Comprehensive Flood Control Program Report

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Flood Control District
of
Maricopa County

Comprehensive Flood Control Program Report

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March, 1990

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I

Introduction

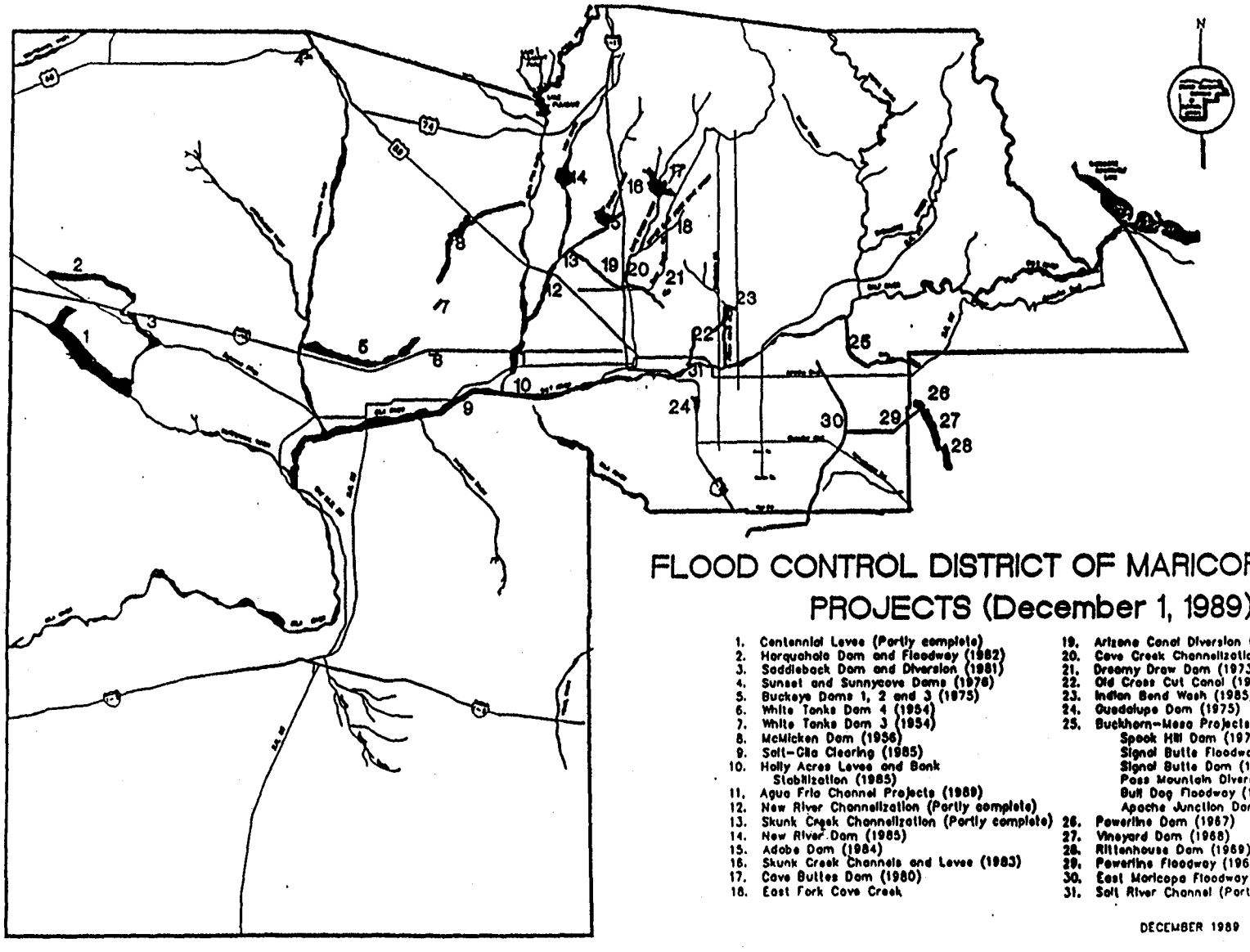
The Comprehensive Flood Control Program Report of 1963 was the culmination of several general area studies that identified flooding problems in Maricopa County. At that time 35 watersheds were delineated on which flooding problems were defined and potential structural solutions proposed. The plan listed 40 flood control projects. The Comprehensive Plan has been the cornerstone for most work performed by The Flood Control District of Maricopa County to date.

Furthermore, the plan designated through engineering economics which of the 40 projects were considered viable at that time and which should be deferred for future consideration. The plan also included potential federal funding mechanisms that could be used in conjunction with local funds to build the projects.

At that time, the District operated under the authority of ARS Article 5, §§ 45-2351 to 45-2371, and was charged with the responsibility of building, operating, and maintaining the projects recommended in the 1963 report. It was further recognized that the District would ultimately construct, operate, and maintain other projects not identified in the plan. Also, projects built by others, such as McMicken Dam, would be operated and maintained by the District, thereby increasing the expenditure of operation funds.

Since 1963 Maricopa County and the District have changed considerably. Some of those changes include:

- The population is now 2,069,000 (versus 614,000 in 1963).
- Non-structural flood control programs are now used in conjunction with structural solutions.
- The District operates and maintains over 29 flood control facilities.
- Annual tax revenues have increased from $250,000 in 1961 to $51,000,000 in 1989; along with tax rate increases from $0.05 to $0.43 per $100 assessed value.
- The District has constructed entirely or in part 15 of the 40 projects listed in 1963 (5 projects have been incorporated into other projects or eliminated, and 20 other projects have not been constructed).



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
PROJECTS (December 1, 1989)

1. Centennial Levee (Partly complete)
2. Hassayampa Dam and Floodway (1982)
3. Saddleback Dam and Diversion (1981)
4. Sunset and Sunnycove Dams (1978)
5. Buckeye Dams 1, 2 and 3 (1975)
6. White Tanks Dam 4 (1954)
7. White Tanks Dam 3 (1954)
8. McMicken Dam (1956)
9. Salt-Gila Clearing (1985)
10. Holly Acres Levee and Bank Stabilization (1985)
11. Agua Fria Channel Projects (1989)
12. New River Channelization (Partly complete)
13. Skunk Creek Channelization (Partly complete)
14. New River Dam (1985)
15. Adobe Dam (1984)
16. Skunk Creek Channels and Levee (1983)
17. Cave Buttes Dam (1980)
18. East Fork Cave Creek
19. Arizona Canal Diversion Channel (Partly complete)
20. Cave Creek Channelization (Partly complete)
21. Dreamy Draw Dam (1973)
22. Old Cross Cut Canal (1975) (Restudy)
23. Indian Bend Wash (1985)
24. Guadalupe Dam (1975)
25. Buckhorn-Mesa Projects:
    - Spook Hill Dam (1979)
    - Signal Butte Floodway (1984)
    - Signal Butte Dam (1987)
    - Pass Mountain Diversion (1987)
    - Bull Dog Floodway (1988)
    - Apache Junction Dam (1988)
26. Powerline Dam (1967)
27. Vineyard Dam (1968)
28. Rittenhouse Dam (1969)
29. Powerline Floodway (1968)
30. East Maricopa Floodway (1989)
31. Salt River Channel (Partly Complete)

DECEMBER 1989

However, two things have not changed: Maricopa County continues to experience rapid growth resulting in increased flooding problems; and, a number of the flooding problems identified in 1963 have not been resolved.

The objectives of this report are to:

1. Update and report on progress toward implementing the *Comprehensive Flood Control Program Report of 1963*; and
2. Identify potential projects from sources more recent than the 1963 Comprehensive Plan.

Future Efforts

The flooding problems, in terms of potential projects, identified in this status report will be analyzed by the District's Planning and Project Management Division. The Planning and Project Management Division will proceed with project implementation for each of the projects which receive a favorable evaluation. The first step in implementation is obtaining approval and a recommendation from the Flood Control Advisory Board, followed by obtaining approval and authority to proceed with the project from the Board of Directors. Project implementation will include, but not be limited to: developing benefit/cost analyses for each alternative that warrants further consideration; identifiying potential partners interested in project funding participation; managing project and design studies; incorporating these projects into the five year capital improvement budget; developing land acquisition schedules; and coordinating all project activities. The Planning and Project Management Division will be assisted as required by all other divisions of the District.

The Watershed Management Branch of the Hydrology Division, in coordination with the Planning and Project Management Division, will prepare a list of additional flooding problems for each of the 35 watersheds. These watershed boundaries, with some modification, follow the boundaries used in the 1963 Comprehensive Plan. The Watershed Management Branch will suggest alternative structural and non-structural solutions for each problem. The problem definition phase will include the development and/or use of watershed hydrology, floodplain mapping, flood damage reports, and other sources from which potential flood damages can be assessed.

II

The 1963 Comprehensive Plan

Background

Even before the *Comprehensive Flood Control Program Report of 1963* was published, there had been many contributors to the study of flood control in Maricopa County. On October 31, 1957, Flood Protection Improvement Committee was appointed by the City of Phoenix, the Board of Supervisors of Maricopa County, and the Board of Directors of the Salt River Project. This committee was directed to prepare a general plan of flood control for the greater Phoenix area and recommend methods for financing, construction, and operation of major flood protection works for the benefit of all people. Creation of this committee constituted one of the first organized efforts to solve Maricopa County's flooding problems. It also provided the main impetus for formation of the present Flood Control District to serve all of Maricopa County; the Flood Control District was created on August 3, 1959, by the Board of Supervisors.

The *Comprehensive Flood Control Program Report of 1963* listed the major flood control problems for Maricopa County (all 9,226 square miles). In addition, the report contained recommendations to prevent or minimize damage and cost estimates for necessary structures. Although the prime objective of the report was to identify flood control problems, other concerns included: erosion control, recreation, irrigation, water storage, and ground water recharge.

Because the Gila and Salt River Basin is the main natural drain system for the County, virtually all stormwater flows to the southwest—into this system. The main tributaries are: the Verde River, Indian Bend Wash, Cave Creek, Skunk Creek, New River, the Agua Fria River, the Hassayampa River, and Centennial Wash. Then, as now, the major flooding problems occurred near the urban population concentrations.

The 1963 Report consisted of years of research into the flooding problems in Maricopa County. In order to provide a historical perspective for past and current flooding problems, this section reviews the previous report and outlines the progress made for each project included in it.

Review and Update

In this section, we provide the area and project descriptions, project data, and summary tables that were presented in the 1963 Report. Project costs are all given in 1963 dollars. Current information regarding viability and construction is presented under the heading "1989 Update."

Salt River Channel

Taming the Salt River has been the high priority for the Flood Control District since its inception. Because the Salt River flows through several highly developed communities and several major thoroughfares, keeping floodwaters within its banks has always been a goal. The 1963 Report presented the following challenge: "In order for the comprehensive plan for Flood Control in Maricopa County to be successful, there must be some solution presented for controlling the Salt River."

The plans proposed for alleviating the Salt River problem all hinged on building Maxwell (Orme) Dam (see page 18). The plan recommended by the U.S. Army Corps of Engineers was based on a regulated discharge from Maxwell Dam of approximately 82,000 cfs. Three alternate plans were conceived, yet they, too, were based on the plan to build Maxwell Dam.

The 1963 plan called for study by the Corps of Engineers and outlined the following recommendations:

a. Construct short levees along the Salt River between 40th Street in Phoenix to Tempe Butte in Tempe. Includes clearing the channel of vegetation along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam.

b. As an alternate to the plan above, the Flood Control District recommends the following: channel clearing from Gillespie Dam to 91st Avenue and a lined channel from this point up the river to Country Club Drive in Mesa, then clearing the channel to Granite Reef Dam.

1989 Update

- The clearing project began in 1980 and a maintenance program has been established. The channel clearing project currently extends the entire distance from Gillespie Dam on the Gila River upstream to 91st Avenue, with the exception of a few short reaches which will soon be cleared. In addition, a pilot channel project within the vegetative clearing began in 1988. The channel will accomodate low flows up to 3,000 cfs. The pilot channel currently extends from just downstream of the State Highway 85 bridge up to Rainbow Road. The reach from Tuthill Road to Sarival Avenue is currently under design/construction. Ultimately, the pilot channel will also extend from Gillespie Dam to 91st Avenue.
- The City of Phoenix has stabilized the channel from I-10 to 40th Street.
- ADOT is in the process of excavating and stabilizing the channel from 40th Street to Mill Avenue. When complete, the District will operate and maintain the channel.
- ADOT, the Flood Control District, and the City of Tempe are channelizing the river from Mill Avenue, east to McClintock Drive. This project is currently in the design phase and will be completed in 1990. Construction will immediately follow the

design phase and will be integrated with ADOT's construction schedule for the Papago Freeway. The channelization should be complete by 1993.

- The reach of the Salt River from McClintock Drive east to Price Road is also being considered for channelization by the same three agencies along with input from the Salt River Pima-Maricopa Indian Community. Conceptual plans should be finalized by the end of 1990 with design and construction to follow immediately.
- The City of Tempe is planning the Tempe Rio Salado project which would modify plans to stabilize the channel banks of the Salt River. The Tempe Community Development project and associated amenities will follow the channelization of the Salt River by ADOT, the District, and Tempe. Tempe will be responsible for the modifications. The District will review the project for hydraulic compatibility with the other parts of the channel.
- The Salt River Pima-Maricopa Indian Community has developed plans to agressively excavate the sand and gravel resources resulting in a *de facto* channel between Granite Reef Dam and Tempe.
- The Corps of Engineers has completed a RECON level study for the Salt/Gila Rivers. The cost/benefit analysis found that there is no justified Federal participation in structural flood control projects along the Salt/Gila Rivers.

Salt River Channel Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
1	Gillespie Dam to 107th Avenue	Channel Clearing	250,000	1,000,000	1,250,000
31	Salt River, Granite Reef to 107th Avenue	Lined Channel	2,679,000	30,261,000	32,940,000

Sols Wash Channel

Sols Wash is located in the "Lower Hassayampa Area," defined in the 1963 Report as the north-central part of Maricopa County, below the Box Canyon Dam Site. The Lower Hassayampa is one of the County's larger drainage areas, containing 1,060 square miles. It is characterized by steep mountains blending into foothills and eventually into a broad valley. From Box Canyon at Morristown to its junction with the Gila River, the Hassayampa River flows through a relatively flat sandy plain. In 1963, the plans for flood protection in the Lower Hassayampa area were all for the Wickenburg area.

The 1963 Report called for the Flood Control District to study the Sols Wash Channel plan which consisted of:

a. Channel clearing and excavation beginning at Highway U.S. 89 and extending west to Flying "E" Wash; then up Flying "E" Wash to a point above the Wickenburg Country Club.

b. Channel clearing will consist of removal of all brush, trees and debris.

c. Excavation will consist of digging a pilot channel for the total length of clearing.

d. Total planned channel work will cover approximately 2 miles.

1989 Update

- There has been no action taken on this project. Vegetative growth has taken place in the channel as well as development along the banks. This project is to be included in the Wickenburg ADMS, fiscal year (FY) 90/91, and the Corps has requested Congressional funding for a RECON study in FY 90/91.

Sols Wash Channel Summary Table

Drainage Area	Location	Job Description	Costs (1963) FCD	Other	Total
7	Sols Wash	Channel Alignment & Protection	40,000	-0-	40,000

Powder House Wash Dam

Powder House Wash can also be found in the "Lower Hassayampa Area." It enters the Hassayampa River on the east side, within the town of Wickenburg.

In 1963, the area along the lower reaches of the wash was described as "a highly developed area, including motels, service stations, private homes and other properties. Heavy runoff causes considerable damage to this developed area." The area was studied by the Corps of Engineers and the following plan was recommended:

a. Construction of an earth-fill dam on the wash northeast of Wickenburg. The dam would be approximately 35 feet high and store 150 acre-feet of flood water.

b. Related outlet works and emergency spillway.

1989 Update

- No action has been taken. Development has occurred in the floodplain. This project is to be included in the Wickenburg ADMS, FY 90/91, and the Corps has requested Congressional funding for a RECON study in FY 90/91.

Powder House Wash Dam Summary Table

Drainage Area	Location	Job Description	Costs (1963) FCD	Other	Total
7	Powder House Wash	Earth Dam	50,000	82,000	132,000

Casandro Wash Dam

Also located in the Lower Hassayampa Area, Casandro wash was described as a 1.5 square mile area beginning near Vulture Mine Road, north of Los Caballeros guest ranch, about a mile south of U.S. Highway 60. Because the terrain was rocky with steep grades, runoff was considerably greater than the normal ratio of runoff to rainfall.

The Flood Control District studied the problems and made the following recommendations in the 1963 report:

a. Construction of an earth-fill dam across the wash north of U.S. Highway 60 and just west of the city of Wickenburg. Maximum height of the dam will be 34 feet and planned flood water storage is 90 acre-feet.

b. Related outlet works and emergency spillway.

1989 Update

- No action has been taken. In 1980 the Community Development Agency for the County conducted a study recommending construction of the dam. This project is to be included in the Wickenburg ADMS, FY 90/91, and the Corps has requested Congressional funding for a RECON study in FY 90/91.

Casandro Wash Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
7	Casandro Wash	Earth Dam	60,000	-0-	60,000

Sunset and Sunny Cove Dams

These two small washes orginate near Vulture Mine Road and run northeast, entering the Hassayampa River. A high velocity of water is the result of steep hills and rocky terrain. After a Flood Control District study, the following was recommended:

a. Construction of an earth-fill dam on each of these two small washes. Height of these dams is approximately 20 feet and total storage of both reservoirs is 137 acre-feet.

b. Related outlet works and emergency spillway.

1989 Update

- Both dams have been constructed; Final Acceptance Date: September 15, 1976
- Development is ongoing upstream and downstream of the dams. The District will need to maintain the conveyance corridors into and out of the structures. Currently proposed floodplain delineations will maintain the 100 year floodplains.
- Discharges from spillways need to be studied.
- Structures will be included in the Wickenburg ADMS for analysis of future modifications or requirements.

Sunset and Sunny Cove Washes
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
7	Sunset & Sunny Cove Washes	Earth Dams	79,000	-0-	79,000

Buckeye Retarding Structure and Floodway

The Buckeye Watershed is located north of the Town of Buckeye and contains 104 square miles. Many washes emerge from the southern end of the White Tank Mountains and cut through the broad plain. Rainfall concentrates quickly in these washes and then runs across the plain toward the Gila River.

In 1963, the floodplain area was practically all under irrigation and the water was deliverd by the canals of the Roosevelt Irrigation District, Buckeye Irrigation Company, and Arlington Canal Company. The 1963 Report stated "damage from flood water occurs almost every year. Water flows across the Roosevelt Irrigation District Canal in many places. Damage to canals and laterals as well as to irrigation land is heavy."

