (Santa Rosa Wash)	Unknown	09/26/62	Unknown
		15,400	10/04/83	300

show that the annual peak discharge occurs most often during the period of August through January (Reference 11).

The estimated maximum discharge at Kelvin is 190,000 cubic feet per second (cfs) and occurred on November 28, 1905. Based on newspaper accounts describing floods of similar magnitude, the Gila River has been known to swell to 1 mile wide, cutting Florence off from communication with other communities and washing out three railroad bridges between Florence and Kelvin. 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 285 years, and at Kearny on the average of once every 220 years.

The maximum recorded discharge at Kelvin is 132,000 cfs, which 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 majority of Riverside is located in the low flood plain immediately adjacent to the 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.

As seen in Table 1, the San Pedro River near Dudleyville experienced five major floods from 1919 to 1940. In the past few years, the only significant flow to come down the San Pedro River occurred in October 1977. That magnitude of flow may be expected to occur on the average of once every 8 years.

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 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 approximately a 10-year event. Homes and businesses along Main Street in Mammoth experienced flood damage as a result of this 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 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.

Floods typically occur in the Apache Junction area during the late summer storms (July to September) or the winter storm months (December to March). The SCS reported the occurrence of an estimated 40 floods in the area since 1910. Of the 40 floods, 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 (Reference 12).

The outline of the shallow flooding floodflow channels and their interrelated flooding problems are explained as follows, and shown in Figure 2. South of Greene Reservoir, the Santa Cruz River floodwater flows northward down a watercourse named Greene Wash. At Chuichu, the hydraulic capacity of Greene Wash is inadequate and a portion of the flow is diverted northeasterly into Santa Cruz Wash. At this point, two distinct watercourses carry floodwater that emanates from a single watercourse. North of State Highway 84, Greene Wash joins the Santa Rosa Wash and continues north to Maricopa. Also north of State Highway 84, the Santa Cruz Wash is joined by the North Branch Santa Cruz Wash. Continuing north, the Santa Cruz Wash is met by the Santa Rosa Wash just north of Maricopa. The Santa Cruz Wash is joined by Vekol Wash, approximately 8 miles north of Maricopa, before it flows into the Gila River.

Flooding characteristics at Maricopa, Stanfield, and Desert Carmel are essentially the same as at State Highway 84 (Reference 13). As floodflows exceed the dredged, well defined, manmade channels, a sheetflow condition prevails. Typically, flood depths average approximately 2 feet across the flood plain, but may be deeper in isolated pockets.

Flooding on the Santa Rosa Wash has occurred frequently, and, according to the COE, (Reference 14) 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 Southern Pacific Railroad, near Maricopa (Reference 15).

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 300-year event. Much of the data resulting from this storm, and subsequent flooding, is still being collected by the USGS and remains in a preliminary, unpublished form.

This event caused widespread flooding 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 (Reference 16).

Observations from aerial photographs (References 17 and 18) and field reconnaissance indicate that flooding in Maricopa resulted from both the Santa Cruz Wash and the Santa Rosa Wash. Flow in the Santa Cruz Wash exceeded the capacity of the bridge structures underneath the Southern Pacific Railroad and backed up, causing water to flow around the dikes. A drainage channel, paralleling the railroad, helped carry the flow toward Maricopa while discharging some flows through the many culverts underneath the railroad. As this channel capacity was exceeded, flow from the Santa Cruz Wash combined with flow from the Santa Rosa Wash and caused sheetflow toward the Santa Rosa Wash bridge crossing.

Debris buildup around the bridge piers on the Santa Rosa Wash restricted the flow capacity to approximately 8,500 cfs. The additional flows from the Santa Cruz Wash caused the channel capacity to be exceeded and resulted in a breach of the banks. Approximately 15,400 cfs were diverted as sheetflow along the south side of the railroad through Maricopa. The water crossed the railroad through the culverts and continued to flow along the path of Vekol Wash prior to recombining with the Santa Cruz Wash.

Of the two flooding sources in San Manuel, no information is available as to the date and magnitude of past flooding events.

2.4 Flood Protection Measures

As discussed previously, Coolidge Dam regulates flow on the Gila River; thus, it is a flood-protection measure for all of the detailed-study reaches on the Gila River. The regulation of this dam reduces the more frequent floods, but does not affect larger events, such as the 100- and 500-year floods.

A SCS flood-control structure southeast of Florence protects that community against 100-year flooding from washes in that area (Reference 19).

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 with a recurrence interval of 100 years.

A small water-supply dam and reservoir at the upstream end of the detailed-study reach on West Branch has no effect on the 100- or 500-year floods. Therefore, it was not considered in the analysis for West Branch.

The SCS, in cooperation with the MCFCD, the East Maricopa Natural Resource Conservation District, and the Pinal County Board of Supervisors, is working on a project for watershed protection and flood prevention in the Apache Junction area (Reference 12). This project is called the Buckhorn-Mesa Watershed Project and includes five flood-retarding structures that will control the 100-year flood. Two of these structures, Apache Junction Dam and Weekes Wash Dam, will significantly reduce the flood hazard in Apache Junction. However, the estimated completion date for these dams is 1987.

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

On the west side of San Manuel, large dikes have been constructed that effectively divert runoff around the northern and southern sides of the community.

