FINAL

ENVIRONMENTAL IMPACT STATEMENT

REGULATORY STORAGE DIVISION
CENTRAL ARIZONA PROJECT

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

LOWER COLORADO REGION

VOLUME I

FINAL

ENVIRONMENTAL IMPACT STATEMENT

REGULATORY STORAGE DIVISION
CENTRAL ARIZONA PROJECT

Maricopa, Pinal, and Gila Counties, Arizona

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

As Lead Agency in Cooperation With

U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, TONTO NATIONAL FOREST

This Environmental Impact Statement describes six alternatives for the proposed construction and operation of the Regulatory Storage Division of the Central Arizona Project (CAP). The alternatives described provide for CAP Regulatory Storage, flood control for the Salt and Gila Rivers through the Phoenix metropolitan area, and concurrent and coincident aspects of the Safety of Dams program. A No Action alternative is also described. This EIS also fulfills the requirements of Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands), and the requirements of the Nationwide Permit in accordance with the provisions of Section 404 of the Clean Water Act.

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PREFACE

Response to public comments on the Draft Environmental Impact Statement (EIS) and continuation of planning on the Proposed Action have resulted in several revisions that are reflected in the Final EIS. These changes include:

- A new plan (Plan 9) was formulated in response to public comments requesting a plan that did not include Cliff Dam. This decision has been incorporated throughout this EIS.

- The decision was made to modify existing Roosevelt and Stewart Mountain Dams rather than construct new dams. The summary of the document has been changed to show this decision; and it has been discussed in Section II.D. of the main EIS. The remaining references in the text of the main document to New Roosevelt and Stewart Mountain Dams have not been revised.

- A mitigation plan for Plan 6 was developed based on updated construction and operation data.

- An environmental commitment section has been added.

- A final Fish and Wildlife Service Coordination Act Report has been included in Appendix G.

Maps for the elements provided with the Draft EIS should be retained for reference. The maps for the Verde River Dams Modifications element of Plan 9 are bound in the EIS.

SUMMARY

I. PURPOSE AND NEED FOR THE ACTION

A. Background

This environmental impact statement (EIS) describes and evaluates the proposed construction and operation of the Regulatory Storage Division of the Central Arizona Project (CAP). Construction of the CAP Regulatory Storage Division was authorized by Section 301(a)(3) of the Colorado River Basin Project Act (P.L. 90-537) of 1968. This feature of the CAP is being investigated under the title Central Arizona Water Control Study (CAWCS). This EIS is prepared to be used by the Secretary in reaching decisions concerning total or partial implementation of the proposed action or approiated alternative.

The CAP was authorized on September 30, 1968. Its principal purpose is to furnish water for irrigation, municipal, and industrial use in central Arizona and western New Mexico through the importation of water from the Colorado River and conservation of local surface waters. Because of its large size and complexity, the CAP is divided into several features serving separate but interrelated functions. Six features, including the main aqueduct system (Granite Reef, Salt-Gila, and Tucson Phase A) are currently completed or under construction. Five remaining features, including the Regulatory Storage Division, are in the planning stage.

An overall EIS was filed for the entire CAP on September 26, 1972 which committed the Bureau of Reclamation (Reclamation) to prepare site-specific EIS's for individual CAP features. The six alternatives for the Regulatory Storage Division described in this EIS address regulatory storage of CAP water and flood control of the Salt and Gila Rivers through metropolitan Phoenix.

The EIS also describes concurrent and coincident aspects of the Safety of Dams (SOD) program. The 1978 Reclamation Safety of Dams Act (P.L. 95-578) directs the Secretary of the Interior to preserve the structural safety of Reclamation dams and related facilities by performing modifications that may be reasonably required. Since the construction and operation of the CAP Regulatory Storage Division and SOD features will involve common timing and locations, the purposes of both authorizing legislations have been combined in the CAWCS.

The EIS is supported by 15 technical reports covering all aspects of CAWCS planning, designs, public involvement, social and environmental impact assessment, economics, and hydrological analyses. Supporting documents are available for review at the Arizona Projects Office of the Bureau of Reclamation. Copies of the Final Environmental Impact Statement may also be obtained from Reclamation by those requiring more detailed information than is presented in this summary.