The plan for the area suggested:

a. Construction of a system of channels, retarding structures and a diversion to carry flood water to the Hassayampa River.

b. Two retarding structures approximately 12 miles long. Maximum height of the dams will be 25 feet and total storage will be 5560 acre-feet.

c. In conjunction with the retarding structures, two floodways and one diversion will be constructed.

1989 Update

- Structures have been constructed; Final Acceptance Date: 1974 (Buckeye FRS #1), March 1975 (Buckeye FRS #2 and #3).

Buckeye Retarding Structure and Floodway
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
9	Buckeye-Palo Verde	Levees & Channels	776,000	2,986,000	3,762,000

Bender and Sand Tank Improvements

Bender and Sand Tank Washes are located in the "Gila Bend Area," which is described in the 1963 report as follows:

> "The Gila Bend area is in the southwestern part of Maricopa County and has an area of 345 square miles. The flood-producing area is the Sand Tank Mountains which are located in the southern section. Highest point is Maricopa Peak. Many washes originate in these mountains and flow out from the southwest and northeastern slopes eventually flowing into the Gila River and in the Gila Bend area.
>
> "Approximately 160 square miles of the total drainage area is steep, rocky terrain with shallow soils. The remaining 185 square miles is a broad, flat, floodplain with deep soils of high infiltration. Major drainages are the Bender and Sand Tank Washes."

Bender Wash is located in the same general area on the southwestern slopes of the Maricopa Mountains about 25 miles southeast of Gila Bend. It flows northwesterly through barren,

rocky country, crossing under Highway 84 (now Interstate 8), and emerging onto the flat alluvial plains. It continues on northwest and passes through Gila Bend approximately 300 yards east of the main channel of the Sand Tank Wash. Before reaching the Gila Bend area, the flows of Bender and Sand Tank Washes have been joined together by means of many small cross-channels.

The Corps of Engineers was to study the flood-prone area. The following suggestions were made:

a. Construction of approximately 2.5 miles of dikes along each side of both washes to guide flood water into the proposed channels.

b. Channelization of Bender & Sand Tank Washes to make their capacity adequate to carry designed flows. Total length of channel: 1.5 miles. Design capacity: 6,000 cubic feet per second (cfs).

c. Relocation of present siphon in Bender Wash. Redesign will allow irrigation water to pass under the wash.

1989 Update

- No action has been taken. Interstate 8 has been constructed, replacing a section of Highway 84. A floodplain study is proposed for FY 90/91.

Bender and Sand Tank Improvements
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
12	Bender & Sand Tank Washes Gila Bend	Levees	152,000	114,000	266,000

Deer Valley Group

Because control measures were so closley related, the following drainage areas were combined to form the Deer Valley Group:

- Lower Agua Fria 110 square miles
- Upper New River 170 square miles
- Lower New River 45 square miles
- Deer Valley 140 square miles
- Skunk Creek 135 square miles
- Cave Creek 240 square miles
- Sunnyslope 80 square miles

The group encompasses an area about 30 miles wide and 55 miles long, north to south. The principal streams in the area are: Agua Fria River, New River, Skunk Creek, and Cave Creek. The Agua Fria is the main drainage into the Salt River. Elevations in this group of individual areas vary from 800 to 5,300 feet above sea level and the topography changes from relatively flat irrigated land to steep mountains.

The projects in the Deer Valley Group that were detailed in the 1963 plan are: the North Phoenix Mountains Diversion; Arizona Canal Diversion; Union Hills Diversion; New River Dam; Adobe Dam; Lower Cave Creek Dam (Cave Buttes Dam); and channel clearing at the Agua Fria River, New River, and Skunk Creek. Since the 1963 report, nearly all of these projects have been built (or are currently under construction) under the U.S. Army Corps of Engineers' *Phoenix, Arizona, and Vicinity (including New River)* flood control project. Each of the projects outlined in the 1963 Report is discussed separately, below.

North Phoenix Mountains Diversion

The 1963 Report proposed construction of a channel parallel to the Arizona Canal from 20th Street to Cave Creek (and eventually into Skunk Creek). The report also proposed construction of a lined channel parallel to the Arizona Canal from 38th Street to 48th Street for disposal of flood waters to the Salt River, through the Old Cross Cut Canal. In 1963, cost planning was based on the U.S. Corps of Engineers participating in the total cost. Alternatively, the Flood Control District would either have to support the complete project or build it jointly with the City of Phoenix.

1989 Update

The District and the City of Phoenix are cooperatively planning and will be cost-sharing a project to improve the capacity of the Old Cross Cut Canal from the Arizona Canal to the Salt River Channel. Construction of the improvements south of McDowell Road are scheduled to commence in 1990. An interceptor drain (Lafayette Drain) from 44th Street to approximately 64th Street will be proposed to provide stormwater drainage collection in the Arcadia subdrainage basin and convey these flows to the Old Cross Cut Canal.

North Phoenix Mountains Diversion
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
22	North Mt.–Arizona Canal, 20th Street to 23rd Avenue (Cave Creek)	Construct Channel	1,400,000	1,926,000	3,326,000

Arizona Canal Diversion

This proposed project involved constructing a channel parallel to Arizona Canal from Cave Creek west to Skunk Creek. The channel was to be lined with an inlet structure at Cave Creek about 0.5 miles west of 19th Avenue.

1989 Update

- The anticipated project completion date of the Arizona Canal Diversion Channel (ACDC) is 1992. The ACDC is being constructed for the 100-year capacity. The channel extends from 40th Street to 75th Avenue, parallel to the Arizona Canal. Areas along the channel need to be modified to accept sheetflow from a 100 year event.

Arizona Canal Diversion
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
22	Arizona Canal–Cave Creek to Skunk Creek	Divert flood water North of Canal	944,000	7,060,000	8,004,000

Union Hills Diversion

The 1963 Plan called for construction of a lined channel beginning at 36th Street between Bell Road and Union Hills Drive running generally west, and emptying into Skunk Creek. The channel was to be concrete-lined and have inlet structures.

1989 Update

- No action has been taken. ADOT is planning the Outer Loop one mile to the north. Phoenix is proposing a master drainage plan for Scatter Wash east of Interstate 17.

Union Hills Diversion
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
22	Union Hills Diversion	Lined Channel	500,000	1,500,000	2,000,000

New River Dam

This proposed project was described as an earth-fill dam located on New River in Section 26, T5N, R1E, approximately 8 miles northwest of Adobe Dam. The dam was to contain 1,300,000 cubic yards of fill and store 33,500 acre-feet of water. Related outlet and emergency spillway plans were included.

1989 Update

- Structure complete; Final Acceptance Date: February 1985. Need to maintain the conveyance corridors downstream.

New River Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
8	Upper New River	Earth Dam Channel	50,000	450,000	500,000

Adobe Dam

This earth-fill dam was proposed in section T5N, R2E, Sections 27 and 34. The reservoir was designed to store approximately 13,000 acre-feet of floodwater and the dam to contain 1,600,000 cubic yards of fill. Outlet works and emergency spillway were to be included.

1989 Update

- Structrue complete; Final AcceptanceDate: May 6, 1982. Major channelization is taking place adjacent to the Skunk Creek Landfill to the north. Possible project would be to construct a channel to the reservoir. Need to maintain the conveyance corridors downstream of the dam.

Adobe Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
22	Northwest of Adobe	Earth Dam	832,000	2,301,000	3,133,000

Lower Cave Creek Dam (Cave Buttes Dam)

An earth-fill dam on Cave Creek in Section 15, T4N, R3E, approximately 4 miles north of Bell Road, was proposed to contain approximately 4,000,000 cubic yards of fill and store 22,000 acre-feet of water at spillway crest. Total surface area: approximately 700 acres. Outlet and emergency spillway were included.

1989 Update

- Structure complete; dedicated in 1980. Phoenix is in the process of master planning Phoenix Peripheral Areas C & D upstream of the reservoir. Subtle watershed divides on the east boundary should be monitored to assure that new development does not divert additional flows to the structure. Need to maintain the conveyance corridors downstream of the dam.

Lower Cave Creek (Cave Buttes)
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
22	Lower Cave Creek Dam Site	Earth Dam	871,000	5,824,000	6,695,000

Channel Clearing—Agua Fria, New River and Skunk Creek

In order to have the Agua Fria, New River and Skunk Creek ready to receive floodwaters introduced from Cave Creek and the North Phoenix areas, it was necessary to ensure a clear path for the water. This project proposed clearing brush and aligning channels for that purpose. All necessary structural works were also included.

1989 Update

- Project has been modified due to the purchase of flowage easement for the *Phoenix and Vicinity (including New River)* project, or due to channelization or the construction of levees.
- Agua Fria River Levee System complete, 1989.
- New River channelization in progress, 1990.

Channel Clearing:
Agua Fria, New River and Skunk Creek
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
19 23	Agua Fria, New River, & Skunk Creek	Channel Clearing	250,000	1,000,000	1,250,000
22	64th St. to New River	Total Deer Valley	7,717,000	21,913,00	29,630,00

Dreamy Draw

The earth dam on the Dreamy Draw has been constructed as a part of the Corps of Engineers' *Phoenix, Arizona and Vicinity (including New River)* flood control project. It was not included specifically in any study area in the 1963 Report.

1989 Update

- Structure complete; Final Acceptance Date: 1973.
- Need to maintain the conveyance corridors downstream. Channelization downstream of the Dam to the Arizona Canal Diversion Channel should be investigated by the Flood Control District.

Dreamy Draw Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
25	Dreamy Draw	Earth Dam	150,000	300,000	450,000

West Phoenix Floodways

These floodways are also included in the Deer Valley Group, as described above. The plan for this area called for a series of channels on the west side of the City of Phoenix. Cost planning was based upon participation of the Corps of Engineers. The channels proposed were:

a. **Glendale-Peoria Drain:** Plan consists of a lined channel, trapezoidal in shape, with 2:1 side slopes, from 35th Avenue and 0.25 mile south of Olive Avenue running westerly for 3.75 miles then southerly 1 mile, then westerly about 4.5 miles to New River.

b. **Maryvale-Glendale Drain:** A lined channel running from Grand Canal 0.5 mile west of 67th Avenue, southerly approximately 7.5 miles to the Salt River.

c. **West Phoenix-Maryvale Drain:** Planned to run from 47th Avenue at Grand Canal south to Thomas Road, then southerly 5.3 miles to the Salt River.

1989 Update

- ADOT has proposed a north-south freeway alignment in the vicinity of 59th Avenue. This alignment is between the alignments proposed for the West Phoenix-Maryvale and Maryvale-Glendale projects. The District has initiated discusssions with ADOT for a potential joint project. The Glendale/Peoria ADMS precipitated the Olive Avenue Storm Drain at the same locale as the Glendale-Peoria Drain. The Olive Avenue Storm Drain, to be completed in 1990, will provide stormwater convergence from 59th Avenue to the Outerloop Interceptor Channel and then to New River. The Glendale/Peoria ADMS also suggested constructing the Orangewood and Cactus Drains, which are discussed more fully in Section V.

West Phoenix Floodways
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
22	Glendale-Peoria Drain	Lined Channel	426,000	2,552,000	2,978,000
22	West Phoenix-Maryvale	Channel	337,000	2,205,000	2,542,000
22	Maryvale-Glendale Drain	Lined Channel	320,000	1,462,000	1,782,000

Old Cave Creek Dam

In 1963, it was believed that a major storm would fill the reservoir behind the Old Cave Creek Dam and cause the present earth spillway to operate. If this occurred, there would be a strong possibility that the spillway would wash out and cause extensive damage below. This problem was studied by the Corps of Engineers, but no final decision had been reached at the time of the 1963 Report. The following alternatives were proposed:

a. **Alternate No. 1:** Building an earth dike 2900 feet long across the natural spillway, and construct a new spillway on the west side of the old dam.

b. **Alternate No. 2:** Construction of an earth-fill dam across the natural spillway as above. An apron would be poured below the old concrete dam and floodwater would flow over the dam during floods.

1989 Update

- Cave Buttes Dam has been constructed, thus eliminating the need for this project. Final Acceptance Date (Cave Buttes Dam): 1980.

Old Cave Creek Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
24	Cave Creek Dam (Old)	Levee	65,000	91,000	156,000

Cave Creek Town Dike

In 1963, the problem was described as follows:

> "There are approximately 115 square miles of drainage above the town of Cave Creek. The runoff-producing area is steep and water concentrates quickly in the washes. Floodwaters run at a high velocity in the well-defined channel of Cave Creek. In the past, overflow from the wash came over the south bank of Cave Creek and traveled in another wash through the developed portion of town."

The problem was studied by Corps of Engineers; the proposed solution was:

> Constructing approximately 800 feet of earth dike with rock revetment on the wash about 0.5 mile east of the town of Cave Creek.

1989 Update

- The current floodplain delineation does not indicate a breakout, therefore no further study of this project is warranted at this time.

Cave Creek Town Dike
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
7	Cave Creek Town	Earth Levee	3,000	12,000	15,000

Lower Indian Bend Channel

The Lower Indian Bend Area lies south of the Arizona Canal and is located in central Maricopa County. It encompasses a 65 square mile area which includes portions of Scottsdale, Tempe, and Phoenix. Most of the floodwater affecting this section is produced in the Pinnacle Peak/Paradise Valley/ Phoenix Mountains areas. The upper boundary is the Arizona Canal and the lower boundry is the Salt River.

The recommended plan was approved by the Corps of Engineers; that plan consisted of:

a. Constructing a lined channel, trapezoidal in section, from the Arizona Canal at Indian Bend Road running southerly to and entering the Salt River about 0.5 mile east of Scottsdale Road.

b. Bottom width is 14 feet and depth varies from 23 to 26 feet with a crossing structure over Arizona Canal and an energy dissipating structure at Salt River.

1989 Update

- The Indian Bend Wash Greenbelt Project was completed in 1980 and is being maintained by the City of Scottsdale.

Lower Indian Bend Channel
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
27	Lower Indian Bend	Floodway Channel	1,770,000	7,250,000	9,020,000

Maxwell Dam

The 1963 Report stated the following:

> "The overall plan for this Dam is to build into the planned terminal storage reservoir, 900,000 acre-feet of flood control storage. Nearly all damages caused by a standard project flood along Salt River will be prevented by the construction of this dam along with the channel improvements recommended under Sec. 9.0-A [Salt River Channelization]. Relatively minor damages along Salt River would still occur to property located in and immediately adjacent to the river channel. Downstream from the mouth of the Salt, partial flood protection would result. Control of floods would be effected by reducing discharges from Maxwell Dam to approximately 50,000 cfs. Smaller flows than 50,000 cfs would not be affected be the operation of this reservoir."

The project was studied by the Flood Control District and the following recommendations were made:

a. Construction of an earth-fill dam that would rise 169 feet above the stream bed with a crest length of 5,200 feet. The reservoir will store approximately 1,250,000 acre-feet, with 890,000 acre-feet assigned to flood water storage.

b. Spillway and related inlet and outlet structures are to be included.

1989 Update

- The dam was renamed Orme Dam and lost congressional support; it was replaced by Plan 6 and then by Plan 9 of the Central Arizona Water Control Study, which will lead to modifying existing dams on the Salt and Verde Rivers. The Flood Control District is contributing 20 percent of the cost of the Roosevelt Dam improvements in return for dedicated flood control reservoir space.

Maxwell Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
31	Maxwell Dam (Flood Control)	Earth Dam	650,000	5,050,000	5,700,000

Apache Junction-Gilbert Structures

The Apache Junction-Gilbert Watershed is located in the eastern section of the Salt River Valley. The flood-producing watershed is made up of steep mountains (up to 5,000 foot elevation) and foothills lying between 1400- and 1700-foot elevations. Peak flows are short in duration but high in intensity. Due to steep slopes and high velocities, serious damage can result from a major storm—as occurred in 1954 when heavy rains covered U.S. Highway 60-70-80-89 in the vicinity of Apache Junction and many businesses and homes along the highway were damaged.

Damage in urban areas is just a part of the total damage that *may* occur from a major storm. The highly productive farm land as well as irrigation systems could be severly damaged due to erosion and silt deposits.

The problem was studied by the Soil Conservation Service, who offered the following plan:

a. Construction of one retarding basin and 14.8 miles of floodways.

b. The retarding structure would be built south of U.S. Highway 60-70-80-89 and west of Vineyard Road. Total storage capacity: 4,135 acre-feet with 3,960 acre-feet reserved for flood storage. Dam proposed to be 3.9 miles long, 25 feet high.

c. Floodways would be constructed to safely carry the water to Queen Creek with a maximum capacity of 2,550 cfs.

1989 Update

- Powerline FRS and Powerline Floodway were completed in 1967; the last reach (6) of the East Maricopa Floodway was completed in June 1989.

Apache Junction-Gilbert Structures
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
32	Apache Junction– Gilbert	Levees & Channels	1,209,000	3,803,000	5,012,000

Buckhorn-Mesa Structures

The Buckhorn-Mesa Watershed is located in eastern Maricopa and northwestern Pinal Counties. The flood-producing areas are the rugged Usery and Goldfield Mountains. Floodwaters drain down onto the wide alluvial fan where slopes are flat and the channels become less defined. The drainage pattern is to the southwest.

From 1910 to 1960, 33 floods of varying magnitudes have damaged land, residences, commercial establishments, roads, and highways. Runoff during the 1954 storm inundated almost 6,000 acres of highly productive irrigated land.

The following plan was recommended in the 1963 Report:

a. The overall plan for flood control will include four floodway retarding structures and 8.1 miles of floodways. Total length 11.2 miles; maximum height: varies from 15.5 to 41 feet.

b. A debris basin and diversion box will be included to properly utilize the floodwater for irrigation purposes.

(The above plan as recommended includes Weekes Wash retarding structure and floodway. While these are considered to be necessary in the watershed plan, the Flood Control Engineer does not recommend that Maricopa County contribute the local share of funds. The greatest benefits do not accrue to developments within the County. If the rights of way and other local costs were borne by local interests, then these structures could be built.)

1989 Update

- All structures except Weekes Wash FRS have been built; Final Acceptance Date: 1988.

Buckhorn-Mesa Structures
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
32	Buckhorn-Mesa	Levees & Channels	3,574,000	3,855,000	7,429,000

Mesa-Chandler-Gilbert Floodways

One of the most rapidly developing areas in Maricopa County—including the population centers of Mesa, Chandler, and Gilbert—is affected by this floodway. Topography of the area is characterized by relatively flat terrain with developed irrigation systems. The general drainage pattern is to the southwest into the Gila River. In 1963, the urban areas had no outlet for storm runoff, and the floodway was designed to provide one. The recommendation was:

a. Construct a system of channels eventually emptying into the Gila River. Channels leading from Mesa, Chandler, and Gilbert are designed for a 5-year frequency flood.

b. Total length: 29 miles; average bottom width: 10 feet; average depth: 10 feet.