In the past, the Santa Rosa Wash was the primary flood hazard to Stanfield and Maricopa. In 1974, however, the COE constructed Tat Momolikot Dam which diminished Santa Rosa Wash as a flooding source. Today, the Santa Cruz River system (Figure 2) represents the major flood hazard to Maricopa, while Greene Wash presents the major hazard to Stanfield. Many dikes have been constructed and channels dredged to divert and concentrate floodwater around Stanfield, Desert Carmel, and Maricopa. Most of these structures are privately built, and may be capable of diverting small recurrence interval floods; however, they are generally ineffective against a 100-year or greater flood.

Immediately after the destructive floods of October, 1983, the SCS began reconstructing the dikes that were breached on the Santa Rosa Wash near the Southern Pacific Railroad crossing. The construction included rechannelization and erosion protection on the west bank of the channel. In view of the events in October 1983, it is assumed these improvements will not provide protection from the 100-year flood, due to the restricted capacity of the railroad bridge. It is therefore assumed that this dike will be breached during the 100-year flood.

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 flood plain 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 exceedence) 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 each flooding source studied in detail affecting the county (Reference 16).

Peak discharge data for floods of the selected recurrence intervals for the San Pedro River at Mammoth were developed by the log-Pearson Type III method (Reference 20) employing records from the USGS stream gage at Mammoth cited below. Peak discharge values for the Gila River at Riverside and the San Pedro River at Dudleyville were developed by the USGS (References 21 and 22, respectively) using the log-Pearson Type III method with data from USGS stream gages cited below.

Gage No.	Flooding Source and Location	Period of Record
09474000	Gila River at Kelvin	1911 to 1978[1]
09473500	San Pedro River at Dudleyville	1966 to 1978[1]
09472500	San Pedro River at Mammoth	1926 and 1931 to 1940[2]
09486500	Santa Cruz River at Cortaro	1939 to 1947 and 1950 to 1978
09489000	Santa Cruz Wash near Laveen	1940 to 1978

[1]Plus Historic Information Dating Back to 1890
[2]Plus Historic Information Dating Back to 1906

Stream gage data were not available for Queen Creek and West Branch at Queen Valley and for Big Wash at San Manuel. The SCS TR-20 program was used to develop peak discharge data in these cases (Reference 23). 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 (Reference 24). Peak discharge values are then calculated from an empirical equation relating the time lapse from the start of rainfall to peak discharge. Peak discharge values for Santa Cruz, Santa Rosa, and Greene Washes were taken from an unpublished planning study of the Lower Santa Cruz River (Reference 25), by the COE, Los Angeles District. These values were determined by a routing model using stream gage data from the USGS gages cited earlier.

Peak discharge data 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 Flood Insurance Study (References 1 through 6) for each study area.

The attenuation of peak discharges apparent in Table 2 for the Gila River between Florence and Kearny and for the Santa Cruz River system is due to overbank storage in the flood plain. 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 were used for those study areas. This is also true for the decrease in the 10-year discharge on the San Pedro River from Mammoth to Dudleyville.

The two major flooding sources that affect 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 were thus analyzed separately.

There is no streamflow data available for either Vekol Wash or Vekol Wash Tributary, so the USGS regression analysis (Reference 21) 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.

Table 2. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Gila River at Florence	18,500	19,000[1]	46,000[1]	120,000[1]	230,000[1]
Gila River at Riverside	18,011	26,000[1]	66,000[1]	140,000[1]	240,000[1]
Gila River at Kearny	18,000	28,000[1]	68,000[1]	140,000[1]	240,000[1]
Gila River at Hayden and Winkleman					
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
San Pedro River at Dudleyville	4,471	20,000	38,800	49,600	82,600
San Pedro River at Mammoth	3,610	23,200[1]	38,300[1]	46,800[1]	72,400[1]
Queen Creek					
Upstream of West Branch	1.79	900	1,885	2,215	2,920
West Branch					
At Queen Valley Drive	1.60	530	1,065	1,250	1,630
North Branch Santa Cruz Wash					
At Burris Road	38	4,050	7,900	9,500	12,700
At Pinal Avenue	27	3,400	5,400	7,800	9,500
At Trekell Road	14	2,400	4,700	5,600	7,600

[1]Discharges Increase With Decreasing Drainage Area Due to Overbank Storage

Table 2. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs)			
		10-Year	50-Year	100-Year	500-Year
Weekes Wash					
At North Apache Trail (State Highway 88)	9.37	2,145	5,610	6,480	9,847
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	3,600[1]	6,400[1]	7,800[1]	12,300[1]
At Southern Pacific Railroad	N/A	---	---	9,800	---
Downstream of Southern Pacific Railroad	N/A	---	---	7,600	---
Greene Wash					
At Stanfield	5,961[2]	5,300[1]	9,500[1]	11,800[1]	18,500[1]
Santa Rosa Wash					
At Maricopa	8,100[2]	2,150[1]	4,400[1]	5,800[1]	11,200[1]
Big Wash					
At San Manuel	2.65	745	1,325	1,605	2,290
South Wash					
At San Manuel	2.05	690	1,160	1,380	1,915
Santa Rosa and Santa Cruz Wash					
Upstream of Southern Pacific Railroad	6,159	---	---	24,600	---

[1]Discharges Increase With Decreasing Drainage Area Due to Overbank Storage
[2]Includes Combined Drainage Areas for Santa Cruz Wash and Greene Wash