B. Geographic Setting

The CAWCS study area encompasses approximately 13,400 square miles, or 8,576,000 acres, in central Arizona, including portions of Maricopa, Gila, and Pinal Counties. The entire Phoenix metropolitan area is located within the CAWCS boundaries. Figure 1 shows the CAWCS study area. The population of the area is over 1.5 million people, almost 90 percent of whom live in Maricopa County. There are six Indian Communities in the study area.

C. Purpose and Need

The alternative actions described in this EIS have three principal purposes. These are:

1. To increase the operating efficiency of the CAP through the conservation of Salt, Verde, and Agua Fria River flows, and through regulation of Colorado River water deliveries from the Granite Reef Aqueduct.

2. To provide facilities and means to meet the flood control needs on the Salt and Gila Rivers through the Phoenix metropolitan area.

3. To provide for the structural safety of existing Bureau of Reclamation dams on the Salt and Verde Rivers.

Construction of a regulatory storage unit for CAP water will improve the operating flexibility and efficiency of the CAP and will allow the importation of greater quantities of Colorado River water in years when it is available. Without regulatory storage capacity the CAP system can be operated only in direct response to demand, limiting the opportunity to effectively manage the project's water and power resources.

A series of floods through the Phoenix metropolitan area between February 1978 and February 1980 caused substantial damage in the form of property damage, income losses, and emergency costs, and had severe impacts on transportation and on people living in the flood zone. These floods heightened public demands for flood control and flood protection.

Hydrologic analyses for the maximum probable flood (or Inflow Design Flood - IDF) indicate that all six Salt River Project (SRP) storage dams on the Salt and Verde Rivers have inadequate storage and/or spillway capacity to contain and/or pass the IDF without overtopping. Such an occurrence could jeopardize the safety of the dams. The potential overtopping or failure of any of these dams is considered serious because of the potentially catastrophic consequences which would result for Phoenix and other downstream communities.

II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

A. Alternatives Eliminated from Further Study

The CAWCS was initiated in July 1978. The study was conducted in three stages, following a process of transition from a wide array of possible solutions in Stage I to a single proposed action at the end of Stage III.

During Stage I and Stage II, individual "elements" were analyzed which could provide CAP regulatory storage and/or flood control. Elements which were evaluated and eliminated from consideration during the CAWCS are shown in Table 1.

At the beginning of Stage III Reclamation widened the focus of the CAWCS to include SOD as a major objective. All "plans" (combinations of elements) developed for Stage III analysis considered both SOD and CAWCS purposes. These plans were evaluated on the basis of performance, cost, and environmental and social impacts. Eight "candidate" plans resulted from this analysis; two of these, Plans 4 and 5, were subsequently eliminated from consideration.

B. Alternatives Analyzed in Detail

Plans 1, 2, 3, 6, 7, and 8, were analyzed in detail and presented in the Draft EIS. In response to comments on the Draft EIS, Plan 9, a plan without Cliff Dam was analyzed. In November 1981, the Secretary of the Interior selected Plan 6 as the agency proposed action. His selection was based on the strong local support for Plan 6, the functional ability to meet statutory obligations required by authorizing legislation, and the fact that the severe impacts to the Fort McDowell Indian Community associated with some plans were avoided.

A description of the six candidate plans follows:

1. Plan 1: Cliff + Modified Roosevelt + Modified Stewart Mountain Dams

Under this plan, Cliff Dam would be constructed on the Verde River between Horseshoe Dam and Bartlett Dam (see Figure 1) and a new or modified Roosevelt Dam would be constructed. Both dams would provide flood control and CAP regulatory functions in addition to SOD. New or Modified Stewart Mountain Dam would be for SOD purposes only in all plans. This plan would not connect directly with the CAP aqueduct. Conservation space at Cliff and Roosevelt Reservoirs would increase CAP yield through water exchanges by 107,000 acre-feet (af) per year. Dedicated flood control space at Cliff and Roosevelt Dams would reduce the 200-year flood of 275,000 cubic feet per second (cfs) to 92,000 cfs at Sky Harbor Airport and 100-year event to 55,000 cfs at the airport. Conceptual recreation plans for Cliff and Roosevelt feature an increase in camping, picnicking, and boating facilities.