1989 Update

- This project has been replaced by the Price Road Drain which is located under the Price Freeway. The water will be pumped, against the grade, to the Salt River.

Mesa-Chandler-Gilbert Floodway
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
32	Mesa-Chandler-Gilbert	Channel	3,000,000	-0-	3,000,000

Williams-Chandler Structures

The Williams-Chandler watershed is composed primarily of steep mountains between contours 1700 and 5000, and foothills between contours 1400 and 1700. Flow is generally southwesterly onto the broad, level plain. Velocities in the washes are high due to steep slopes and well-defined channels.

Many homes, businesses, highways and roads are located in the floodplain. U.S. Highway 60-70-80-89 crosses the flood area and is subject to damage. Williams Air Force Base is considered vulnerable to heavy floods even though protective dikes and channels have been constructed there.

Chandler would suffer damage from a heavy flood. The heavy rains of 1954 caused extensive damage in the watershed. Many acres of farm land are subject to damage.

To alleviate flooding problems evident from the past, the 1963 plan was to build a system of channels to serve Mesa, Chandler, Gilbert, and adjacent developments. Specifically, the following structures were recommended:

a. Two floodwater retarding structures, 9.2 miles of floodway construction and one irrigation water turnout with gates.

b. Total length: 9 miles; average height of dams: 22 feet.

c. Floodway length: 9.2 miles; capacity adequate to handle floodwaters released from the retarding structure.

1989 Update

- Vineyard and Rittenhouse flood retarding structures (FRS) were completed in 1968 and 1969, respectively.

Williams-Chandler Structures Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
32	Williams-Chandler	Levees & Channels	837,000	3,738,000	4,575,000

Queen Creek Floodway

Floodwaters released by the Buckhorn-Mesa, Apache Junction-Gilbert, and Williams-Chandler watersheds in the southeastern part of Maricopa County are to be directed into the EMF. Water from lower Queen Creek also empties into this floodway. All of this water is then carried on to the Gila River Indian Reservation in the northwest quarter, Section 4, T3S, R6E. The Queen Creek Floodway was to carry a controlled flow of approximately 7,000 cfs to the Gila River.

This was a Flood Control District Project with aid expected from U.S. Bureau of Indian Affairs.

a. Overall plan included a channel to pick up floodwater near the end of the RWCD Canal at the Maricopa/Pinal County line and take it through the Gila Indian Reservation and into the Gila River.

1989 Update

- This portion of the EMF is complete. The EMF was completed in 1989.

Queen Creek Floodway
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
33	Queen Creek	Channel	920,000	880,000	1,800,000

Harquahala Valley Structures

The flood-producing area consists primarily of steep mountains between contours 1300 and 5700. The topography is characterized by the presence of many washes which emerge from the southern end of Harquahala and Bighorn Mountains onto a broad and level plain. Rainfall concentrates quickly in the washes and then flows across the plain generally in a southerly direction, toward Centennial Wash.

The matter was to be studied by Soil Conservation Service. The recommendations from the 1963 Report were:

a. A levee approximately 10 miles long, parallel to the 1400-foot contour line from the west side of Range 10 West approximately in the center of Township 3 north, then east to Gin Road.

b. Improvements of the channel along Gin Road to carry released floodwater to Centennial Wash.

1989 Update

- The structures have been completed.

Harquahala Valley Structures
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
4	Harquahala Valley	Levees & Channels	400,000	3,770,000	4,170,000

Tonopah Structures

The flood-producing area consists primarily of steep mountains between contours 1300 and 3000. The topography is characterized by many washes which emerge from the southern and eastern slopes of the Bighorn Mountains onto the floodplain below. Rainfall gathers rapidly into the washes and flows across the plain, south toward Centennial Wash.

In 1963, there was no extensive urban development in the area, however, small concentrations of populations were located at Tonopah. Furthermore, there was little information available concerning prior flood damage as development of the area had only recently begun.

Flooding in the area was to be studied by the Soil Conservation Service. Recommendations in 1963 were:

a. A levee approximately 12 miles long, along the 1200-foot contour beginning in Section 17, T2N, R7W, and extending to Section 16, T2N, R5W.

b. Improve the channel in Winters Wash to make it adequate to carry the designed release flow.

1989 Update

- No action has taken place. Although Interstate 10 has been constructed through the area, development potential is restricted because of the Palo Verde nuclear power plant.

Tonopah Structures Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
4	Tonopah & Winters Valleys	Levees & Channels	120,000	1,950,000	2,070,000

Eagle Tail Mountain Structures

The drainage area is composed primarily of steep mountains and foothill slopes between contours 1300 and 2900. The topography is rough and many washes emerge from the northeastern slopes of Eagle Tail Mountains and cut through an extensive floodplain. Runoff flows northeasterly, toward Centennial Wash.

The matter was to be studied by Soil Conservation Service. The 1963 Report recommendations were to build:

a. A dike beginning in Section 26, T2N, R11W, and running along the 1400-foot contour in Section 1, T1S, R10W. Total length: 14 miles.

b. A floodway beginning in Section 1, T1S, R10W, and running easterly along the section line intersecting Centennial Wash. Enlarge the old channel.

1989 Update

- The structures have not been built. A distribution system for the Irrigation District has been completed since initial damages were developed for the 1963 Report. The irrigation system was designed to handle drainage from a 25 year event. Initial SCS planning authorization was granted in FY 1966. In April 1985, the planning purpose was changed from flood control to water conservation. The planning authorization for the SCS was terminated on 9/1/87 due to lack of interest.

Eagle Tail Mountain Strucures Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
4	Eagle Tail Mountain	Levees & Channels	700,000	1,849,000	2,549,000

Matthie Dam

The proposed structure was to be located on Sols Wash, approximately eight miles west of Wickenburg on the county line between Maricopa County and Yavapai County. The total area of Sols Wash above this proposed structure is 125 square miles. Except for very small areas, this wash drains through a broad valley with relatively flat slopes. The general drainage pattern is to the east, emptying into the Hassayampa River in Wickenburg.

The major benefit of this structure would be the addition of recreational amenities, although, in 1963, there was doubt that the watershed would produce enough water to keep the reservoir full. This project was recommended for construction by the District in 1963.

a. An earth-fill dam located on Sols Wash approximately 8 miles west of Wickenburg. Maximum dam height: 70 feet; total surface area: 500 acres.

1989 Update

- The proposed structure is somewhat remote from Wickenburg and benefits are not self evident. Areas of inundation are indicated on the current flood insurance maps for the area. This project is to be considered in the Wickenburg ADMS, FY 90/91.

Matthie Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
7	Sols Wash (Matthie Dam)	Earth Dam	500,000	556,000	1,056,000

Flying "E" Wash Dam

The flood-producing area consists primarily of rugged, steep mountains ranging up to 3,500-foot elevations. There are many washes and drainage is generally north, eventually draining into Sols Wash, about two miles above the Hassayampa River.

There were no centers of population within this area when the 1963 Report was published. The principal damage noted was to the golf course at the Wickenburg Country Club. Damage was also reported north of the U.S. Highway 60 bridge. The plan proposed for this area included:

a. An earth-fill dam south of U.S. Highway 60, west of Wickenburg. Approximate height: 33 feet; capacity: 335 acre-feet.

1989 Update

- New development has occurred along the wash. A floodplain delineation is proposed in the near future. This project is to be considered in the Wickenburg ADMS, FY 90/91.

Flying "E" Wash Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
7		Earth Dam	-0-	183,000	183,000

South Mountain Structures

In the 1963 Report, the South Mountain Area was defined as the area " located just south of the Salt River across from Phoenix, [which] contains an area of 240 square miles, bordered on the north by the Salt River and on the southwest by the Gila River. General drainage is in a semi-circular direction due to the fact that the center is occupied by the Salt River Mountains and water drains away in all directions."

The 1963 Report further warned: "If a reasonable degree of protection of the South Mountain floodplain is to be achieved, a channel paralleling the foothills is required. Flood storage reservoirs require fairly rapid draining and the Highline Canal capacity is limited. If channels are built directly north from the mountains to the Salt River, there is still a need for transverse collection facilities covering principal washes between these south-north channels."

The project was to be referred to Soil Conservation Service and the following plans were put forth:

a. Construct an unlined channel, trapezoidal in section, parallel to Highline Canal on the south side, from 48th Street west to the Indian Reservation boundary and then to Salt River.

b. Construct a dam west of Guadalupe and one near 43rd Avenue, with related inlet and outlet control work as required.

1989 Update

- Area is developing south of South Mountain. Drainage flowpaths are not being maintained. Project could be a joint project with ADOT to tie into the southwest loop freeway.
- Area to be included in the Laveen ADMS, FY 90/91.

South Mountain Structures Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
26	South Mountain, 40th Street to 75th Avenue	Levees & Channels	2,652,000	6,251,000	8,903,000

Upper Indian Bend Channel

The Upper Indian Bend Area lies above Arizona Canal, northeast of the city of Phoenix, and has an area of 187 square miles. The runoff comes from the Phoenix Mountains, Paradise Valley, and Pinnacle Peak. Drainage is to the southwest, turning southward at the old Verde Canal.

Ground cover is sparse in the lower reaches and ratio of runoff to rainfall is high. Soils in the hills are shallow and relativley impervious. Water concentrates quickly in the washes and runs at high velocity to the relatively flat floodplain below.

The 1963 Report called for this area to be studied by the Corps of Engineers. Recommendations included:

a. An unlined channel from Cholla Road and 36th Street to the Arizona Canal below Indian Bend Road, joining lower Indian Bend Channel at the Canal.

b. Install box culverts to accommodate low flows and wide sections at half-mile roads.

1989 Update

- Sturcture complete: Final Acceptance Date for the inlet channel: April 1979.

Upper Indian Bend Channel
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
28	Indian Bend Wash Above Arizona Canal	Channels	1,217,000	1,701,000	2,918,000

Guadalupe Retarding Structure and Floodways

The Guadalupe Watershed comprises the southern and eastern slopes of the South Mountains. The flood-producing area consists mainly of steep mountains between contours 1150 and 2310. Many washes emerge from the eastern end of the South Mountains and enter the broad, level plain. Rainfall concentrates quickly in the washes and flows southeasterly to the Gila River. The following recommendations were made in the 1963 Report:

a. Construct three levees of varying lengths; average height: 15 feet; total storage: 1170 acre-feet.

b. Construct four floodways in conjunction with retarding structures to take floodwater to the Gila River. The channels were to be concrete-lined and have adequate capacity to carry maximum flow for the retarding structures.

1989 Update

- Final Acceptance Date for Guadalupe FRS: April 1975.
- Flood retarding structure built although system outlet is north into the Highline Canal. Structures to the south have been partially incorporated into ADOT facilities for Interstate 10.

Guadalupe Retarding Structure and Floodways
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
26	Guadalupe Watershed	Levees & Channels	519,000	660,000	1,179,000

Box Canyon Dam

In the Hassayampa River basin, approximately 6 miles north of Wickenburg, the hills come in close to the channel to form what is known as "The Box." This area was to be studied by Corps of Engineers. Recommendations made in 1963 were:

a. Construct an earth-fill dam across the Hassayampa River. Height approximately 246 feet; storage capacity: 200,000 acre-feet.

b. Construct related outlet works to provide for flood control and domestic water.

1989 Update

- No action has been taken on this structure. Areas that the structure would protect are defined on the most current flood insurance study. This project is to be considered in the Wickenburg ADMS, FY 90/91.

Box Canyon Dam
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
6	Box Canyon	Earth Dam	652,000	6,948,000	7,600,000

San Tan Structures

Although located in Pinal County, the San Tan Mountains contribute runoff affecting Maricopa County. The flood-producing area consists of steep mountains between contours 1300 and 3100. Many washes come from the north slopes of San Tan Mountains into the level plain. Rainfall concentrates quickly and the washes flow to the north. The floodplain area is trapezoidal and elongated in the east-west direction. The principal urban area (in 1963) was Chandler Heights. This problem was to be studied by the Soil Conservation Service. The following recommendations were made in 1963.

a. Construct a system of retarding structures and floodways to intercept and carry the floodwater to Queen Creek.

b. Construct four levees and four floodways. Total length of levees: approximately 7.3 miles; height: 18 feet. Length of floodways: 6.1 miles; capacity: 400 cfs.

1989 Update

- No action has been taken. Increased urbanization has occurred in the watershed. These structures were investigated in the Queen Creek ADMS as possible features of a drainage plan alternative.

San Tan Structures
Summary Table

Drainage Area	Location	Job Description	Costs (1963)		
			FCD	Other	Total
33	Santan Watershed	Levees & Channels	895,000	2,678,000	3,573,000

III

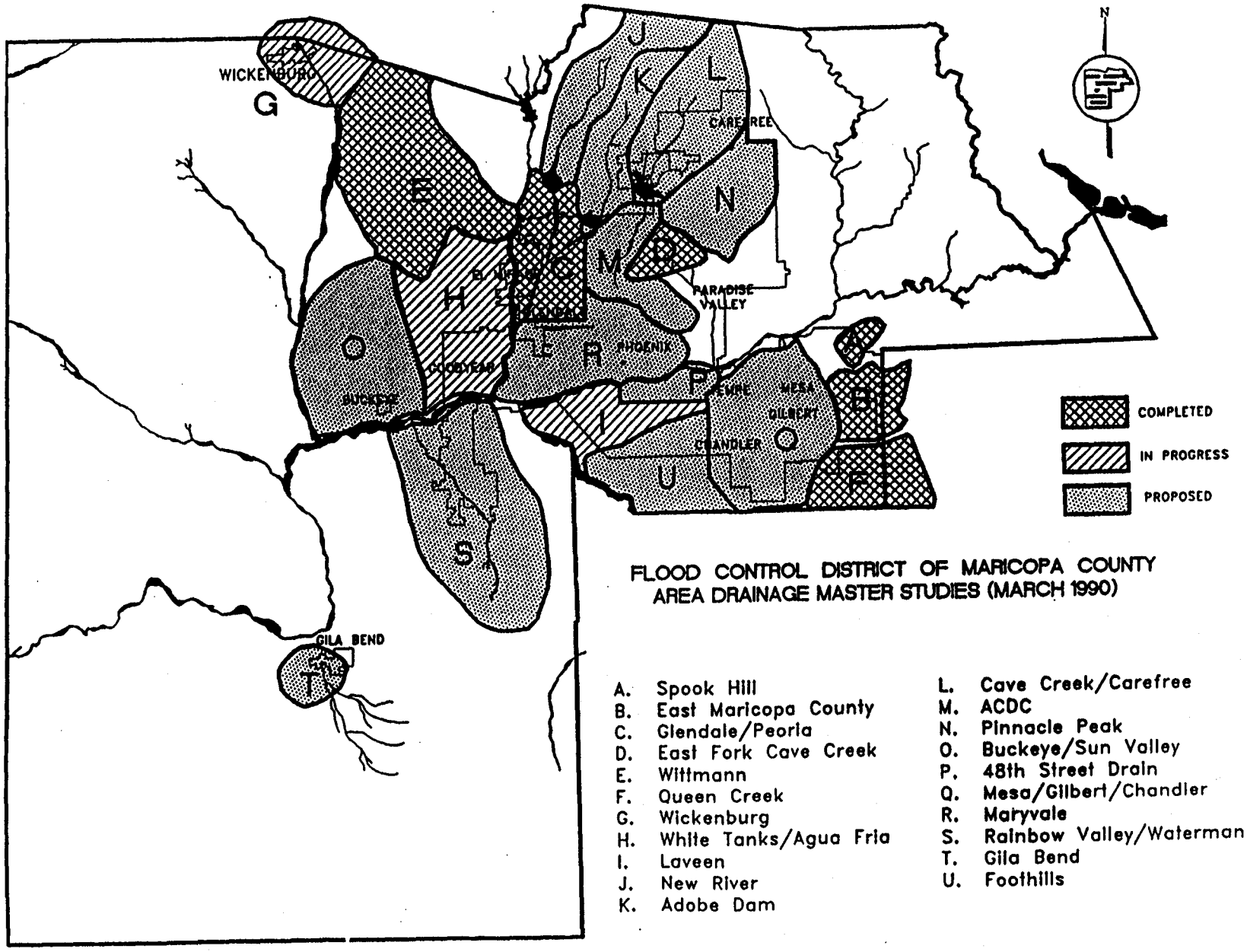
Area Drainage Master Study Program

Background

The Area Drainage Master Study (ADMS) Program was originally conceived in 1983 as a potential series of watershed analyses for areas experiencing street flooding and damage to yards and homes virtually every time it would rain. The first two studies began in 1984, and several more followed. By early 1985, a total of 18 areas were on the project list. In April, 1985, the Board of Directors of the Flood Control District approved the concept of pursuing these studies as a program.

Each Area Drainage Master Study uses a problem solving approach uniquely suited to that watershed or watershed cluster. Each ADMS then has as its product a unique Area Drainage Master Plan (ADMP). An Area Stormwater Management Plan (ASMP) is the preferred drainage plan alternative. ASMPs will provide outlines for the development of Comprehensive Plan projects as part of the planning cycle. The planning cycle will include reconnaissance level investigations to determine the full extent of a reported flooding problem and to identify alternative solutions worthy of consideration; and may include feasibility level studies and economic analysis to determine if a project is justified. The ASMPs will then provide the guidelines for stormwater management as development in each area proceeds.

Drainage problems in a number of areas of the County (incorporated and unincorporated), are both serious and complex to resolve. Many of the problem watersheds cross jurisdictional boundaries, and some cross through three or even four jurisdictions. The study watersheds vary in area from 15 to 250 square miles. For example, the ADMS for Eastern Maricopa County includes areas in the City of Mesa, and the Glendale-Peoria ADMS includes the City of Peoria, the City of Glendale, and unincorporated areas of the County. Smaller municipalities often do not have the funding available to thoroughly evaluate problems or to implement effective stormwater management plans. The Flood Control District is in a unique position to facilitate in technical matters *and* assist in funding, thus reducing the potential for worsening stormwater problems due to partial solutions that may later prove ineffective.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
AREA DRAINAGE MASTER STUDIES (MARCH 1990)

A. Spook Hill
B. East Maricopa County
C. Glendale/Peoria
D. East Fork Cave Creek
E. Wittmann
F. Queen Creek
G. Wickenburg
H. White Tanks/Agua Fria
I. Laveen
J. New River
K. Adobe Dam
L. Cave Creek/Carefree
M. ACDC
N. Pinnacle Peak
O. Buckeye/Sun Valley
P. 48th Street Drain
Q. Mesa/Gilbert/Chandler
R. Maryvale
S. Rainbow Valley/Waterman Wash
T. Gila Bend
U. Foothills

In February 1990, the Flood Control Advisory Board approved a five-year priority schedule for the ADMSs proposed by the District. The ADMSs that will be funded in the next five years are: ACDC, 48th Street Drain, Maryvale, Adobe Dam, Buckeye/Sun Valley, Mesa/Gilbert/Chandler, New River, and Foothills. These ADMSs are more fully discussed in the *ADMSs for the Future* section of this chapter.