Table 2. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Culvert Flows					
Between Santa Cruz and Santa Rosa Washes	N/A	---	---	2,200	---
Santa Rosa Wash (Greene Wash)					
At Southern Pacific Railroad	N/A	---	---	14,800	---
Downstream of Southern Pacific Railroad	N/A	---	---	8,500	---
Through Maricopa	N/A	---	---	6,300	---
Vekol Wash Tributary					
At Southern Pacific Railroad	156	---	---	13,700	---
Vekol Wash					
At Southern Pacific Railroad	297	---	---	18,850	---
Vekol Wash and Vekol Wash Tributary Downstream of Southern Pacific Railroad	453	---	---	23,300	---

Stream gaging stations are not present on the Santa Cruz River system near Maricopa. The closest upstream and downstream gages are located at Cortaro and Laveen, respectively (Reference 26). Using available data, including estimates from the October 1983 flood, a log-Pearson Type III discharge-frequency relationship (Reference 20) was determined for these gaging stations (Reference 16). 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 (Reference 21). 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 100-year flood limits in the vicinity of Maricopa (Reference 17).

Approximate hydrologic studies employed regional regression equations to determine discharge-frequency relationships (Reference 21).

Peak discharge-drainage area relationships for the streams studied in detail in Pinal County are shown in Table 2.

3.2 Hydraulic Analyses

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.

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 (Reference 27).

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 (Reference 28).

For 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 (Reference 29). 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 (Reference 30).

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 (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness factors (*Manning's "n"*) used in the hydraulic computations were chosen by engineering judgment based on field observations of the river and flood plain areas. These values ranged from 0.025 to 0.100 for the channels, and from 0.035 to 0.120 for the overbanks.

Starting water-surface elevations in all cases were calculated using the slope-area method.

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).

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 100-year 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.

In the case of North Branch Santa Cruz Wash, distances are also measured along the centerline of the 100-year flow path. However, a Profile Base Line was not established for the wash in the Flood Insurance Study for the City of Casa Grande (Reference 5); therefore, none is presented in this study.

Hydraulic analyses 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 Flood Insurance Study for each study area (References 1 through 6).

For approximate analyses of Big Wash, South Wash at San Manuel, Queen Creek at Queen Valley, Santa Rosa Wash at Stanfield, and 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 downslope 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.

Average flooding depths at Arizona Childrens Colony, Colina del Sol, Lake in the Desert, Randolph, and Twilight Trails were also determined to be less than 1 foot. No defined watercourse exists to concentrate floodflows in these areas, which results in shallow sheetflows. Average flood depths were determined on the basis of previous flooding history, field examination, and engineering judgment.

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 (Reference 27). 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 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 (Reference 31). 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 (Reference 32).

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. Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment based on field observations of the rivers and flood plain areas. These values range from 0.030 to 0.040 for the channels, and from 0.040 to 0.060 for the overbanks in the Vekol Wash and the Santa Rosa Wash areas.

Flow across the flood plain, in the vicinity of Maricopa, is restricted by culverts and bridge crossings along the Southern Pacific Railroad. A backwater effect thus results and the culvert capacities were calculated using hydraulic charts published by the Bureau of Public Works (Reference 33). Where flow exceeded the culvert capacity, flow across the railway was calculated by weir flow equations (Reference 16).

The COE, in an earlier analysis of the Santa Cruz River system, determined that flow within Greene Wash and 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.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the county. For the Gila River at Riverside, San Pedro River at Dudleyville, 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 (Reference 28).

Boundaries of the 100- and 500-year floods for Gila River at Florence, Gila River at Kearny, Gila River at Hayden and Winkelman, North Branch Santa Cruz Wash, and Weekes Wash were taken from the appropriate Flood Insurance Study for each study area (References 1 through 6).

For Santa Cruz Wash at Desert Carmel and Greene Wash at Stanfield, 100-year shallow 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 (Reference 20). Approximate flood boundaries in the immediate vicinity of the shallow flooding described above and for 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 (Reference 30), based on elevations determined by the methods described in Section 3.2.

For Vekol Wash, Vekol Wash Tributaries and 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 (References 31 and 32).

The shallow flooding zone south of State Highway 84, between Greene Wash and Santa Cruz Wash, represents floodwaters that become trapped behind the highway embankment. These flood boundaries were delineated on topographic maps referenced previously (Reference 29) 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 flood 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 (Reference 34), based on the depths determined by the methods described in Section 3.2.

Approximate 100-year flood 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 (Reference 35).

Flood boundaries for the approximate study areas of Arizona Childrens 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 (Reference 36), 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 flood boundaries presented on the Flood Hazard Boundary Map for Pinal County (Reference 37), are adequate and thus, no changes were made.

Approximate 100-year flood boundaries for Mine and School Washes were taken from the Flood Insurance Study for the Town of Superior (Reference 38). Approximate flood boundaries for Weekes Wash, approximately 2,200 feet south of Apache Junction, were taken from the Flood Insurance Study for Apache Junction (Reference 6).

Unpublished work maps for the City of Eloy also presented flood boundaries in unincorporated areas of Pinal County (Reference 39). These Zone A and Zone B boundaries were added to this study at Eloy in the vicinity of Bataglia Drive, Interstate 10, and the Southern Pacific Railroad.