Table 1

ELEMENTS ELIMINATED FROM CONSIDERATION

VERDE RIVER:

Tangle Creek Dam, Modified Horseshoe Dam, New Bartlett Dam

SALT RIVER:

Carrizo Creek Dam, Klondike Buttes Dam, Coon Bluff Dam, New Granite Reef Dam, Rio Salado Low Dams, New Multipurpose Stewart Mountain Dam

AGUA FRIA RIVER:

Lake Pleasant Storage, Agua Fria Siphon Dam, Calderwood Butte Dam, North Phoenix flood control dams

GILA RIVER, SANTA ROSA WASH:

Coolidge Dam, Florence Dam, Buttes Dam, Tat Momolikat Reservoir, Painted Rock Reservoir

CHANNELS:

Granite Reef Dam to Country Club Drive, Country Club Drive to 35th Avenue, 35th Avenue to Gillespie Dam

LEVEES:

Granite Reef Dam to Country Club Drive, Country Club Drive to 35th Avenue, 35th Avenue to Salt/Gila Confluence, Salt/Gila Confluence to Gillespie Dam

GILA RIVER CHANNEL CLEARING FOR CAWCS FLOOD CONTROL

WATER EXCHANGE WITH SALT RIVER PROJECT (SRP)

SRP REREGULATION

GROUNDWATER RECHARGE

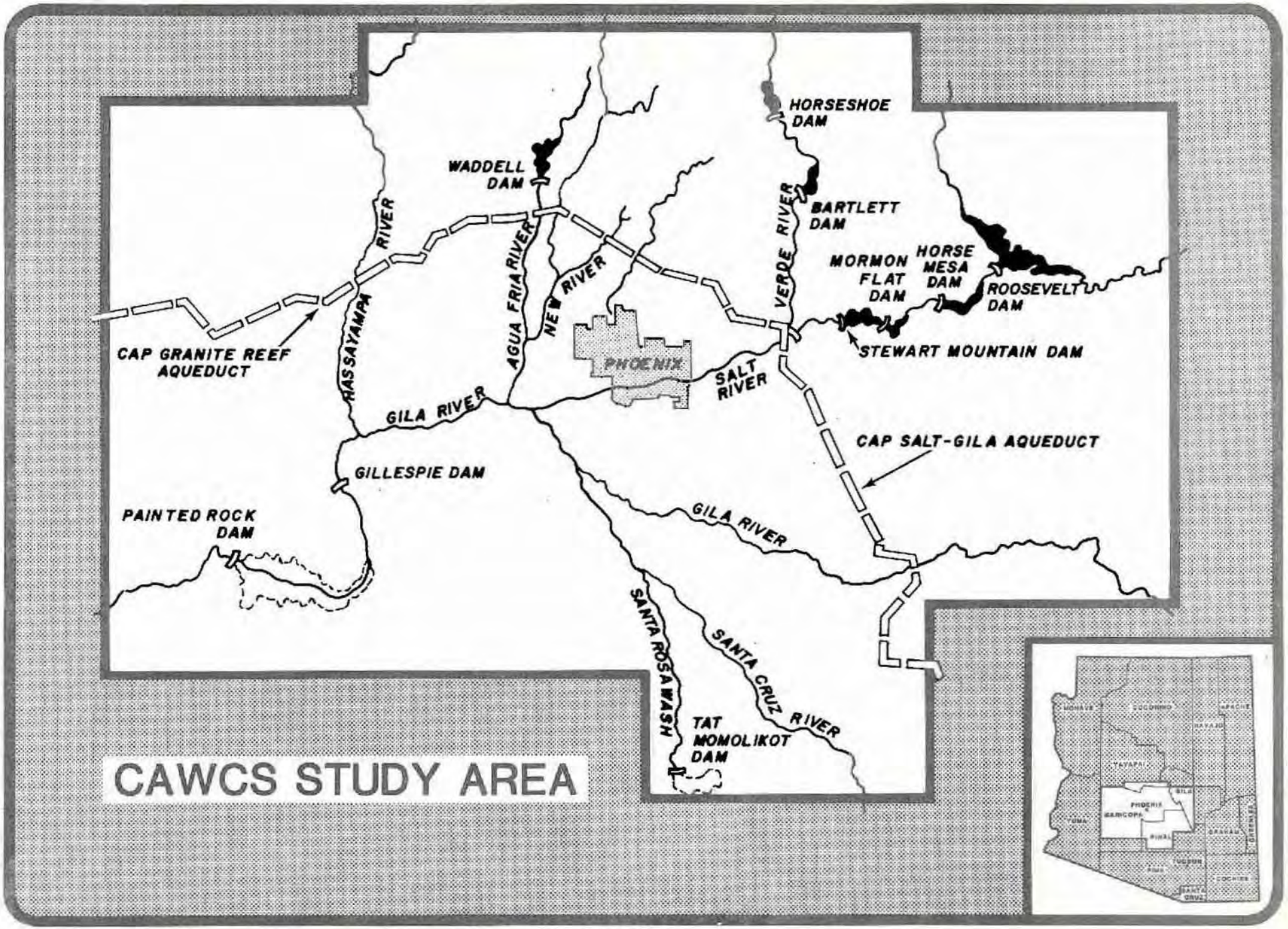
CAWCS STUDY AREA
HORSESHOE DAM
WADDELL DAM
BARTLETT DAM
MORMON FLAT DAM
HORSE MESA DAM
ROOSEVELT DAM
STEWART MOUNTAIN DAM
VERDE RIVER
HASSAYAMPA RIVER
AGUA FRIA RIVER
NEW RIVER
PHOENIX
SALT RIVER
CAP GRANITE REEF AQUEDUCT
GILA RIVER
CAP SALT-GILA AQUEDUCT
GILLESPIE DAM
PAINTED ROCK DAM
GILA RIVER
SANTA ROSA WASH
SANTA CRUZ RIVER
TAT MOMOLIKOT DAM