The map on the facing page depicts the locations and general areas of the ADMSs that have been completed, are in progress, or have been proposed by the District for the future.

Completed ADMSs

A. Spook Hill

The recommended elements of the Spook Hill ADMS are as follows:

- Design Raven's Roost Dam and Outfall and Usuary Park Levee; acquire rights of way for these features.
- Design Quenton Street Lateral and Retention Basins.
- Design McDowell Road Outfall from Spook Hill FRS to Sossaman Road.
- Acquire right of way for McDowell Road outfall and basins east of Sossaman Road.
- Design Red Mountain Freeway Outfall channel for "as needed" construction.
- Design Freeway basins for "as needed" construction.

B. East Maricopa County

A detention basin will be constructed northeast of the intersection of the East Maricopa Floodway (EMF) and University Drive. An interceptor channel with 100 year capacity will be constructed from Power Road west to the detention basin. The channel will be located in the utility corridor along the quarter section line north of University Drive. A 10-year capacity storm drain will be constructed along University Drive from Power Road west to a storm drain owned by the City of Mesa.

A second element of the drainage plan is under consideration by the District: a channel extending from the Superstition Freeway at Ellsworth Road, south to Elliot Road, west along Elliot Road and draining into the EMF. The channel will have 100-year discharge capacity. There will also be a detention basin within the channel to meter the water to the EMF, which has a smaller capacity.

Also under consideration is a third element of the drainage plan: a channel from the Superstition Freeway at Sossaman Road, south to Baseline Road. The channel will then extend west along Baseline, draining into the EMF.

C. Glendale–Peoria

The recommended elements of the Glendale–Peoria ADMP are as follows:

- Olive Drain—ongoing FCD project.
- Cactus Drain—scheduled for design FY 90/91 (project description in Section V, *Cooperative Projects with other Agencies*).
- Orangewood Drain—scheduled for design FY 90/91 (project description in Section V, *Cooperative Projects with other Agencies*).

D. East Fork Cave Creek

There are five detention basins to be constructed as part of the project. The Flood Control District will pay 100 percent of the cost of detention basin #4, located on the campus of the Paradise Valley Community College. Costs for the other four detention basins will be shared 50/50 between the District and the City of Phoenix.

A second element of the project will be the "Upper East Fork Channel," which extends from Beardsley Road to Union Hills Drive. The channel will be designed as a greenbelt that will accomodate the 100-year discharge. Again, the District will share the costs 50/50 with the City of Phoenix.

E. Wittmann

The area is presently undeveloped and flooding problems are relatively minor. ADMP projects can be implemented in the future as the area develops or as the projects become economically feasible. In the interim, prudent floodplain management and existing drainage regulations should preclude additional flood damages from occurring.

F. Queen Creek

There are four different components to the drainage plan from the Queen Creek ADMS, some or all of which may be constructed as the need and money become available.

The first component is a series of eight detention basins that would reduce the peak flows draining into the EMF.

The second component consists of two detention/sediment basins and 11 miles of channel, called the San Tan Structures, located in Pinal County. The basins trap sediment eroding off the San Tan Mountains and prevent it from entering the channels and decreasing their capacity. The channel is intended to concentrate the water before it sheet flows and floods the area along the southern border of Maricopa County (the Chandler Heights area).

Improvements to Queen Creek and Sanoqui Wash constitute the third component of the drainage plan. The channels will be improved to convey the 100 year discharge.

The fourth component of the drainage plan is a grid pattern of interceptor channels designed to collect water entering Maricopa County from Pinal County. The channels are to concentrate flows and carry them to major drainage channels, i.e., the EMF, Queen Creek, or Sanoqui Wash.

ADMSs in Progress

G. Wickenburg

Wickenburg is a small town of about 4,400 people located approximately 60 miles northwest of Phoenix. Formerly a ranching and agricultural center, Wickenburg has recently become a popular area for winter residents and tourists. The town itself is located at the junction of several rivers. The town has a history of flooding problems due to these rivers. New development in the outlying area varies in its degree of planning and sophistication, and so its effect on downstream drainage also varies. The town itself does not have the financial resources to deal with all the regional drainage problems, therefore, it is appropriate for the Flood Control District to conduct an ADMS in the area.

H. White Tanks/Agua Fria

The study area is the largest of the ADMSs. It encompasses approximately 240 square miles on the west side of the Phoenix metropolitan area. The boundaries are McMicken Dam and Grand Avenue on the north, the Agua Fria River on the east, the White Tanks Mountains on the west, and the Gila River on the south. Land use varies widely; there are: several incorporated cities, Luke Air Force Base, residential areas, and a large percentage of the area is used for agriculture. There are no major natural drainage corridors through the area. The land has little topographic relief. Drainage is controlled, to a large extent, by man-made features such as irrigation canals, railroads, and Interstate 10. ADOT intends to build the Estrella Freeway through the area as part of the Outer Loop, further enhancing the area for development. The District's goal is to have a stormwater management plan available prior to major development.

I. Laveen

The Laveen ADMS area is located just southwest of Phoenix and actually includes a small portion of that city. The limits of the study include all the drainage for the Salt River Project ditch known as the Champion Drain. The general boundaries are the Salt River on the north, Central Avenue on the east, South Mountain on the south, and the Gila River Indian Reservation on the west. This locale is prime for development in conjunction with the future construction of the South Mountain Freeway. Currently, the land is being used primarily for agriculture and, hence, real estate prices are relatively low. Once development begins, however, the cost of obtaining rights of way will increase. The sooner these projects are begun, the less expensive the rights-of-way costs will be for the taxpayer.

ADMSs for the Future

Because of rapidly increasing development in the Greater Phoenix Metropolitan Area, the District recommends that Area Drainage Master Studies be conducted in the following areas.

J. New River

Completion of the New River Dam in 1985 provided protection of development downstream on the New River and the Agua Fria River. Recently, development pressure has increased in the drainage area above the dam, upstream to the Maricopa/Yavapai County line. An Area Drainage Master Plan conducted now would allow for the development in a manner compatible with the natural drainage pattern.

K. Adobe Dam

Adobe Dam was completed in 1982 for protection on and downstream of Skunk Creek. Since construction, there have been large housing developments constructed both up- and downstream. This project needs to be studied comprehensively to ensure flood protection has not diminished and the integrity of the structure has not been compromised. A master plan of the drainage into the dam would be insurance against potential future problems. The area to be considered here would be the drainage above the Dam, which includes parts of Phoenix Peripheral Areas C & D.

L. Cave Creek/Carefree

The communities of Cave Creek and Carefree and surrounding countryside are currently going through a very rapid growth. Therefore, it would behoove the District to have a Drainage Plan prepared as soon as possible. There were flooding problems addressed as far back as the 1963 Plan, but to this date little has been attempted to alleviate those problems. If the ADMS is started before more development occurs, the necessary hydrology can be provided by a Flood Insurance Study (FIS) contract now being completed for the drainage area above Carefree Highway. The lower portion of this proposed study also includes some of the Phoenix Peripheral Areas C & D. The boundaries of this report would coincide with the drainage boundaries of the Cave Buttes Dam.

M. Arizona Canal Diversion Channel

This area incorporates most of the northern part of the City of Phoenix. It is bounded on the south by the Arizona Canal, on the east by the Indian Bend Wash watershed, on the west by Skunk Creek and Adobe Dam watersheds, and on the north by the Cave Buttes Dam and East Fork Cave Creek ADMS. On the southern boundary the Arizona Canal Diversion Channel (ACDC) diverts stormwater from the north into Skunk Creek, protecting major portions of Phoenix and Glendale. Recent rapid development upstream of the ACDC requires a new look at the hydrology and at development of a systematic scheme for getting the stormwater into the channel safely.

N. Pinnacle Peak

The Paradise Detention Dike is a Bureau of Reclamation project designed to protect that portion of the CAP from Cave Creek Road to 104th Street. This study would include the drainage area for that dike.

O. Buckeye/Sun Valley

This study should encompass the area up- and downstream of the existing Buckeye Structures. Downstream, there is significant commercial and residential development in the area bounded by the Gila River on the south extending north to the Buckeye Structures, between Dean Road on the east and the Hassayampa River on the west. With the completion of the Sun Valley Parkway, there are large tracts of land with a potential for development upstream of the Buckeye Structures. Essential to the District's goals for this part of the County is a plan to protect the structures from uncoordinated development upstream. It is essential that the structures continue to function as designed in order to protect the high density development downstream.

P. 48th Street Drain

The 48th Street Drain evolved, as opposed to being designed. It started out as an irrigation wastewater ditch, but as agricultural lands gave way to development, the ditch became a floodway that was excavated and lined, and became a District maintenance responsibility. Although there have been hydrologic studies completed over the years, they were done piecemeal for projects such as Tempe drainage design and ADOT highway design. Those studies were for different frequency storms and uncorrelated drainage areas. Therefore, it is imperative that a master study be completed as soon as possible to assure that the Drain will perform as needed for such a highly developed area. The geographic boundaries for this study are the Salt River on the north, Rural Road on the east, Baseline Road on the south, and 24th Street on the west. In addition, Interstate 10 traverses the watershed, interrupting and diverting the natural drainage patterns.

Q. Mesa–Gilbert–Chandler

Currently, an FIS is being prepared for most of this area. Therefore, the hydrology will soon be finished and a comprehensive ADMS may be completed at a reduced cost. The projects set forth in the 1963 Plan for this area need to be reevaluated. Furthermore, based on the change in land use, some projects may no longer be feasible, although others may still be required. The boundaries are the Salt River on the north, the East Maricopa Floodway on the east, the Gila River Indian Reservation on the south, and Interstate 10 on the west.

R. Maryvale

The area referred to here as the Grand Canal ADMS encompasses most of the central and west portions of the City of Phoenix, and the Cities of Glendale and Peoria. It is bounded on the south by the Salt River; on the east by the Indian Bend Wash watershed; on the west by the Agua Fria River, New River, and Skunk Creek; and on the north by the ACDC. The SRP Grand Canal traverses the central portion of the entire locale and is the major infrastructure running east to west. The north-south infrastructure is Interstate 17; Grand Avenue is another infrastructure, running northwest to southeast. Even though the ACDC

provides flood protection for a large section of this area, there are projects that were proposed in 1963 that need to be updated for current and future conditions and resubmitted for approval. Due to rapid development, the flooding potential here has increased and will continue to grow.

S. *Rainbow Valley/Waterman*

Development in this area has already begun—residential construction has commenced and commercial development has been foreshadowed since Lufthansa expanded its training facility in Goodyear to include an airstrip in the Waterman Wash area. This is a large, relatively flat watershed, therefore properly placed flood control projects could reclaim many acres of floodplain. The area in question is all of the Waterman Wash drainage west of the Gila River Indian Reservation, and inclusive of the drainage along the Gila River between the wash and the reservation.

T. *Gila Bend*

At this writing, the District has scheduled an FIS for the Gila Bend area for fiscal year 91/92. With no more growth than is occurring presently, it is suggested that the FIS is sufficient to identify any flood control needs for the area.

U. *Foothills*

The Foothills ADMS encompasses the area bounded by South Mountain on the north, Interstate 10 on the east, the Gila Indian Reservation on the south, and the Gila River on the west. The area is currently experiencing rapid growth, which will be intensified when the South Mountain loop of the freeway is constructed.

IV

Arizona Department of Transportation Cooperative Projects

The Urban Highways group of the Arizona Department of Transportation (ADOT) has identified nineteen potential joint drainage projects between ADOT and the Flood Control District. These drainage projects are associated with the new Maricopa Association of Governments (MAG) freeway system. The table below was provided by ADOT in August, 1989, and lists the projects and their locations. FCD staff is gathering information from the ADOT design consultants associated with each of the projects. The diagram at the end of this chapter shows the locations of these projects throughout the County.

Arizona Department of Transportation Cooperative Projects

Freeway	Location	Project	Est. Cst.*	Description
1. Pima	Arizona Canal Floodway	Bridge & Channel	1991	The project is located near Lincoln Drive and the Arizona Canal at the intersection with the future Pima Freeway. Interceptor channels will run parallel to the freeway and a bridge will span the channel.
2. Pima	South of Arizona Canal	Channel	1992	An interceptor channel will be installed adjacent to the freeway. The project is located in the vicinity of Pima Road and McDonald Drive.
3. Agua Fria	Scatter Wash	Channels	1992	The project will consist of bank stabilization, grade controls, and a stilling basin for Scatter Wash along with concrete box culverts to convey the water from 35th Avenue north of the freeway, to Skunk Creek, south of the freeway, west of 43rd Avenue.
4. Pima	19th Avenue	Basin	1994+	A detention basin will be built on the north side of the freeway, in the vicinity of the intersection of Beardsley Road and Cave Creek Road.

*Estimated Construction Date, is based on the *Fiscal Year 1990/94 5-year Highway Construction Program* and is subject to substantial modifications.

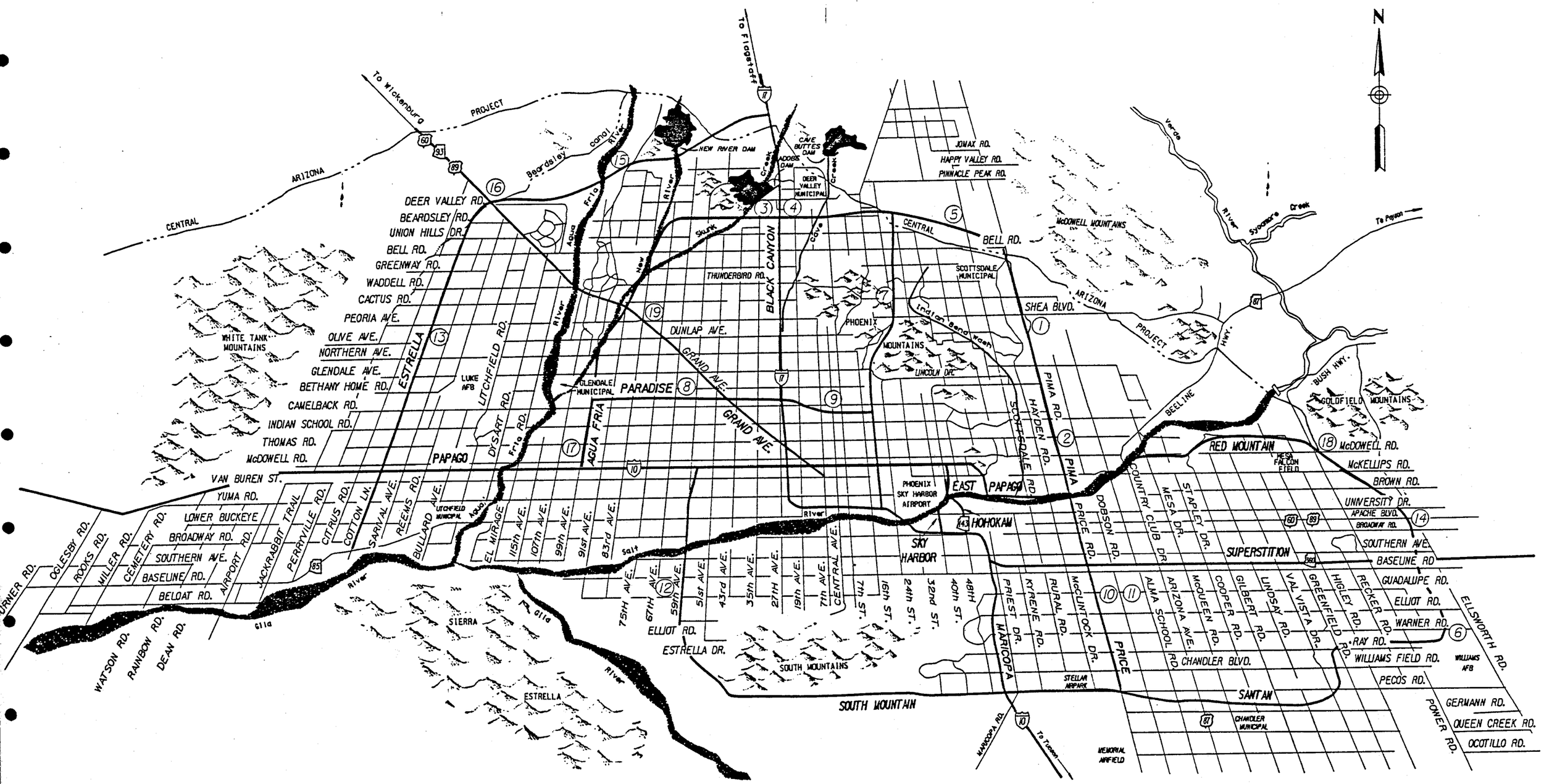
Arizona Department of Transportation Cooperative Projects				
Freeway	**Location**	**Project**	**Est. Cst.***	**Description**
5. Pima	North of CAP	Basins & Channels	1994+	An interceptor channel and a series of detention basins will be installed along the north side of the freeway extending from the CAP to the vicinity of the future extension of the Squaw Peak Freeway (between 32nd and 40th Streets). Concentrating the flows will eliminate several ADOT "pass through" drainage facilities. The detention basins could have multiple uses, including recreational. Any such improvements would be installed by private developers.
6. San Tan	East of RWCD	Basins & Channels	1994+	The interceptor channel will extend from Baseline Road to Warner Road along the east side of the freeway and along the south side of the freeway from Hawes Road to Gilbert Road. It will then run along the north side of the freeway from Gilbert Road to 56th Street. The channel is intended to concentrate the sheetflow and deliver the water to detention basins. The detention basins will be landscaped and used for recreational purposes. Recreational amenities will be installed by private interests.
7. Squaw Peak	Indian Bend Wash	Outfall & Channel	1994+	The interceptor channel will extend along the east side of the freeway from the Outer Loop Highway south to the vicinity of Cactus and 40th Street, where it will outfall to Sweetwater Wash and then to Indian Bend Wash.
8. Paradise	West of I-17	Channel to New River	1994+	The interceptor channel will be installed along the north side of the freeway on the Bethany Home Road alignment, extend under Agua Fria Freeway, and intersect the Grand Canal which outfalls at the New River.
9. Paradise	East of I-17	Tunnel	1994+	The project will consist of a tunnel extending from 19th Avenue east to approximately 20th Street, at the future Squaw Peak Parkway alignment.
10. Price	Pecos to Carriage Lane	Chandler Storm Drain	1994+	An interceptor channel will extend along the east side of the Price Freeway from the Superstition Freeway and outlet to the Price Drain.
11. Price	Price Road	Basins	1994+	Detention basins will be installed along the east side of the Price Freeway, south of the Western Canal, with the outfall to the Price Drain under the freeway. The Price Drain flows north to the Salt River, against the natural grade. Pump stations will move the water north, to the Salt River.
12. South Mountain	South of Salt River	Champion Drain	1994+	The channel will extend from the vicinity of South Mountain Park and 43rd Avenue to the outfall at the Salt River and 81st Avenue. An interceptor channel along the east side of the South Mountain Freeway will collect flows from the east and direct them to the Champion Drain and then on to the Salt River.