Flood plain boundaries for Vekol Wash, Vekol Wash Tributaries and Santa Rosa Wash are indicated on the Flood Insurance Rate Maps (published separately). On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AO). 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.

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown. Small areas within the flood 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 flood boundaries in some portions of the study area were taken from the Flood Hazard Boundary Map (Reference 37).

4.2 Floodways

Encroachment on flood plains, 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 flood plain management involves balancing the economic gain from flood plain 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 flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year 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 study 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 study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

For Vekol Wash, Vekol Wash Tributaries and 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 flood plain 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.

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 Flood Insurance Study for each study area (References 1 through 6). 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 Flood Insurance Study for the Town of Hayden (Reference 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 3.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Gila River at Florence								
A	156.660	2,701	17,691	6.8	1,466.2	1,466.2	1,467.2	1.0
B	156.790	3,009	19,546	6.1	1,467.5	1,467.5	1,468.5	1.0
C	156.870	3,059	18,872	6.4	1,468.2	1,468.2	1,469.1	0.9
D	156.950	3,230	19,257	6.2	1,469.0	1,469.0	1,469.9	0.9
E	157.010	3,300	19,778	6.1	1,469.6	1,469.6	1,470.3	0.7
F	157.160	3,183	17,867	6.7	1,470.9	1,470.9	1,471.7	0.8
G	157.370	3,352	14,813	8.1	1,473.4	1,473.4	1,474.3	0.9
H	157.580	4,209	22,483	5.3	1,476.5	1,476.5	1,477.4	0.9
I	157.740	4,373/ 3,403[2]	25,642	4.7	1,477.7	1,477.7	1,478.5	0.8
L	158.080	4,786	38,783	3.1	1,482.9	1,482.9	1,483.4	0.5
M	158.130	4,858	37,984	3.2	1,483.0	1,483.0	1,483.5	0.5
Gila River at Riverside								
A	185.733	821	24,354	5.7	1,793.4	1,793.4	1,794.3	0.9
B	185.824	817	25,510	5.5	1,793.7	1,793.7	1,794.6	0.9
C	185.899	776	24,163	5.8	1,793.8	1,793.8	1,794.7	0.9
D	186.000	699	20,978	6.7	1,794.0	1,794.0	1,794.9	0.9
E	186.143	748	19,646	7.1	1,794.8	1,794.8	1,795.6	0.8
F	186.276	813	21,581	6.5	1,795.9	1,795.9	1,796.7	0.8
G	186.376	865	21,944	6.4	1,796.5	1,796.5	1,797.3	0.8
H	186.490	917	23,534	5.9	1,797.3	1,797.3	1,798.1	0.8
I	186.630	821	20,877	6.7	1,798.0	1,798.0	1,798.7	0.7
J	186.721	837	22,536	6.2	1,798.9	1,798.9	1,799.6	0.7

[1]Miles Above Painted Rock Dam [2]Width/Width Within Study Area

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

GILA RIVER AT FLORENCE - GILA RIVER AT RIVERSIDE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Gila River at Riverside (Cont'd)								
K	186.802	836	22,722	6.2	1,799.4	1,799.4	1,800.1	0.7
L	186.902	783	22,870	6.1	1,800.0	1,800.0	1,800.7	0.7
M	186.974	710	20,720	6.8	1,800.3	1,800.3	1,801.0	0.7
Gila River at Kearny								
A	190.750	2,549	35,332	4.2	1,812.8	1,812.8	1,813.8	1.0
B	191.050	3,630/3,465[2]	44,056	3.4	1,814.6	1,814.6	1,815.6	1.0
C	191.230	3,131/2,961[2]	35,074	4.3	1,815.1	1,815.1	1,816.1	1.0
D	191.420	2,510/2,300[2]	24,568	6.1	1,815.6	1,815.6	1,816.5	0.9
E	191.590	2,224/1,624[2]	15,901	9.4	1,817.0	1,817.0	1,817.9	0.9
F	191.770	1530/250[2]	15,252	9.8	1,820.9	1,820.9	1,821.3	0.4
H	192.070	1789/359[2]	25,364	5.9	1,830.1	1,830.1	1,830.8	0.7
I	192.270	1,615/1,135[2]	25,476	5.9	1,832.0	1,832.0	1,832.7	0.7
M	193.390	2031/0[2]	26,053	5.8	1,838.2	1,838.2	1,839.2	1.0
N	193.490	2271/0[2]	27,618	5.4	1,838.8	1,838.8	1,839.8	1.0
O	193.640	1,950	24,081	6.2	1,839.8	1,839.8	1,840.8	1.0
P	193.750	1,456	17,528	8.6	1,840.8	1,840.8	1,841.7	0.9

[1] Miles Above Painted Rock Dam [2] Width/Width Within Study Area

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

GILA RIVER AT RIVERSIDE-GILA RIVER AT KEARNY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Gila River at Hayden and Winkelman								
F	4,040	1,719/ 1,560	20,307	5.19	1,928.9	1,928.9	1,929.9	1.0
G	4,855	1,120/ 970	15,710	7.64	1,930.8	1,930.8	1,931.8	1.0
H	5,215	960/ 770	13,413	8.95	1,932.1	1,932.1	1,932.9	0.8
I	5,715	716/ 290	11,641	10.31	1,933.3	1,933.3	1,934.2	0.9
J	6,230	1,120/ 255	18,442	6.51	1,936.2	1,936.2	1,936.8	0.6
K	6,675	1,195/ 135	19,609	6.12	1,936.7	1,936.7	1,937.6	0.9
L	7,535	1,439/ 160	20,956	5.73	1,938.2	1,938.2	1,939.1	0.9
M	8,160	1,636/ 480	24,311	4.94	1,939.7	1,939.7	1,940.7	1.0
N	8,500	1,905/ 610	27,512	4.36	1,940.2	1,940.2	1,941.2	1.0
O	9,320	2,144/ 525	28,538	4.20	1,941.0	1,941.0	1,942.0	1.0