*Estimated Construction Date, is based on the *Fiscal Year 1990/94 5-year Highway Construction Program* and is subject to substantial modifications.

Arizona Department of Transportation Cooperative Projects				
Freeway	**Location**	**Project**	**Est. Cst.***	**Description**
13. Estrella	Cotton Lane	Channel	1994+	An interceptor channel and a series of detention basins will be built along the west side of the freeway (approximately the Cotton Lane alignment), outfalling into the Gila River. ADOT has proposed a "pass through" drainage system; FCD would upgrade the system to provide for flood control; private interests would further upgrade the system to provide for recreational amenities and aesthetic considerations.
14. Red Mountain	Ellsworth Road Alignment	Basins & Channels	1994+	An interceptor channel and a series of detention basins will be installed along the east side of the freeway from the Superstition Freeway to University Drive. The channel will outfall into the East Maricopa Floodway.
15. Estrella	Agua Fria River	Channels	1994+	The project will consist of a short, channelized reach of the Agua Fria River to maintain the alignment of the river as it crosses under the freeway bridge. The current bridge alignment is in the vicinity of Jomax Road as it crosses the Agua Fria River. Additional flood control benefits could be realized by upgrading and extending the bank stabilization along the river, beyond the minimum proposed by ADOT.
16. Estrella	McMicken Dam	Outfall Channel	1994+	An improved outfall channel from McMicken Dam will be constructed. The outfall channel will be connected to the Estrella Freeway interceptor channel and detention basin system. The outfall will be at the Aqua Fria River.
17. Agua Fria	Thomas Road	Basin	1994+	A detention basin will be built on the east side of the Agua Fria Freeway at Thomas Road. The outfall for the basin will be the interceptor channel along Thomas Road to the Agua Fria River.
18. Red Mountain	Spook Hill Dam	Dam Crossing	1994+	Improvements will be made to the existing Spook Hill Dam and Signal Butte Floodway to allow the Red Mountain Freeway to cross over the structures. The freeway will cross Signal Butte near the intersection of Ellsworth Road and Brown Road, run northeast of the Spook Hill structure, and then turn to the west, over the structure at Bush Highway between McDowell and Thomas Roads.
19. Grand	Northern–Grand Canal	Basins–Storm Drain	1994+	A storm drain and a series of detention basins will be built along the east side of Grand Avenue, extending from the intersection of Northern Avenue and 67th Avenue to the Grand Canal near the intersection of Indian School Avenue and 35th Avenue.

*Estimated Construction Date, is based on the *Fiscal Year 1990/94 5-year Highway Construction Program* and is subject to substantial modifications.

POTENTIAL ADOT/FCDMC JOINT DRAINAGE PROJECTS



V

Cooperative Projects with Other Agencies (Cities)

In many cases, drainage, flood control, or stormwater management problems extend across the countryside with little regard for political boundaries. Water problems need to be solved on a watershed or watercourse basis, not along political boundaries. The Flood Control District can assist local municipalities by "filling in the gaps" on flood control projects and constructing those sections of projects on the reaches of the watercourses in unincorporated areas of the County. The District can also function as the coordinating agency when a flood control or regional drainage project involves more than one local municipality.

Following are several examples of projects that are suitable for—and may require—multiple agency sponsorship.

Upper Indian Bend Wash Regional Drainage and Flood Control Plan

An area with the need for one agency to take the coordinating lead role is the Scottsdale "Fan" area on the West side of the McDowell Mountains. The area under study, Phoenix Peripheral Areas C & D, covers portions of northeast Phoenix and northern Scottsdale. Major channels extend from the City of Scottsdale, through unincorporated parts of the County, and then into the City of Phoenix. Some flood control projects would be appropriate to concentrate shallow flows and increase the land area available for development. Regional sediment basins may be needed to trap sediment and allow for its collection and removal in an organized fashion. A set of guidelines allowing for orderly development of the area, consistent across political boundaries, is also required. The District is entering into Intergovernmental Agreements with Phoenix, Scottsdale and others to share in the cost of drainage analysis of the area.

Orangewood Storm Drain

A six-mile length of regional storm drain is proposed for construction in the City of Glendale approximately along Orangewood Avenue from Grand Avenue (67th Avenue) to the New River. The drain would also be used by the City of Peoria as a drainage outfall. Potentially, Peoria, Glendale, and ADOT may share costs with the District on the project.

In addition to the drain, two detention basins may be required. The Orangewood drain was recommended in the Glendale/ Peoria ADMS. It would be constructed to protect against the 10-year frequency storm. Estimated total cost is $15 million.

Cactus Drain

The Cactus Drain is a three and one-half mile long storm drain extending from 67th Avenue west to the New River. The drain will have a ten-year flood capacity. The District will share the cost of the drain with the cities of Glendale and Peoria.

Old Cross Cut Canal

This project involves the construction of a channel from the Arizona Canal to McDowell Road to provide protection against the 25-year frequency storm. The District would share costs with the City of Phoenix; Phoenix would pay for obtaining the rights of way, relocating utilities, and coordinating public involvement, and the District would pay for the remaining costs. The total project cost is $10.6 million with Phoenix paying $2.9 million and the District paying $7.9 million.

Tenth Street Wash

The City of Phoenix is interested in participating in the construction of an urban channel to collect flows in this drainage area. However, the project requirements have to be defined: an analysis of the drainage area contributing to the 10th Street Wash and its tributaries is required before the design concept can be finalized.

Cave Creek Improvements

The drainage improvements associated with ADOT's Outer Loop Freeway between 7th Street and 16th Street may generate a positive benefit/cost ratio for drainage improvements to Cave Creek in that area. The City of Phoenix is a potential partner in the project.

Salt River Channel, Tempe (Mill Avenue to Price Road)

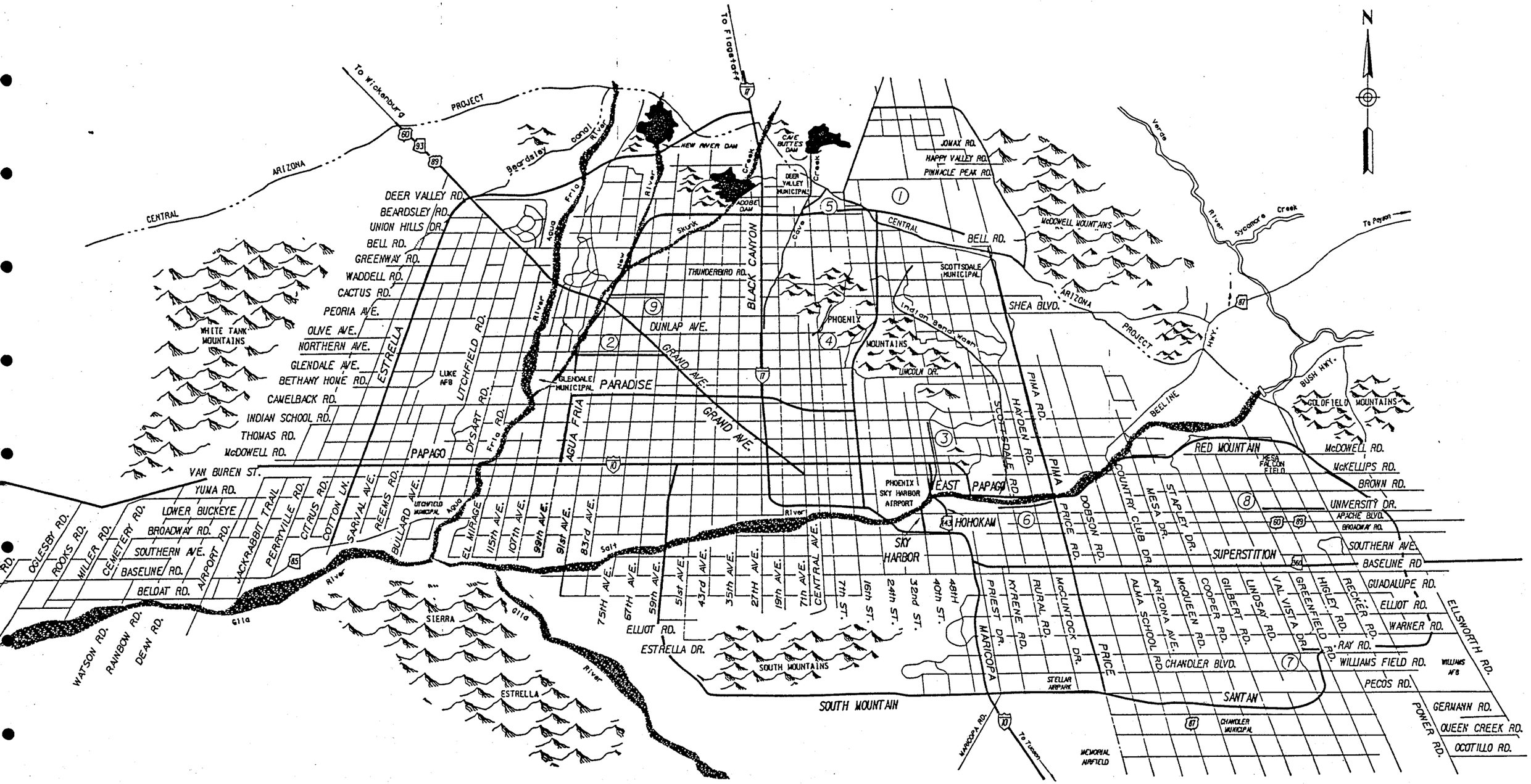
The District, together with Tempe and ADOT, will channelize a reach of the Salt River. ADOT is participating by providing bank stabilization needed for the Papago Freeway; the District is participating in the flood control aspects of bank stabilization; Tempe is interested in the project to enhance the riverfront area for community development. The intergovernmental agreements are currently being negotiated between the District, ADOT, and Tempe.

Gilbert Detention Basin

A detention basin will be constructed in the east valley, north of the Southern Pacific Railroad and east of the Eastern Canal. This basin will detain water which now flows across the Eastern Canal and floods the Town of Gilbert. The District and the Town of Gilbert will share the cost for this project.

Velda Rose Channel and Storm Drain Project

A detention basin will be constructed northeast of the intersection of the East Maricopa Floodway and University Drive. An interceptor channel with 100-year capacity will be constructed from Power Road west to the detention basin. The channel will be located in the utility corridor along the quarter section line north of University Drive. A 10-year capacity storm drain will be constructed along University Drive from Power Road west to a City of Mesa storm drain, located near Higley Road. The District and the City of Mesa will share the cost of this project.



COOPERATIVE PROJECTS WITH OTHER AGENCIES (CITIES)

1. Upper Indian Bend Wash
2. Orangewood Storm Drain
3. Old Cross Cut Canal
4. Tenth Street Wash
5. Cave Creek Improvements
6. Salt River Channel, Tempe (Mill Ave. to Price Rd.)
7. Gilbert Detention Basin
8. Velda Rose Channel and Storm Drain Project
9. Cactus Drain

VI

Soil Conservation Service Cooperative Projects

Soil Conservation Service Proposed Construction Work

The following table outlines the flood control projects that have been developed and proposed by the Soil Conservation Service (SCS) of the United States Department of Agriculture. The SCS has provided construction cost estimates (in 1989 dollars) as well as the proposed construction start dates for each project. The Flood Control District would be responsible for construction costs.

Flood Control Projects Proposed by the SCS

Project	Watershed	SCS Estimated Construction Cost (1989 Dollars)	Start Date
Signal Butte Floodway Inlet Repair	Buckhorn-Mesa	100,000	1990
Powerline FRS Repair	Apache Junction- Gilbert	1,500,000	1990
East Maricopa Floodway Reach 1 Repair	Williams-Chandler	1,500,000	1990
Powerline Floodway	Apache Junction- Gilbert	625,000	1991
Spookhill Floodway Extension	Buckhorn-Mesa	2,625,000	1992
East Maricopa Floodway Reaches 3, 4, 5, & 6—Landscaping	Apache Junction- Gilbert	2,000,000	1993
Centennial Levee, Reach 2	Harquahala	1,000,000	1993
Centennial Levee, Reach 2–Landscaping	Harquahala	100,000	1995

Multi-Objective Flood Control Projects in Cooperation with the SCS

Overbank storage is being eliminated by upstream urban development that continues to encroach on the floodplain. Furthermore, as stormwater is forced through narrow, urbanized sections of the river, space needs to be provided downstream to diffuse the energy of the floodwater. Downstream overbank storage is also required to account for the difference between FEMA floodway delineations presently in effect (which are supposed to limit the rise in the 100-year water surface elevation to one foot or less), and the encroachment limits for the Modified Floodway (which actually do affect the one-foot rise in the 100-year water surface elevation). The Flood Control District is seeking non-structural methods of recapturing lost overbank storage and reducing the speed of channelized floodwater.

One method currently being considered is to convert overbank areas to wetlands, using natural vegetative communities to diffuse the energy of the floodwater, thereby preventing soil erosion. A secondary objective is obtained by the creation of wetlands: compliance with the Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System (NPDES) program. The EPA now identifies governmental agencies as the responsible parties for reducing non-point source pollution, making the Flood Control District responsible for reducing pollutants in the stormwater that drains into the rivers. Wetlands can be used to "detoxify" high levels of chemical wastes in stormwater. The technology is available to use natural vegetative communities to reduce harmful toxin levels from municipal wastewater, industrial wastewater (metals), and agricultural waste products (e.g., nitrates, pesticides).

The District, in order to comply with and further the NPDES concept, is interested in modifying existing and future Flood Control District project facilities to include natural or artificial wetland features. One reason is that unnaturally high levels of nutrients in runoff from agricultural lands and from urban sewage effluent have dramatically increased vegetative growth in the river channels. This, in turn, increases the maintenance costs for the Flood Control District—the agency charged with maintaining a clear flow path for floodwaters in the river channels and within the floodplain limits (as shown on the FEMA maps).

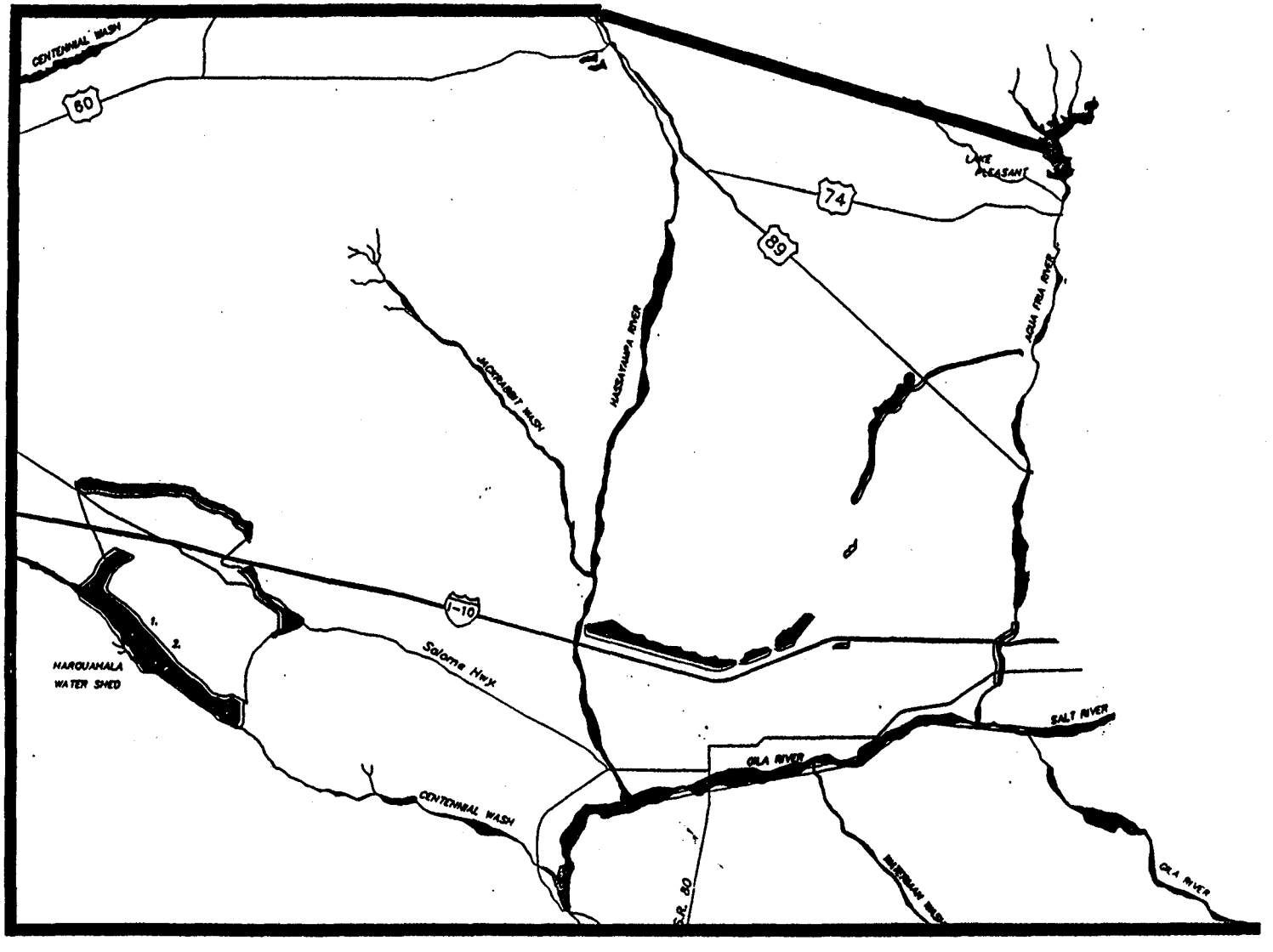
Because the major river channels containing the wastewater effluent and urban stormwater drainage are within the Flood Control District's jurisdiction, it is the logical agency to undertake a wetlands project—in cooperation with an environmental sponsor. The projects would be constructed by the District as "overbank storage" areas and then be converted by environmental agencies into wetland areas—without compromising the flood control objectives of the project.

Potential Locations for Demonstration Projects

The following areas have been identified as possible locations for demonstrating the effectiveness of wetlands for flood control purposes. These areas have been chosen based on available surface water.

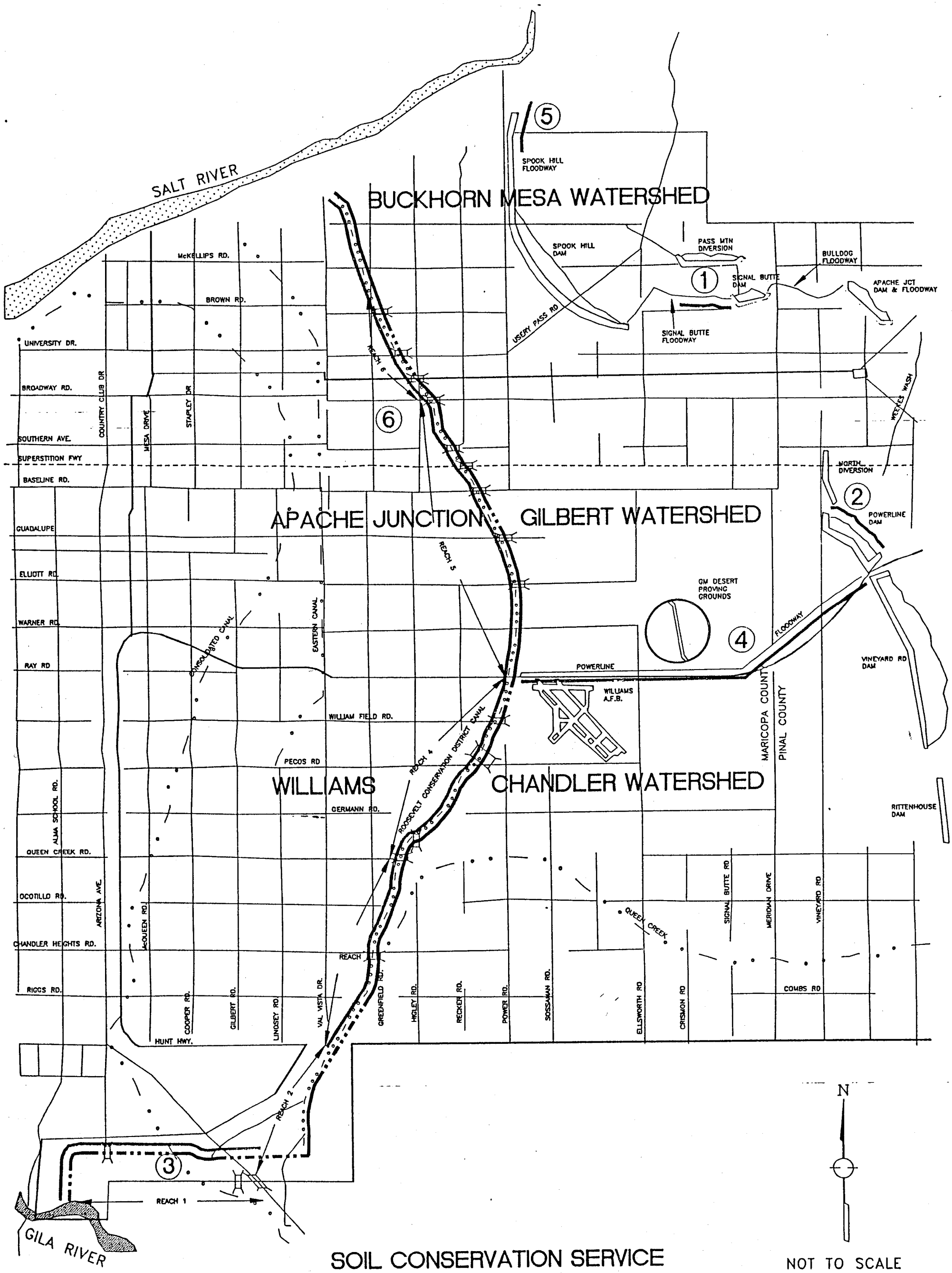
- Salt River, 27th Avenue West to Gillespie Dam; (District channel clearing project extends from Gillespie Dam, East to 91st Avenue) or Gillespie Dam to Painted Rock Dam.

- Hassayampa River at the Wildlife Refuge downstream from Wickenburg; or, downstream from Wickenburg's wastewater treatment plant (no nearby District project).
- Centennial Wash, upstream from Aguila, at the existing marsh area (no nearby District project).



Soil Conservation Service Proposed Construction Work

1. *Centennial Levee, Reach 2*
2. *Centennial Levee, Reach 2 Landscaping*



SOIL CONSERVATION SERVICE
PROPOSED CONSTRUCTION WORK

1. SIGNAL BUTTE FLOODWAY INLET REPAIR
2. POWERLINE FRS REPAIR
3. EAST MARICOPA FLOODWAY REACH 1 REPAIR
4. POWERLINE FLOODWAY
5. SPOOKHILL FLOODWAY EXTENSION
6. EAST MARICOPA FLOODWAY REACHES 3,4,5,& 6 – LANDSCAPING

VII

Regional Hydraulic Master Plan

The Salt and Gila Rivers flow through eight different local political subdivisions in the Phoenix metropolitan area. Development in the floodplain is regulated separately by each agency on a site-specific basis. The effect of each development on other sites is not considered—either within one jurisdiction or throughout the rest. Given the rapid development of the Phoenix metropolitan area, and the 75 miles of river channel involved, the cumulative effect of development needs to be evaluated before this problem grows worse.

The cumulative effect of developing the floodplain was first recognized as a problem when local regulatory agencies were reviewing individual building permits in the floodplain. Individuals developing in the floodplain would have to generate only simple data to show that they were *not* affecting the rest of the floodplain. However, if two adjacent parcels were developed, the effect of each development on the other became readily apparent. The engineering safeguards were much more complicated than in the individual cases.

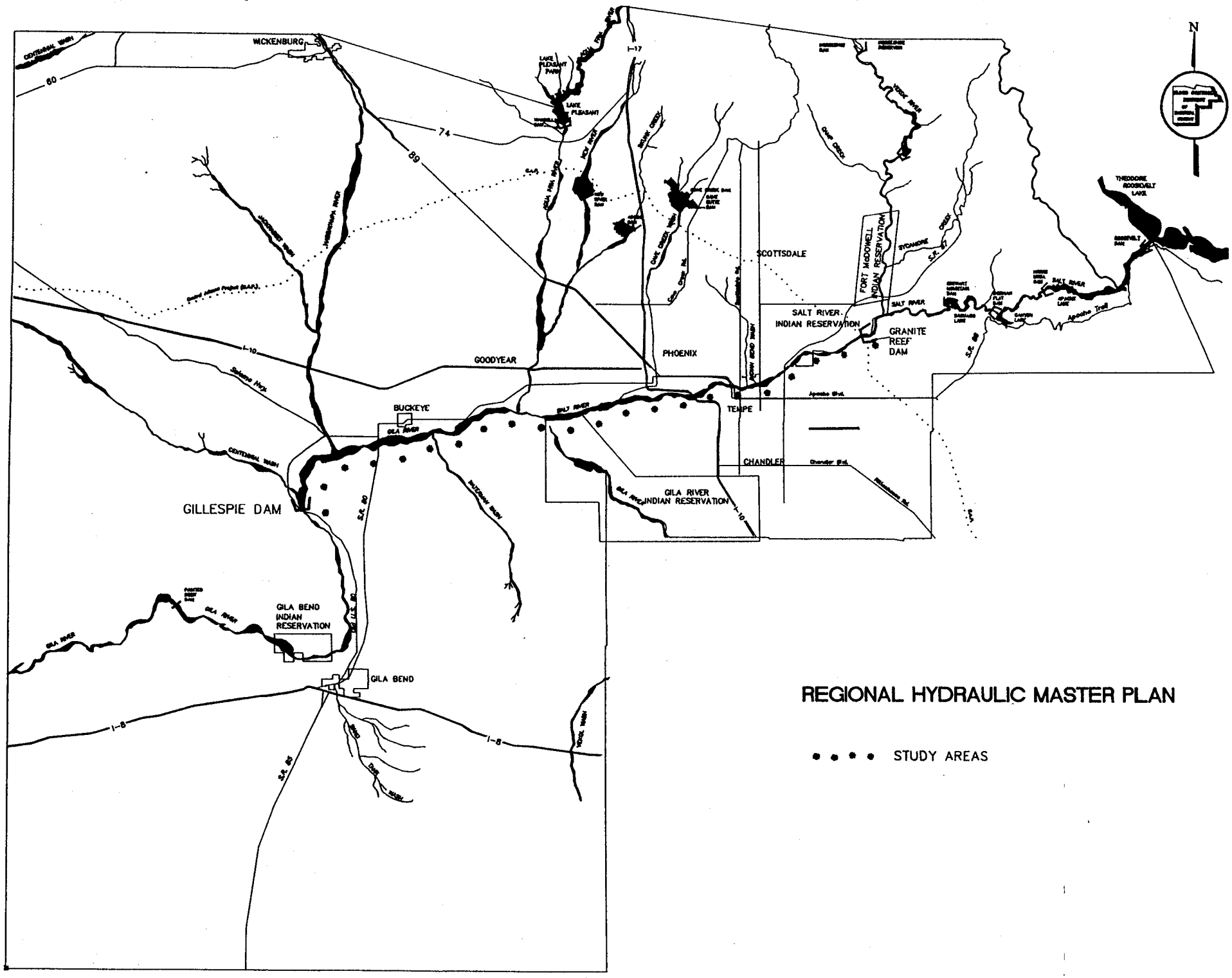
On a larger scale, developers were coming to the Flood Control District with requests to channelize one side of the channel of the major rivers, several miles at a time. The channelization would affect adjacent bridges as well as the property on the opposite side of the river.

The downstream half of the Salt/Gila River flows through unincorporated County, falling under the jurisdiction of the Flood Control District. Having jurisdiction over the unincorporated, downstream river reach, the District becomes the recipient of the changes in the river channel geometry upstream, with the attendant changes in hydraulic characteristics.

The District is promoting the formulation of a Regional Hydraulic Master Plan of the Salt and Gila Rivers through the metropolitan area to determine opportunities and solutions to flood control, drainage, and environmental problems associated with the rivers. The objective of a Regional Hydraulic Master Plan is to generate a hydraulic master plan for the river with all of the political entities involved setting forth their projected maximum development schemes. The point is not to restrict development, but to anticipate development, make that information readily known, and design accordingly—up *and* down the rivers.

The geographical, jurisdictional, and river-related concerns that exist here in the Phoenix Metropolitan area are also present in the Trinity River corridor in the Dallas/Fort Worth (DFW) area. The Corps of Engineers, in cooperation with the DFW local governments, has published the Final Regional Environmental Impact Statement (EIS) report which establishes the Corps of Engineers' permitting strategy for modification and development in the Trinity River and its tributaries. Their efforts serve as a model for cooperation along the Salt and Gila Rivers.

The project concept is to conduct a cost-shared study to produce a detailed comprehensive hydrologic and hydraulics model which will be updated as new developments occur within the affected watersheds. The common database will utilize a regional geographic information system. The Flood Control District, Arizona Department of Water Resources (ADWR), or a consultant could be contracted to maintain the model for the local communities, once that model is developed.


N
WICKENBURG
LAKE PLEASANT PARK
LAKE PLEASANT
I-17
60
74
89
SCOTTSDALE
FORT McDOWELL INDIAN RESERVATION
SALT RIVER INDIAN RESERVATION
GRANITE REEF DAM
THEODORE ROOSEVELT LAKE
PHOENIX
GOODYEAR
I-10
BUCKEYE
TEMPE
CHANDLER
GILA RIVER INDIAN RESERVATION
GILLESPIE DAM
GILA BEND INDIAN RESERVATION
GILA BEND
I-8
REGIONAL HYDRAULIC MASTER PLAN
STUDY AREAS

VIII

Non-Structural Flood Control

The bulk of this report has been concerned with *structural* means of reducing or eliminating flood losses within Maricopa County. There are, however, several other ways of mitigating flood damages which do not require the construction of a dam or channel. Non-structural programs currently in effect at the District are: floodplain management, drainage administration, flood warning, and public involvement.

Floodplain Management

When regulating floodplains, the District identifies flood-prone areas and limits or restricts land use within those areas. In 1973, the Arizona State Statutes were modified to specifically address flood problems and to empower counties, cities, and towns to establish appropriate regulations in accordance with the National Flood Insurance Program (NFIP) for the floodplain management of streams, lakes, and watercourses within their jurisdictions.

On July 14, 1975, the first approved floodplain regulation for the unincorporated areas of Maricopa County was adopted by the Board of Supervisors, and the County began reviewing land development and issuing floodplain use permits based on preliminary floodplain delineations. The District began acting as the technical staff in charge of reviewing plans and commenting on whether development is appropriate for the floodplain or if it would conflict with the operation and function of any existing or proposed flood control projects.

In August 1984, the State Statutes were again revised, specifically charging each County's Flood Control District with floodplain management responsibility—even within corporate limits of cities and towns, unless their governing body accepted the responsibility by resolution.

The old 1975 floodplain regulation was replaced by a more comprehensive regulation to remain in compliance with the revised statutes and the previous revisions to the NFIP rules and guidelines. The new regulation became effective August 4, 1986, and is still in effect. The objectives of the District's aggressive floodplain regulation program are to:

1) maintain the County's participation in the NFIP;
2) identify flood-prone areas as required by State Statutes;
3) update and expand the flood insurance mapping coverage within Maricopa County;
4) determine which areas of development may require protection; and
5) minimize the potential liability as a result of allowing development in or near delineated flood hazard areas.

Since 1986, approximately 100 linear miles of floodplain have been delineated each year, in addition to delineations that are being conducted as a part of the Area Drainage Master Studies. (ADMS floodplain delineation is estimated at 200 to 300 linear miles per year.)

Drainage Administration

In addition to floodplain management, the District—pursuant to an agreement with the County—also administers drainage regulation throughout the unincorporated areas of the County. Drainage administration is performed in accordance with the *Uniform Drainage Policies and Standards for Maricopa County* and the *Drainage Regulation for Maricopa County* (adopted September 26, 1988). The District, as a contract agent, also administers drainage regulation for some incorporated communities, and reviews drainage plans for proposed development. These communities then reimburse the District for staff time spent reviewing plans.

The drainage branch also responds to inquiries about flooding that occur during rainfall events, and coordinates development to assure that there is continuity of drainage design and no conflict between proposed development and existing or proposed Flood Control District projects.

Flood Warning

The District's Flood Warning System is an important element of nonstructural flood protection because it provides current or "real time" information about rainfall and runoff across Maricopa County. The District budgets toward the development, maintenance and operation of a flood alert and storm monitoring capability in support of the County Civil Defense and Emergency Services Department's (CD&ES) mission. The flood warning alert system is based on a system of rain and stream stage gauges strategically located throughout the County and telemeter-linked to a central computer equipped with software to collect and analyze precipitation data. An audio and visual alarm alerts the operator to investigate conditions during an unusual event. A secondary function of the flood warning program is that the rain gauges are calibrated and maintained to provide precipitation data that is precise, consistent, and suitable for entering in the database and for later retrieval when compiling reports and models.

A short range goal of the system is to provide instrumentation at all existing and planned flood control structures to facilitate the execution of the requirement to monitor these during impoundment or flow events.

An intermediate goal of the system is to develop watershed runoff models for each of the gauged watersheds so that precipitation data can be readily converted to runoff estimates. Consideration is given in the development of runoff models as to the needs of the County CD&ES Department, the County Highway Department, and the District's need to monitor existing critical flood control problem areas.

A long range goal of the system is to develop a flood forecasting program that would supplement the National Weather Service forecasting program and monitor specific needs of the County and municipalities in the District.

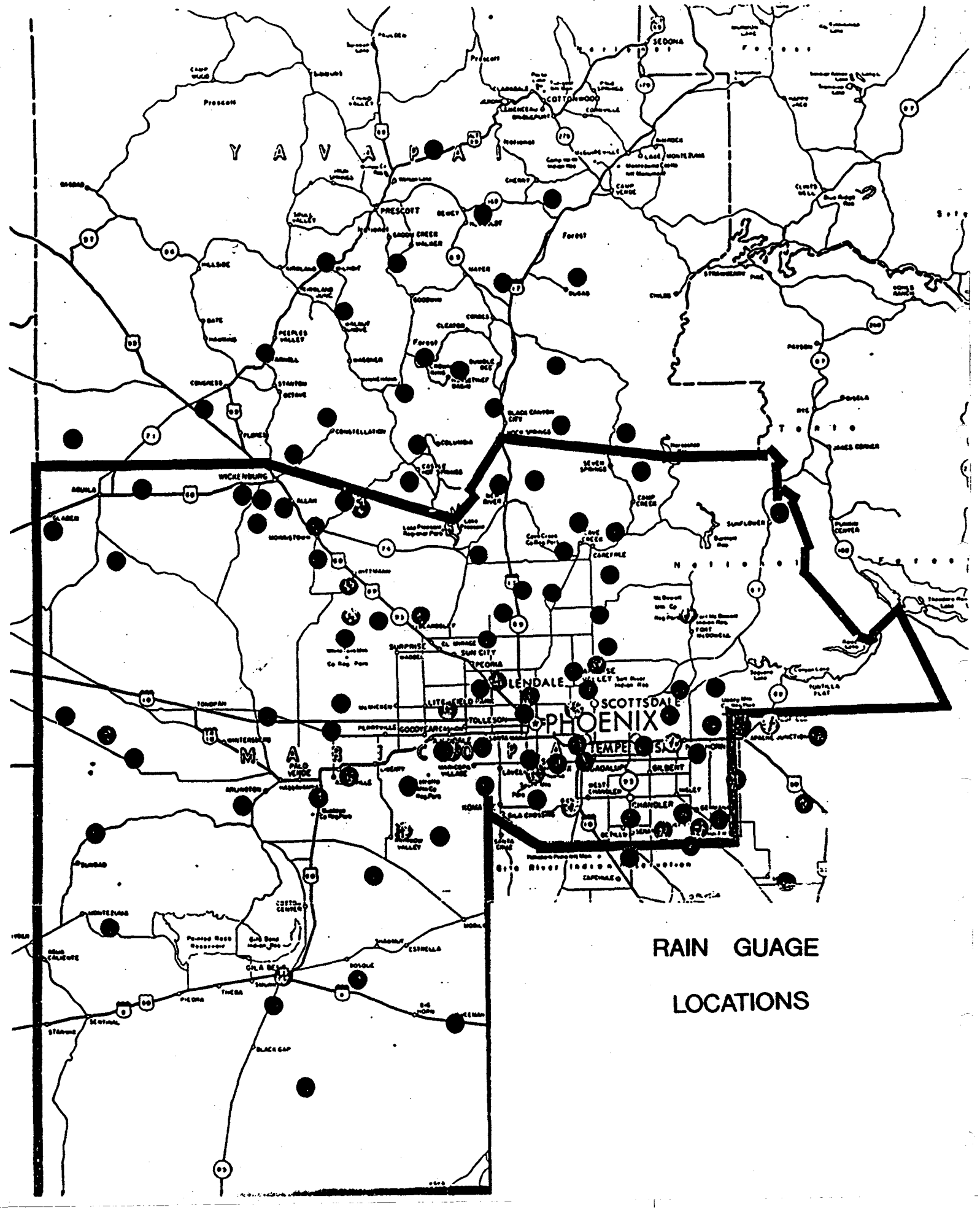
The District installed its first telemetered rain gauge in 1980, after the floods of 1978 demonstrated the importance of having rainfall and runoff information on a real time basis. By the end of 1990 the District expects to have 123 telemetered rain gauges and 47 telemetered stream gauges in Maricopa County and surrounding counties.