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

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

GILA RIVER AT HAYDEN AND WINKELMAN

TABLE 3

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
San Pedro River At Dudleyville								
A	12,000	1,602	9,570	5.2	1,951.5	1,951.5	1,952.5	1.0
B	12,870	1,565	9,267	5.4	1,953.8	1,953.8	1,954.8	1.0
C	13,700	1,235	6,447	7.7	1,956.1	1,956.1	1,957.0	0.9
D	15,280	1,170	6,373	7.8	1,961.7	1,961.7	1,962.6	0.9
E	16,150	1,320	7,758	6.4	1,964.5	1,964.5	1,965.3	0.8
F	17,500	1,060	5,466	9.1	1,968.9	1,968.9	1,969.1	0.2
G	18,970	980	6,373	7.8	1,974.5	1,974.5	1,975.1	0.6
H	20,270	980	6,121	8.1	1,979.0	1,979.0	1,979.0	0.0
I	21,140	998	6,798	7.3	1,981.6	1,981.6	1,981.8	0.2
J	21,740	1,140	6,196	8.0	1,983.0	1,983.0	1,983.7	0.7
K	22,760	1,145	7,824	6.3	1,988.7	1,988.7	1,989.0	0.3
L	24,180	1,520	8,370	5.9	1,993.3	1,993.3	1,994.0	0.7
M	25,380	1,230	4,932	10.1	1,997.2	1,997.2	1,997.8	0.6
N	26,980	1,360	8,310	6.0	2,003.4	2,003.4	2,003.9	0.5
O	28,040	1,360	5,731	8.7	2,006.3	2,006.3	2,006.6	0.3
P	29,490	1,010	6,562	7.6	2,014.3	2,014.3	2,014.8	0.5
Q	30,890	1,377	10,667	4.6	2,019.6	2,019.6	2,020.3	0.7
R	32,490	2,001	13,123	3.8	2,024.5	2,024.5	2,025.5	1.0
S	33,530	1460/370[2]	7,372	6.7	2,027.2	2,027.2	2,027.8	0.6
T	34,410	1330/340[2]	5,149	9.6	2,031.5	2,031.5	2,031.8	0.3
U	35,750	1885/0[2]	9,207	5.4	2,039.3	2,039.3	2,040.0	0.7
V	36,970	1,715/ 1,360[2]	7,103	7.0	2,044.0	2,044.0	2,044.1	0.1
W	38,230	1,710/ 1,510[2]	8,043	6.2	2,049.2	2,049.2	2,049.5	0.3
X	39,530	1,615	7,352	6.7	2,054.1	2,054.1	2,054.6	0.5
Y	41,230	1,400	7,925	6.3	2,062.4	2,062.4	2,063.2	0.8

[1] Feet Above Mouth Along Profile Base Line   [2] Width/Width Within Study Area

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN PEDRO RIVER AT DUDLEYVILLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
San Pedro River At Mammoth								
A	100,000	1,960	8,661	5.4	2,311.4	2,311.4	2,311.9	0.5
B	100,650	1,860	7,357	6.4	2,313.7	2,313.7	2,314.3	0.6
C	101,400	1,370	6,408	7.3	2,316.8	2,316.8	2,317.7	0.9
D	102,030	815	5,274	8.9	2,319.7	2,319.7	2,320.6	0.9
E	102,850	340	2,893	16.2	2,323.4	2,323.4	2,323.5	0.1
F	102,890	351	3,664	12.8	2,325.5	2,325.5	2,325.8	0.3
G	103,220	500	5,125	9.1	2,328.5	2,328.5	2,328.5	0.0
H	103,730	740	7,362	6.4	2,329.4	2,329.4	2,329.5	0.1
I	104,420	693	6,016	7.8	2,330.4	2,330.4	2,330.8	0.4
J	104,950	680	5,411	8.6	2,331.7	2,331.7	2,332.3	0.6
K	105,750	783/650[2]	7,599	6.2	2,334.3	2,334.3	2,335.2	0.9
L	106,230	850	7,302	6.4	2,335.5	2,335.5	2,336.5	1.0
M	106,630	1,045	8,066	5.8	2,336.7	2,336.7	2,337.6	0.9
N	107,220	1,467	11,255	4.2	2,338.1	2,338.1	2,339.1	1.0
O	107,750	1,763	12,280	3.8	2,338.9	2,338.9	2,339.8	0.9
P	108,440	1,940/1,690[2]	9,075	5.2	2,340.5	2,340.5	2,341.2	0.7
Q	109,360	2,000/1,900[2]	10,456	4.5	2,344.8	2,344.8	2,345.7	0.9
R	110,130	1,906/1,620[2]	10,858	4.3	2,347.2	2,347.2	2,348.1	0.9
S	110,690	1,700/1,330[2]	9,839	4.8	2,348.5	2,348.5	2,349.5	1.0
T	111,320	1,341/1,150[2]	8,303	5.6	2,350.0	2,350.0	2,350.8	0.8