Public Involvement

Through the Public Involvement program, the District holds public meetings and hearings to inform citizens of the potential impact of flood control projects on their neighborhoods. The public is informed of the nature of the hazards and the measures being considered to mitigate them.

The primary purpose of the public involvement program is to gather citizen input about flooding in an area and to develop criteria to be used in designing protective measures. A secondary mission of the program is to preserve, for the record, a summary of the planning activities, operations, and actions for each of the District's capital projects. The Public Involvement Coordinator also produces information and educational materials for citizen self-help efforts for protection against local runoff and drainage problems, floodplain management program information, and drainage administration program information.

Additional information and educational programs are developed and kept current for use in school and civic organization programs. The District has set up booths at the State and County Fairs; published pamphlets, brochures, and coloring and activity books; and made classroom presentations to promote flood awareness for all age groups.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CHANDLER
SUN CITY
PEORIA
TOLLESON
GOODYEAR
BUCKEYE
PALO VERDE
GILA BEND
RAIN GUAGE
LOCATIONS

ARS § 48-3616.
Survey and report of flood control problems and facilities; comprehensive program; adoption by board; hearing

A. After a flood control district has been established in a county having a population of over three hundred thousand persons according to the latest federal decennial census, the board shall cause the chief engineer to make or have made by the flood control engineer or by qualified private engineers a survey of the flood control problems of the district and to prepare a report describing existing flood control facilities in the area, recommendations as to cooperation between the district and the owner or owners of existing facilities, recommendations and a preliminary plan for the construction of or other acquisition of facilities to carry out the purchase of the district, a description of the property proposed to be acquired or damaged in performing the work, a program for carrying out the regulatory functions, a map showing the district, boundaries and location of the work proposed to be done and property taken or damaged, an estimate of the cost of the proposed work and such other things as the board of directors may request. Before submission to the board of directors, the report shall be submitted to the citizens' advisory board if one is established for its review and recommendations. The report shall be prepared at least every five years beginning in 1985 and shall indicate the past efforts of the district in eliminating or minimizing flood control problems and state the planned future work of the district to eliminate or minimize flood control problems.

B. The chief engineer and his staff shall then prepare a comprehensive program of flood hazard mitigation, taking into consideration the recommendations submitted in the report. When a comprehensive program satisfactory to the board is available, the board shall tentatively adopt and schedule a public hearing on the program and the performance of the proposed work. The comprehensive program shall be reviewed and modified as necessary to reflect the past and future planned flood control works of the district. Notice of the hearing shall be given by publication once a week for two consecutive weeks in a newspaper of general circulation in the area of jurisdictions, the first of which shall be at least ten days before the date fixed for the hearing.

C. The chief engineer and his staff shall prepare and submit to the board a five year capital improvement program in a form approved by the board three months before the final date for submission of the annual budget. The program shall separately identify capital improvements for engineering, rights-of-way and land acquisition and construction with such supporting explanations, cost estimates and completion schedules as the board may require. The program shall be annually reviewed for endorsement by the citizen's advisory board if one is established.

D. After a flood control district has been established in a county with a population of fewer than three hundred thousand persons, the chief engineer may conduct a survey of flood control problems, prepare a comprehensive program for flood control and a five year capital improvement program pursuant to this section. He shall at least make an assessment of flood control problems in the area of jurisdiction and make an annual report of his findings and recommendations for dealing with them to the board.

General Policies Concerning the Allocation of Fiscal Resources to Accomplish the District's Functions and Responsibilities

I. PURPOSE

This policy statement is designed to describe the functions and responsibilities of the District and to reflect the fiscal policy of the District as it relates to funding and cost sharing with others for the accomplishment of engineering or hydrologic studies, engineering designs, master planning, and construction implementation of the resulting plans.

II. OPERATIONS

A. GENERAL—The District is organized pursuant to ARS § 48-3601, et seq. The District's functional purpose is to prevent loss of life or injury to residents and the elimination or minimizing of damages to real and personal property from flooding within the geographical limits of Maricopa County. In accomplishing this purpose, the District uses a variety of structural (dams and channels) and nonstructural (managing and regulating) tools. These tools are discussed in subsequent sections. While the District is both reactive and proactive in its work, historically most of its energies have been appropriately directed toward remedial measures rather than anticipating and preventing future problems. An intent of this policy is to make the District more proactive in the resolution of flooding problems within Maricopa County.

B. MAINTENANCE—The highest priority for the annual expenditure of District funds shall be for the operations, maintenance, and repair of existing flood control facilities as follows:

- Maintenance and repairs necessary to ensure the safe operations and the structural integrity of facilities, and to assure the operation of facilities in accordance with the design/construction capabilities and local sponsorship agreements between the District and federal agencies, or intergovernmental agreements with municipalities in the county. This funding shall take precedence over other operational or capital improvement projects.
- Preventive maintenance and repairs necessary to prevent or reduce damages or deterioration resulting in future repairs. This funding may be prioritized after the allocation of funds necessary to complete capital projects in progress.
- Maintenance and repair of landscaping, aesthetic treatment, and maintenance access roadways in accordance with the original design/construction or to project a positive image of the District. This funding may be prioritized after the allocation of funds to initiate Comprehensive Plan projects, but before the allocation of funds for cost sharing in capital projects with other municipalities.

C. PLANNING—Each five years, the District shall conduct a survey and prepare a report describing the remaining flooding problems and the existing flood control facilities in the district (see Appendix A for the requirement contained in ARS 48-3616). In the conduct of the survey, the District shall solicit comments from and consult with communities in the district. The report shall include recommendations concerning cooperation among the District, incorporated communities and the owner(s) of existing facilities, conceptual or preliminary plans for construction or acquisition of facilities to mitigate each flooding problem, and a description of the land to be acquired to perform the work. The report shall also include a description of the programs necessary to carry out the regulatory functions of the District.

Following the preparation and approval of the above mentioned Survey Report of Flooding Problems, a Comprehensive Plan for Flood Hazard Mitigation shall be prepared each five years, taking the recommendations of the survey report into consideration. The plan shall include a tentative priority, time schedule, estimated cost, and the estimated benefit/cost ratio for implementation of the various projects or project elements required to mitigate the flooding problems in the district. In the preparation of the Comprehensive Plan, the District shall consult with and consider the recommendations of the incorporated communities, and conduct at least one public hearing before the Flood Control Advisory Board (FCAB) or the Board of Directors. The Survey Report of Flooding Problems, and the Comprehensive Plan for Flood Hazard Mitigation shall be approved by both the FCAB and the Board of Directors.

In conjunction with the Annual Budget and 5-year Capital Improvements Program submittal, a Budget Plan shall be prepared to describe the expenditures necessary to achieve the regulatory programs and implementation of the Comprehensive Plan. The Budget Plan shall include the functional categories of the operational budget and the capital improvements budget.

1. The operational budget shall include a detailed description of the expenditures necessary to accomplish the operations and maintenance, regulatory functions (floodplain management and drainage administration), public involvement program (information booklets, etc.), and the planning functions of the District. It will include expenditures necessary to accomplish Area Drainage Master Studies (ADMS) and Area Stormwater Management Plans (ASMP), and the planning cycle for development of Comprehensive Plan Projects (reconnaissance level investigations to determine the full extent of a reported flooding problem and to identify alternative solutions worthy of consideration; feasibility level study and economic analysis necessary to determine if a project is justified).

2. The annual capital improvements budget and 5-year Capital Improvements Program shall include a detailed description of the expenditures necessary to achieve projects involving cost sharing with other agencies, implementation of ASMPs resulting from the ADMS program, and implementation of the priorities and time schedule in the Comprehensive Plan, e.g., engineering and hydrologic studies, engineering design, acquisition of rights-of-way, relocations of utilities, construction management, and construction.

D. FLOOD WARNING—The District shall budget up to 2 percent of its tax revenues on an annual basis, including personnel and overhead, toward development, maintenance and operations of a flood alert and storm forecasting capability in support of the County Civil Defense and Emergency Services Department's (CD&ES) mission. The flood warning alert system shall be based on a system of rain and stream stage gauges appropriately sited throughout the County and telemeter-linked to a central computer equipped with adequate software to collect and analyze precipitation data and sound an audio or visual alarm to cause an operator to investigate the circumstance of the alarm. As a secondary requirement, the rain gauges shall be calibrated and maintained so that the precipitation data will be of adequate quality for archiving.

A short range goal of the system is to provide instrumentation at all existing and planned flood control structures to facilitate the execution of the requirement to monitor those during impoundment or flow events, and to develop watershed models so that inflows and outflows can be estimated on the basis of precipitation data.

An intermediate goal of the system is to develop watershed runoff models for each of the gauged watersheds so that precipitation data can be readily converted to runoff estimates and alert or warning messages. The development of the runoff models shall be based upon the requirements of the County CD&ES Department, the County Highway Department, and the needs of the District to monitor existing critical flood control problem areas.

A long range goal of the system is to develop a flood forecasting program to supplement the National Weather Service forecasting program, but geared to the specific needs of the County and the municipalities in the District.

E. REGULATORY FUNCTIONS

1. FLOODPLAIN MANAGEMENT—The District shall maintain the County's good status in the Federal Flood Insurance Program through the administration and enforcement of the Floodplain Regulation for Maricopa County. Pursuant to ARS § 48 - 3609, the District shall exercise floodplain management jurisdiction throughout Maricopa County including all incorporated communities unless the community has assumed the powers and duties for floodplain management pursuant to ARS § 48 - 3610.

   In accordance with the survey report of flood control problems and the Comprehensive Plan, the District shall budget up to 2 percent of its tax revenues on an annual basis, including personnel and overhead, toward the nonstructural solutions to floodplain management. The District shall cost share with the Federal Emergency Management Agency (FEMA), in order to entice FEMA into a higher priority for the accomplishment of new or revised floodplain delineations of natural rivers, streams, and washes within its jurisdiction by providing the necessary aerial mapping and topography to the federal government. The District may accomplish new or revised floodplain delineations without FEMA participation when approved by the FCAB and the Board of Directors. The District may assist local jurisdictions by cost sharing for not more than 50 percent of the cost for aerial mapping and topography provided that the resulting floodplain delineation

is an integral part of and/or ties into a floodplain within the District's management jurisdiction.

2. DRAINAGE ADMINISTRATION—Pursuant to an agreement with the County, the District exercises drainage administration jurisdiction throughout the unincorporated areas of Maricopa County. Drainage administration shall be in accordance with the Uniform Drainage Policies and Standards for Maricopa County and the Drainage Regulation for Maricopa County. The District may perform the function of drainage administration for an incorporated community, including review of drainage plans for development within the community's jurisdiction, under the authority of an IGA, provided the community will pay the hourly wage and benefits for the review time, and the submitter will pay review fees to the District.

F. PUBLIC INVOLVEMENT—A portion of the annual operating budget, and a portion of each major Capital Project budget, shall be earmarked for a public involvement program. The public involvement shall use the public meeting and hearing format to inform the citizens to be impacted by a capital flood control project. The public will be informed of the nature of the hazard and the measures being considered to mitigate the hazard. The primary purposes of the public involvement program are the gathering of citizen input about concerns of flooding in their area and assembling criteria to be used in design of the protective measure, e.g., the desire for wide open channels to facilitate public recreational use versus underground conduit or narrow lined channels to provide a greater area for development. A secondary mission of the program shall be directed to preserving for the record a summary of the planning activities and actions in each capital project and the operations of the District. The Public Involvement Coordinator shall also produce information and educational materials for citizen self-help efforts for protection against local runoff and drainage problems; floodplain management program information; and drainage administration program information.

An information and educational program concerning District activities shall be developed and kept current for use in school and civic organization programs. Every attempt shall be made to maintain the public image of the District as a proactive rather than a reactive organization, with a positive attitude of service to the citizen.

III. CAPITAL IMPROVEMENTS

The 5-year Capital Improvements Program shall include all costs associated with the implementation of projects or elements of projects in the Comprehensive Plan, including federal projects sponsored by the District; all costs associated with cost sharing in projects to be owned and maintained by others; and all costs associated with implementation of the Area Stormwater Management Plans (ASMP) resulting from the Area Drainage Master Study (ADMS) program.

Public involvement meetings will be held in the area impacted and protected by the proposed project prior to initiation of final design. The purpose of the meetings will be to determine public support and acceptance for the project and to receive public input concerning the design parameters to be used as they affect aesthetics and multipurpose uses of the project.

Multipurpose uses of flood control projects will be encouraged to the extent that other uses do not interfere with the operation of the flood control facility and do not significantly increase the maintenance requirements of the facility. Flood control funds shall not be expended for project elements or items designed to exclusively serve purposes other than flood control, however, flood control funds may be expended to upgrade elements required for flood control purposes if such upgrade will make the element suitable for multipurpose uses, e.g., meandering maintenance access roads for hiking and bicycling trail use. Funding for upgrades shall be budgeted in the Capital Improvements Program.

A. COMPREHENSIVE PLAN PROJECTS—The District shall budget up to 75 percent of its tax revenues on an annual basis toward the accomplishment of projects or elements of projects included in the Comprehensive Plan to the extent that such projects are available or ready for implementation; if no such projects exist, these revenues may be used for other projects in the Capital Improvements Program. This level of funding may be reduced if funds are required for the maintenance of existing facilities in accordance with the priorities specified in paragraph IIB. above.

Comprehensive Plan projects shall include all federally funded flood control projects for which the District has agreed to be a local sponsor.

Comprehensive Plan projects developed locally shall be considered on the basis of an economic analysis of the annual flood control benefits being greater than the annual project costs, including all engineering design, administration, land acquisition, construction, maintenance, operations, and repair, over the life of the project (normally assumed to be equal to the level of flood protection provided) using a nominal 3 percent discount rate (as an approximation of the average annual rate of inflation). In addition to flood damages prevented or relieved, other economic benefits including inconvenience to the public, transportation delays, multiuse programs, environmental and social benefits may be credited to the extent that they can be quantified and supported. The benefit to cost ratio determined for each project shall be published in the Comprehensive Plan and used in the decision process for determining priorities.

Comprehensive Plan projects shall normally provide protection from flood damages resulting from the 100-year rainfall event runoff (future development conditions assumed in accordance with the projections of the County Planning and Development Department) producing a peak flow of not less than 800 cfs. A lower level of protection may be used if an economic analysis indicates a greater benefit to cost ratio for the lower level of protection than for the 100-year protection, and damages are not induced at higher recurrence intervals.

Flood retarding structures or dams constructed under this program shall be designed in accordance with Corps of Engineers or Soil Conservation Service design criteria.

Flood control channels will be designed to contain the selected design flow plus an appropriate amount of freeboard.

Flood control levees will be designed in accordance with Corps of Engineers design criteria to contain the Standard Project Flood (SPF) or to withstand

overtopping without catastrophic failure, except in that case where downstream conditions would be significantly worsened or where an existing downstream flood control structure would be endangered or rendered ineffective, and excepting the case where the area protected by the levee remains in the floodplain under the jurisdiction of the District. The exceptions will be evaluated and criteria established on an individual basis.

Funding priorities for Comprehensive Plan projects will be determined on the basis of the benefit to cost ratio computed for the project prior to the publication of the plan, and will be published in the plan. Funds will be budgeted for implementation of projects on the basis of priorities except as recommended by the Flood Control Advisory Board and approved by the Board of Directors. The annual level of budgeting and priority for each project will be determined based upon the District's ability to achieve the work within the budget year, e.g., accomplish the engineering design, acquire land rights, and initiate construction contracts. Funding priorities published in the Comprehensive Plan will be reviewed during the third year after publication of the plan, revised, and an amendment published, if appropriate.

B. SHARING OF COST IN PROJECTS TO BE OWNED BY OTHERS—The District shall budget up to 5 percent of its tax revenues on an annual basis for cost sharing in local flood control or stormwater management plan (other than the District's ADMS program) implementation with municipalities. Projects eligible for cost sharing will be individual or stand alone projects or projects not resulting from the Area Drainage Master Study program having a total cost of less than $2 million. No more than 30 percent of the funds budgeted for this purpose shall be allocated to any one municipality, unless no competing projects have been developed or unless a greater need can be justified. During the March meeting of the Flood Control Advisory Board each year, staff will advise the Board as to the funds remaining and available in this category for cost sharing in other projects or for allocation to an ongoing project.

The District's cost sharing contribution to individual, stand alone projects, or elements of the municipal stormwater management plan shall not exceed 50 percent of the project engineering, construction, construction management, and land acquisition costs (no payment or cost sharing will be made for road or street rights-of-way). The District shall not cost share in the internal administrative cost of the municipality for development or management of the project. Projects in this category must demonstrate clear flood control benefits, however, no detailed analysis of the benefits is required.

C. AREA STORMWATER MANAGEMENT PLAN—The District shall budget up to 10 percent of its tax revenues on an annual basis for the implementation of Area Stormwater Management Plans arising from the Area Drainage Master Study program. The purpose and goals of the ADMS program and the methodology for developing an ADMP are enumerated in Appendix C. Cost sharing in the implementation of an ASMP is an effort to avoid the flooding problems which would require future remedial measures.

The Flood Control District will maintain a master map file showing the location of all reconnaissance, feasibility, and ADMSs requested or underway, along with a file of background material for each area to include but not limited to: acreage,

approximate population and assessed valuation, history of flood events and damages, and a preliminary staff assessment of the known flooding problems.