[1] Feet Above Mouth Along Profile Base Line [2] Width/Width Within Study Area

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN PEDRO RIVER AT MAMMOTH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
San Pedro River At Mammoth (Cont'd)								
U	111,780[1]	1,122	6,940	6.7	2,351.4	2,351.4	2,352.3	0.9
V	112,480[1]	1,023	7,194	6.5	2,353.7	2,353.7	2,354.4	0.7
W	113,120[1]	1,260	7,764	6.0	2,355.4	2,355.4	2,356.2	0.8
X	113,730[1]	1,304	7,834	6.0	2,357.6	2,357.6	2,358.2	0.6
Y	114,370[1]	1,320	7,061	6.6	2,359.1	2,359.1	2,359.8	0.7
Z	115,050[1]	1,495	7,921	5.9	2,361.8	2,361.8	2,362.5	0.7
AA	115,950[1]	1,465	8,828	5.3	2,365.4	2,365.4	2,366.4	1.0
Queen Creek								
A	154,000[2]	100	390	7.9	1,992.4	1,992.4	1,993.0	0.6
B	154,630[2]	106	464	6.7	1,995.6	1,995.6	1,996.1	0.5
C	155,020[2]	68	289	10.7	1,998.2	1,998.2	1,998.2	0.0
D	155,740[2]	62	277	7.4	2,004.7	2,004.7	2,004.7	0.0
E	155,970[2]	41	182	11.3	2,005.5	2,005.5	2,005.5	0.0
F	156,080[2]	86	315	6.5	2,009.7	2,009.7	2,009.7	0.0
G	156,280[2]	106	384	5.4	2,010.7	2,010.7	2,010.7	0.0
H	156,680[2]	85	221	9.3	2,012.8	2,012.8	2,012.8	0.0
I	157,200[2]	95	202	6.4	2,016.5	2,016.5	2,016.5	0.0
J	157,660[2]	78	197	9.5	2,020.7	2,020.7	2,020.7	0.0
K	157,910[2]	98	382	4.9	2,021.9	2,021.9	2,022.6	0.7
L	158,080[2]	120	746	2.5	2,028.3	2,028.3	2,028.3	0.0
M	158,230[2]	74	412	4.5	2,028.3	2,028.3	2,028.3	0.0
N	158,820[2]	81	287	6.5	2,028.3	2,028.3	2,029.0	0.7
O	159,290[2]	107	190	7.1	2,033.3	2,033.3	2,033.3	0.0
P	159,920[2]	205	264	1.9	2,038.5	2,038.5	2,038.8	0.3
Q	160,140[2]	125	99	5.1	2,044.8	2,044.8	2,044.8	0.0

[1] Feet Above Mouth Along Profile Base Line [2] Feet Above Confluence With Roosevelt Canal

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN PEDRO RIVER AT MAMMOTH-QUEEN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Weekes Wash								
A	13,990	503	1,017	6.7	1,872.8	1,872.8	1,873.8	1.0
B	14,790	439	967	7.1	1,881.6	1,881.6	1,882.5	0.9
C	15,510	400	972	7.0	1,889.0	1,889.0	1,889.4	0.4
D	16,240	260	799	8.6	1,897.8	1,897.8	1,897.8	0.0
E	17,190	492	950	7.2	1,906.8	1,906.8	1,906.8	0.0
F	17,610	884	1,590	4.3	1,913.2	1,913.2	1,913.2	0.0
G	17,710	780	3,177	2.2	1,916.4	1,916.4	1,916.4	0.0
H	17,940	500	1,670	4.1	1,916.5	1,916.5	1,916.5	0.0
I	18,790	381	825	8.3	1,924.7	1,924.7	1,924.7	0.0
J	19,940	247	786	8.7	1,935.7	1,935.7	1,935.8	0.1
K	20,740	296	751	9.1	1,946.8	1,946.8	1,946.8	0.0
L	21,390	526	1,022	6.7	1,954.3	1,954.3	1,954.3	0.0

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

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

WEEKES WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
West Branch								
A	70[1]	20	127	9.8	1,999.6	1,999.6	1,999.6	0.0
B	250[1]	20	128	9.7	2,000.6	2,000.6	2,000.6	0.0
C	510[1]	20	137	9.1	2,002.1	2,002.1	2,002.1	0.0
D	800[1]	96	178	7.0	2,005.3	2,005.3	2,005.8	0.5
E	1,330[1]	210	358	3.5	2,007.5	2,007.5	2,008.4	0.9
F	1,860[1]	51	140	8.9	2,012.6	2,012.6	2,012.6	0.0
G	2,220[1]	37	127	9.9	2,017.4	2,017.4	2,017.4	0.0
H	2,440[1]	51	134	9.3	2,019.9	2,019.9	2,019.9	0.0
I	3,060[1]	154	204	6.1	2,026.9	2,026.9	2,026.9	0.0
J	3,334[1]	108	123	3.3	2,029.3	2,029.3	2,029.3	0.0
K	3,880[1]	77	72	5.5	2,036.5	2,036.5	2,036.5	0.0
L	4,330[1]	65	69	5.8	2,044.7	2,044.7	2,044.7	0.0
North Branch Santa Cruz Wash								
A	1,730[2]	800/710[3]	2,120	3.7	1,365.4	1,365.4	1,366.1	0.7
B	2,800[2]	880/550[3]	3,700	2.1	1,368.4	1,368.4	1,369.4	1.0
C	3,988[2]	920/570[3]	3,680	2.1	1,370.9	1,370.9	1,371.9	1.0
D	5,030[2]	800/650[3]	2,930	2.7	1,373.5	1,373.5	1,374.5	1.0
E	6,500[2]	650/480[3]	3,030	2.6	1,376.4	1,376.4	1,377.1	0.7
F	7,862[2]	700/470[3]	2,400	3.3	1,378.5	1,378.5	1,379.2	0.7
G	9,167[2]	750/420[3]	2,410	3.3	1,380.9	1,380.9	1,381.7	0.8
N	15,514[2]	1000/490[3]	2,700	2.1	1,389.9	1,389.9	1,390.7	0.8
O	16,808[2]	1200/240[3]	3,280	1.7	1,390.5	1,390.5	1,391.5	1.0

[1] Feet Above Mouth [2] Feet Above City of Casa Grande West Corporate Limits (Extended)
[3] Width/Width Within Study Area

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOODWAY DATA

WEST BRANCH-NORTH BRANCH SANTA CRUZ WASH

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Gila River at Florence							
Reach 1	0514	-4.1	-2.5	2.2	040	A8	Varies - See Map
Gila River at Riverside							
Reach 1	0554	-18.3	-9.3	8.0	180	A28	Varies - See Map
Gila River at Kearny							
Reach 1	0566,0568	-8.1	-4.6	3.6	080	A16	Varies - See Map
Gila River at Hayden and Winkleman							
Reach 1	0803,0804	-8.4	-4.2	6.1	085	A17	Varies - See Map
Reach 2	0804	-7.5	-3.5	4.1	075	A15	Varies - See Map
Reach 3	0804	-9.4	-4.2	5.7	095	A19	Varies - See Map
San Pedro River at Dudleyville							
Reach 1	0804,0812 0814,0818	-2.3	-0.7	1.8	025	A5	Varies - See Map
San Pedro River at Mammoth							
Reach 1	1257,1259	-2.3	-0.7	2.0	025	A5	Varies - See Map
Queen Creek							
Reach 1	0307	-1.4	-0.3	0.5	015	A3	Varies - See Map
Reach 2	0307	-2.6	-0.6	0.8	025	A5	Varies - See Map
Reach 3	0307	-0.9	-0.2	0.4	010	A2	Varies - See Map

[1] Flood Insurance Rate Map Panel [2] Weighted Average [3] Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

GILA RIVER AT FLORENCE-GILA RIVER AT RIVERSIDE-GILA RIVER AT KEARNY-GILA RIVER AT HAYDEN AND WINKELMAN-SAN PEDRO RIVER AT DUDLEYVILLE-SAN PEDRO RIVER AT MAMMOTH-QUEEN CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND 10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)	FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
West Branch							
Reach 1	0307	-2.8	-0.6	1.4	030	A6	Varies - See Map
Reach 2	0307	-1.2	-0.2	0.5	010	A2	Varies - See Map
Reach 3	0144,0307	-0.6	-0.1	0.2	005	A1	Varies - See Map
North Branch Santa Cruz Wash							
Reach 1	0695	-0.8	-0.2	0.4	010	A2	Varies - See Map
Weekes Wash							
Reach 1	0019,0107	-1.2	-0.2	0.5	010	A2	Varies - See Map
Reach 2	0019	-2.7	-0.5	0.8	025	A5	Varies - See Map
Santa Cruz Wash							
Shallow Flooding	0700,0900 0925	N/A	N/A	N/A	N/A	A0	Depth 2
Greene Wash							
Shallow Flooding	0675,0900	N/A	N/A	N/A	N/A	A0	Depth 2
Santa Rosa Wash							
Shallow Flooding	0450,0675	N/A	N/A	N/A	N/A	A0	Varies - See Map
Vekol Wash							
Shallow Flooding	0450,0675	N/A	N/A	N/A	N/A	A0	Varies - See Map
Ponding	0450	N/A	N/A	N/A	035	A7	1152
Vekol Wash Tributary							
Shallow Flooding	0450,0675	N/A	N/A	N/A	N/A	A0	Varies - See Map

[1] Flood Insurance Rate Map Panel [2] Weighted Average [3] Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

PINAL COUNTY, AZ
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

WEST BRANCH-NORTH BRANCH SANTA CRUZ WASH-WEEKES WASH-SANTA CRUZ WASH-GREENE WASH-SANTA ROSA WASH-VEKOL WASH-VEKOL WASH TRIBUTARY