During the budget preparation cycle beginning in December of each year and with the assistance of the Consulting and Advisory Groups (community representatives and others interested in flood control) to the Flood Control Advisory Board, staff will prepare a recommended priority listing for reconnaissance, feasibility, and ADMS accomplishment during the next fiscal year. The recommended priority list will be presented to the Flood Control Advisory Board at its February meeting for approval and inclusion in the budget. The priority list will identify those studies and ADMSs in each phase of accomplishment (e.g. mapping, hydrologic modeling, stormwater management alternative development, implementation) and the expenditures required to complete each remaining phase of each study. Staff will recommend a total budget amount to be allocated for the studies and the ADMS program for the fiscal year being budgeted. Representatives from the local jurisdictions will be given an opportunity to address the FCAB in support of their project.

The priority for accomplishing an ADMS shall be raised on the recommended priority list prepared by staff if the local jurisdiction has indicated a willingness to cost share in the study process and/or has made a commitment via its Council to approve and implement the ASMP resulting from the study.

1. FUNDING OF STUDIES, MODELING, AND IMPLEMENTATION OF APPROVED PLANS—The Flood Control District will fund the initial mapping, hydrologic study, and modeling of the selected area.

    a. Computer modeling for a specific recurrence frequency event and the development of the stormwater management alternative will be cost shared by the District and the local jurisdiction (and others as appropriate) such that the District's cost shall not exceed 50 percent of the total cost. Development of stormwater management alternative plans will ordinarily be accomplished by A/E Consultants under the management of the District's staff. The District shall not cost share in the implementation of an alternative stormwater management plan element which provides less protection than its counterpart in the plan originally developed by the District.

    b. Implementation of the Area Stormwater Management Plan will be the responsibility of the local jurisdiction through the planning, zoning, and development process. Implementation of the ASMP in areas where development has already taken place will be the responsibility of the local jurisdiction, with financial assistance from the Flood Control District not to exceed 50 percent based on criteria outlined below.

2. SHARING OF COST—Cost sharing in the implementation of ASMP elements shall be evaluated on a project element by project element basis upon written request from the local jurisdiction to the District. Upon receipt, the staff shall prepare a recommendation for presentation and approval of the Flood Control Advisory Board and subsequently by the Board of Directors. The local jurisdiction shall be given the opportunity of presenting factual information to the Advisory Board both in writing and in public presenta-

tion when the item is heard. Cost sharing by the District shall be considered under the following criteria:

(1) The local jurisdiction (City or Town Council) has adopted floodplain regulations and is enrolled in the National Flood Insurance Program.

(2) The local jurisdiction has adopted and is implementing the Uniform Policies and Standards for Drainage (UPSD).

(3) The local jurisdiction has approved and adopted the Area Stormwater Management Plan, or an alternative plan prepared by the District for a specific recurrence frequency rainfall event.

(4) The area is already developed and it is too late or impractical for the community to require implementation of the stormwater management plan element as a planning and zoning condition of development.

(5) Remedial action is required to reduced damages to the acceptable level as determined by the ASMP (reduction of damages below the acceptable level may be considered when justified by an economic analysis).

(6) The project element is a major or regional drain. Although a major drain is defined in the UPSD as a natural or man-made channel, conduit or wash serving a watershed of from 160 acres to 10 square miles, for the purposes of District cost sharing, the watershed shall be greater than 640 acres. A regional drain is defined as a main outfall for drainage, including rivers, washes, or man-made channels serving a watershed of more than 10 square miles.

    (a) Design, construction, construction management, and operations and maintenance for regional drains shall be the responsibility of the District.

    (b) Design, construction, construction management, operation, and maintenance of major drains shall be the responsibility of the local jurisdictions, unless they are interjurisdictional. A major drain is interjurisdictional if the most reasonable solution to the drainage problem lies substantially in more than one jurisdiction and/or significantly benefits one jurisdiction more than another. The District may assume responsibility for the design, construction, construction management, operation, and maintenance if requested by all the local jurisdictions involved and the local cost share is equally provided by the local jurisdictions.

    (c) Positive outfall must exist and be capable of handling the maximum discharge from the project element under consideration.

    (d) Detention basins constructed as an integral part of a regional or major drain shall be the maintenance responsibility of the local jurisdiction.

(7) Public involvement meetings have been conducted by the local jurisdiction concerning the project element and public support has been clearly demonstrated.

(8) If a project element serves purposes other than flood control (recreation or irrigation), the District will cost share only in the flood control aspects.

(9) If the local jurisdiction chooses to deviate from the approved ASMP and provide a facility of greater cost, e.g., closed conduit system verses an open channel system, the local jurisdiction shall bear the full incremental cost of the change based on the engineer's estimate of the cost for the most economical element.

The District's cost sharing with any one local jurisdiction shall not exceed 25 percent of the District funds budgeted for this purpose in that fiscal year, except when no cost sharing has been requested and approved for other local jurisdictions.

The District's cost share in any project element shall not exceed 10 percent of the District funds budgeted for this purpose in any fiscal year, except when no cost sharing has been requested and approved for another local jurisdiction.

D. ACCEPTANCE OF FACILITIES BUILT BY OTHERS—In accordance with its statutory authority, the District may acquire existing flood control or drainage facilities, or acquire and convert existing irrigation facilities with the mutual agreement of the owners, for the benefit of the district. The acquisition of facilities shall be approved by the Flood Control Advisory Board and the Board of Directors. Normally, acquisition will include fee title to the underlying lands and be permanent in nature. In some special cases, such as common detention basins constructed as part of the drainage system for development in the unincorporated areas of the county, acceptance of maintenance and operations responsibility may be only for the time period until the development is annexed into a municipality.

The criteria and standards for the acceptance of facilities and flood control structures constructed by others in order that the ownership and operation and maintenance responsibilities may be transferred to the District are contained in other documents approved by the Board of Directors for those purposes.

E. GROUNDWATER RECHARGE—The District's authorizing legislation allows the District to construct, operate and maintain artificial groundwater recharge facilities if they have flood control benefits, and contract and join with other governmental units for the purpose of constructing, operating, and maintaining groundwater recharge or underground storage and recovery projects, except that District tax revenues may not be expended for any project that does not have flood control benefits.

1. RECHARGE—The District shall budget up to 2 percent of its tax revenues on an annual basis, including personnel, overhead, engineering design, construction, and maintenance for the development of artificial groundwater recharge projects having identifiable, supportable flood control benefits at existing District owned facilities, or in conjunction with the construction of new projects. The recharge of excess stormwater runoff to the groundwater shall be a priority consideration in the engineering design

for all new flood control facilities and the development of maintenance and operations procedures and methods.

2. STORAGE AND RECOVERY—The District shall not expend its tax revenue funds for the development of artificial groundwater storage and recovery projects, however, it shall cooperate with and/or serve as the agent for other government units by making District owned lands available for uses which are compatible with the flood control function, and by providing its technical expertise and counsel during the development of storage and recovery projects. The District shall accept operation and maintenance responsibility for storage and recovery projects using District owned lands on a reimbursable contract basis. Additional staffing or equipment required solely as a result of such a contract will be paid for prior to expenses being incurred by the District.

3. POLLUTION ELIMINATION—The District shall comply with the criteria and standards of the Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) program for the regulation of stormwater. In areas where there is a high probability that inflows may contain pollutants, the District shall require that a NPDES permit be obtained by the owner or jurisdiction controlling the property where such discharge originates before it is accepted into District owned or controlled flood control facilities.

Summary of Allocation of Fiscal Resources

Percentage	Description	Cost Sharing	Reference
As Required	Maintenance and Repair to ensure safe operations and structural integrity in accordance with the design and constructed capabilities.		IIB.
2	Flood Warning		IID.
2	Floodplain Management (Aerial Mapping and Topography)	Yes	IIE.1.
75	Comprehensive Plan Projects		IIIA.
5	Projects to be Owned by Others	Yes	IIIB.
10	Area Stormwater Management Plans	Yes	IIIC.
2	Groundwater Recharge		IIIE.

Note: The allocation of tax levy revenue funds for a specific category of work will be computed after the funds required to perform the necessary maintenance, repair, and operations functions have been budgeted. The funds necessary for the operations and administrative function of the District will normally come from the 4% not otherwise allocated.

The Area Master Drainage Study Program and Area Stormwater Management Plan Development

1. PURPOSES OF THE PROGRAM

   a. For the Flood Control District of Maricopa County at the urging of the incorporated communities of the County, to assume a leadership role in developing a uniform, comprehensive inventory and model of the natural and man-made features that influence rainfall-runoff in the study area (hydrologic study and model).

   b. For the Flood Control District, in cooperation with local jurisdictions, to develop an acceptable skeleton stormwater management alternative for a given watershed or portion thereof. By definition, an acceptable stormwater management alternative must satisfy the prerequisites of maintaining the integrity of existing flood control facilities at design capacities and maintaining the continuity of drainage across political boundaries.

   c. For the Flood Control District, with the approval of the Board of Directors, to provide financial assistance to local jurisdictions for the implementation of facilities which are part of an approved stormwater management plan jointly developed as a part of the ADMS program.

   d. For the Flood Control District to assume a leadership role in the development and production of Uniform Policies and Standards for Drainage and a Stormwater Drainage Design Manual, and in the research and in-depth analysis and evaluation of regional rainfall data for development and production of Design Precipitation Guidelines and Isohyetal Maps for Maricopa County.

2. GOALS OF THE PROGRAM

   a. To create a flexible, state of the art, hydrologic computer model based on the collective knowledge and agreement of the hydrology experts from the staff of all government agencies having regulatory review or project jurisdiction within the the study area.

   b. To provide the regulating jurisdiction with a performance oriented hydrological resource model and consulting service for verification of adequacy, and compatibility prior to implementation of developer proposed improvements.

   c. To provide all government agencies having proposed projects an up-to-date model of the hydrologic conditions of the study area and a guide for the post-project condition to be maintained.

   d. To provide an impartial forum and organizational structure for the identification, arbitration, and resolution of drainage problems involving two or more jurisdictions.

e. To identify a skeleton stormwater management alternative which can be implemented at the lowest possible cost to resolve identified or known flooding problems, to be used as a guide for planning the orderly development of a stormwater management system for the study area based on the following criteria.

(1) The 100 year recurrence interval runoff will be used to delineate floodplains of major washes (Q100 1000 cfs). Sizing of flood control facilities, and detention/retention basins will be adequate to accomplish the objectives of the plan, and not be tied to a recurrence interval runoff frequency.

(2) Natural drainage features in undeveloped and sparsely developed areas will be considered as the point of departure in the planning and design of the component parts of the stormwater system.

NOTE: If the jurisdiction having regulatory authority and supplying services to the major portion of the study area requests, a hydrologic model for a more frequent recurrence event and a recommended storm drain system (to preliminary design level development) will be provided.

f. To maintain the hydrologic computer model in an up-to-date condition with input from regulatory jurisdictions or governmental agencies implementing projects, and the results of field reconnaissance to represent the current hydrologic conditions of the watershed.

g. To provide cost sharing assistance for implementation of remedial measures in areas where development has already taken place and it is too late or not practical for the community to require installation of drainage measures as a condition of planning and zoning approval.

h. To provide cost sharing participation for the resolution of drainage problems involving two or more jurisdictions when the problem can not be beneficially resolved in the jurisdictions where the runoff originates but can be beneficially resolved in the receiving jurisdiction.

3. THE HYDROLOGIC MODEL—The hydrologic model developed during the ADMP process will be maintained as a flexible tool based on the collective knowledge and good engineering judgement of the staff of all the government agencies involved in the study and development of the plan. The model will use the 100-year storm duration and placement which will generate the greatest runoff under existing natural and man-made conditions.

The first iteration of the model will compute flow rates at identified points of runoff concentration, known points of physical constraint (bridge or culvert openings, etc.), and points of known flood damages.

Critical control points will be established at points of known hydraulic constraint. Control points will also be established at known points of flood damages in existing developed areas and an acceptable level of flood damages determined in order to establish the maximum allowable flow rate at each point.

Analyze the maximum allowable flow rate established on the basis of minimizing flood damages at each critical control point to determine if it is feasible/economical to achieved. If not, adjust flow rate upward.

NOTE: The flow rate at a critical control point (point of flood damages) will not be established at a rate higher than the pre-project worst case 100-year runoff flow rate.

Make assumptions as to how the area will develop and, on the basis of 80 acre cells, establish the next level of critical control points and determine allowable flow rates.

Subsequent iterations of the model will be required for adjustments necessary to establish maximum allowable flow rates for the 100-year recurrence interval event causing the greatest peak runoff, at all critical control points.

Publish and distribute the model to all jurisdictions.

Update the model to incorporate man-made features approved by the regulatory agency or installed by governmental agencies.

Publish and distribute the revised model to all jurisdictions.

NOTE: Maintenance of the computer model to represent current conditions on the watershed will require a continuing effort, and the District will request input from the local jurisdiction on a quarterly basis for updating the model. Revised model data and stormwater management plan maps will be provided to the local jurisdiction after each update.

4. ACCEPTABLE LEVEL OF DAMAGES—Critical to the development of the hydrologic model is the concept of identifying an acceptable level of damages at any point in the watershed. This is an area requiring subjective judgements on the part of the engineer/hydrologist doing the study. Among the factors considered in this determination are:

   a. Protection of life, safety, health, and welfare—Sheet or sidewalk flows shall not be allowed to exceed the standards established by the community for the safety of its citizens.

   b. Effects on Public Services—Flow rates which would result in inundation of public facilities and cause curtailment of electric power services, telephone services, operations of sanitary sewer services (lift station), isolation of fire stations or emergency medical treatment facilities shall not be allowed.

   c. Water Quality Impacts—Flow rates which would result in inundation of waste water treatment facilities, chemical or petroleum manufacture or storage areas, exposure of sanitary landfills, or generate significant erosion and sediment shall not be allowed.

   d. Type of Development—Flows shall be contained within public rights-of-way as much as practical, however in no case shall the depth of flow in nondelineated flood prone residential areas be allowed to exceed the elevation of the lowest habitable floor of the lowest residence. In areas zoned for commercial or industrial use, the economics of requiring flood proofing will be analyzed before limiting the water surface to below the ground floor level.

e. Delineated Flood Prone Areas—Damages from a depth of flow and velocity less than or equal to that computed in the delineation analysis shall be deemed acceptable. An economic analysis shall be used to justify the costs of stormwater management measure implementation to reduce the damages below the acceptable level verse removal or flood proofing of facilities.

The public involvement process shall be used to assist the study team in the identification of criteria and levels to be used in making determinations of allowable damages for the study area.

Glossary of Terms

ADMS	Area Drainage Master Study
ARS	Arizona Revised Statutes
ASMP	Area Stormwater Management Plan
CD&ES	Civil Defense and Emergency Services Department of Maricopa County
CIP	Capital Improvements Program
EPA	Environmental Protection Agency
FCAB	Flood Control Advisory Board
FEMA	Federal Emergency Management Agency
IGA	Intergovernmental Agreement
Level of Protection	The recurrence frequency of the rainfall runoff event that the project is design to handle, e.g., SCS flood control dams normally are designed to provide 100-year protect, or store the total runoff volume from a rainfall event occurring once each 100 years.
Major Drain	A natural or man-made channel, conduit, or wash serving a watershed of from 160 acres to 10 square miles.
NPDES	National Pollutant Discharge Elimination System
Positive Outfall	The point of discharge from a natural or man-made channel, conduit, or wash into a natural or man-made channel, conduit, or wash of sufficient hydraulic capacity to handle the discharge without creating a backwater or damages.
Project Life	The design life of a flood control project based on the useful life expectancy of the materials used in construction of the project. For economic analysis purposes, the project life is normally assumed to be equal to the level of protection provided.
Regional Drain	A natural or man-made channel, conduit, river, or wash serving a watershed area greater than 10 square miles.
SCS	The Soil Conservation Service
SPF	Standard Project Flood

Completed Projects Not Identified in the 1963 Report

The following list outlines projects constructed by the Flood Control District that were not identified in the *1963 Comprehensive Flood Control Program Report*. The projects are separated into two groups: those funded 100 percent by the Flood Control District and those that were cost-shared between the District and other agencies.

Funded 100 percent by the District	District Cost*
Levees along the Agua Fria River.	$ 25,730,000
New River Channelization: Grand Avenue to Olive Avenue.	
Holly Acres Levee.	1,140,000
Skunk Creek Channelization.	
Perryville bank stabilization.	288,743
Gila River Clearing and Pilot Channel. The 1000-foot clearing project is described in detail in the U.S. Army Corps of Engineers Los Angeles District *1957 Interim Report on Gila and Salt Rivers* and described in general ters in the District's 1963 Report.	648,100
Projects in which the District has cost-shared	**District Cost***
Skunk Creek Channels and Levees at Interstate 17.	
East Fork Cave Creek improvements.	$ 2,780,000
48th Street Drain.	76,000
Indian Bend Wash.	3,400,000
Indian Bend Wash interceptor channel and side drains.	5,850,000
Plan 6 contributions.	4,250,000
Price Drain.	8,510,000
Agua Fria landfill relocation.	
Bell Road drainage improvements.	497,000
Olive Drain.	
Detention basins along the Superstition Freeway within the City of Mesa.	1,632,000
Union Hills Drain.	
Gila Drain replacement/Tempe channels and detention basins at Warner Road and Interstate 10.	
Salt River Channel in Tempe.	
Paradise Valley/Scottsdale/Phoenix (PVSP) channel and improvements	1,330,000

Drainage conduit from Cactus Road and Scottsdale Road to Indian Bend Wash, and retention basin at Cactus Road and Scottsdale Air Park.	
Alma School Drain.	13,400
Sossaman Drain/Guadalupe channel.	264,000
Dysart Drain.	2,600
McMicken Dam reconstruction.	11,100,000
City of Phoenix detention basins. North Mountain detention basin South Mountain detention basin Sweetwater Wash Shea Boulevard and Indian Bend Wash	2,949,000
Old Cross Cut Canal. Current plans are the same as outlined in the *1963 Comprehensive Flood Control Report.* Improvements were made in 1975 by the District, SRP, and the City of Phoenix.	993,335
Sunny Skies Mobile Home Park in Mesa at Apache Drive and 90th Street (Ellsworth Road).	
Camelot Mobile Home Park at McKellips and Recker north to the Salt River; channel constructed by the City of Mesa, Maricopa County Highway Department, and the District.	
Two detention basins within the Town of Gilbert.	1,300,000
ACDC: Cave Creek to 40th Street, Reaches 3 and 4. [Construction of a canal up to 20th Street was mentioned in the 1963 Report.]	55,000,000
Indian School Road Drain: 107th Avenue to the Agua Fria River.	
Gila Bend: bank stabilization and channel improvements to Balboa Wash and Sand Tank Wash, 1974.	

* Total project costs were not presently available for all the projects listed here. This list will be updated when total costs are available.