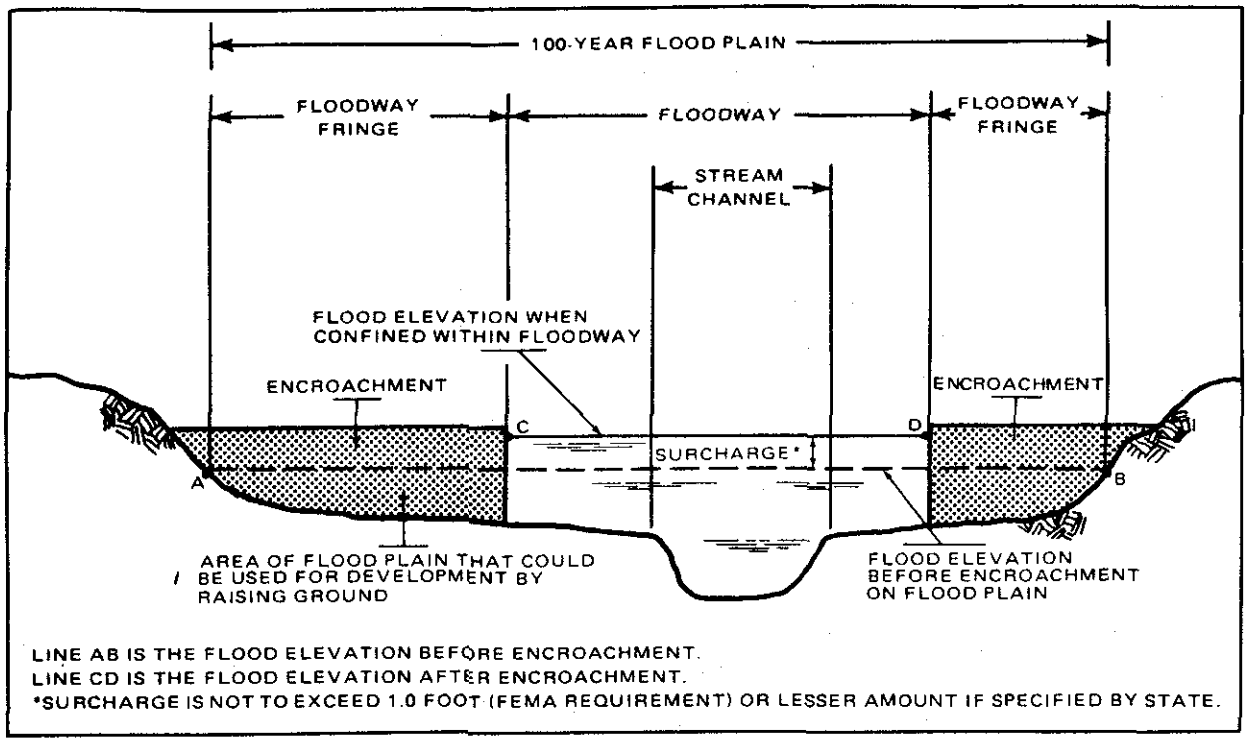

Figure 3. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the unincorporated areas of Pinal County, Arizona.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard. In riverine areas, reaches are based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of Pinal County are shown on the Flood Profiles (Exhibit 1), and the reaches are summarized in Table 4.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10-and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot. For the A7 zone area located immediately upstream of the Southern Pacific Railroad on Vekol Wash, the FHF was determined from the average difference between the ground and the BFE, since for this shallow flooding area, no elevations were computed for the 10-, 50-, and 500-year flood.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.
Zones A1-A3, A5-A8, A15-A17,and A28:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.
Zone D:	Areas of undetermined, but possible flood hazard.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the unincorporated areas of Pinal County, Arizona, is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

Flood Insurance Studies have been completed or are in the progress for the Cities of Casa Grande and Apache Junction (References 5 and 6, respectively); the Towns of Florence, Kearny, Hayden, Winkelman, and Superior (References 1, 2, 3, 4, and 38, respectively); and the unincorporated areas of Maricopa and Pima Counties (References 40 and 41, respectively).

Due to differences in the scope of study, the Flood Insurance Studies for Apache Junction, Casa Grande, and Maricopa County are not entirely in agreement with this study. Areas designated as Zones A and B in Apache Junction are adjacent to areas designated as Zone C in Pinal County. A large area north of North Branch Santa Cruz Wash in Casa Grande has been designated as Zone B. Except for Colina del Sol, the adjoining areas of Pinal County are Zone C. Areas of Maricopa County designated as Zone B adjoin areas of Pinal County designated as Zones A and C. Allowing for these exceptions, the Flood Insurance Studies listed above are in agreement with this study.

The Flood Insurance Studies for Apache Junction, Casa Grande, Florence, Hayden, Kearny, and Winkelman were used as sources of data for detailed-study areas in this study. The Flood Insurance Studies for Apache Junction and Superior were sources of additional approximate flood boundaries. Therefore, they are in agreement with this study.

An unpublished report on the lower Santa Cruz River basin by the COE (Reference 25) was used as a source of discharge data and some approximate flood boundaries for Santa Cruz, Santa Rosa, and Greene Washes. Two reports by the USGS were used as sources of peak discharge-frequency data on Gila and San Pedro Rivers for this study (References 21 and 22); therefore, they are in agreement with this study.

A Flood Insurance Study was prepared for the Town of Mammoth. Due to minimal flooding in only undeveloped areas of the town, officials of the community and Federal Emergency Management Agency agreed to convert Mammoth to the Regular Flood Insurance Program with only a Flood Insurance Rate Map (Reference 42). This map shows 100-year approximate flood boundaries based on the study contractor's detailed study. However, detailed flood and floodway boundaries are shown in the unincorporated areas of Pinal County adjacent to the town.

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Insurance Study for the unincorporated areas of Pinal County, Arizona (Reference 43).

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

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Building 105, Presidio of San Francisco, San Francisco, California 94129.

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