Figure 1

2. Plan 2: Cliff + Modified Roosevelt + Modified Stewart Mountain Dams + Nonstructural Measures

This plan limits construction at Cliff and Roosevelt Dams to that necessary for SOD purposes. Flood control, provided by the use of the surcharge space at Cliff and Roosevelt in combination with nonstructural flood damage reduction measures downstream would reduce the 200-year flood to 157,000 cfs and the 100-year flood to 150,000 cfs at the airport. Increased water supply for CAP (16,000 af per year) could be developed by additional water conservation at Roosevelt Reservoir. Because this is a limited structural plan, additional recreational facilities would be provided. New Roosevelt Dam is not being considered in Plan 2 since this is a SOD only plan, and the existing Roosevelt Dam can be reconstructed for SOD purposes.

3. Plan 3: Confluence + Cliff + Modified Roosevelt + Modified Stewart Mountain Dams

Under this plan, a dam at the confluence of the Salt and Verde Rivers (see Figure 1) would be constructed as well as Cliff, Roosevelt, and Stewart Mountain Dams. Cliff and Roosevelt Dams would provide flood control, new conservation space, and SOD. Confluence dam would be constructed for regulatory storage purposes. Confluence Dam would connect directly with the Salt-Gila Aqueduct via a pumping plant and canal. Under this plan, the 200-year flood would be reduced to between 92,000 and 70,000 cfs and the 100-year flood to 55,000 to 50,000 at the airport. The CAP yield could be increased by 163,000 af per year. Conceptual recreation plans include new recreation sites for Confluence, Cliff, and Roosevelt Dams.

4. Plan 6: (Agency Proposed Action) New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain Dams

New Waddell Dam would replace the existing Waddell Dam at Lake Pleasant on the Agua Fria River (see Figure 1). It would be constructed for regulatory storage and would provide dedicated operational flood control. New Waddell would be connected to the CAP Granite Reef Aqueduct by a canal with a pumping plant. The CAP water supply would be increased by 137,600 af per year. Flood control, additional water conservation, and SOD would be provided at Cliff and Roosevelt. This plan would reduce the 200-year flood at the airport to 92,000 cfs and the 100-year flood to 55,000 cfs. Conceptual recreation plans include additional sites at New Waddell, Cliff, and Roosevelt.

5. Plan 7: New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain Dams (environmental enhancement

This plan is the same as Plan 6, but would be operated to emphasize opportunities for environmental enhancement. A portion of the water supply generated at Cliff, Roosevelt and New Waddell Dams would be used for recreation and fish and wildlife conservation. Due to system losses for these purposes, the increase in CAP water supply is 114,000 af per year. Recreation plans are the same as for Plan 6.

6. Plan 9: New Waddell + Verde River Dams Modifications + Modified Roosevelt + Modified Stewart Mountain Dams

New Waddell Dam and Reservoir would be constructed and operated as in Plan 6. The CAP water supply would be increased by 115,500 af per year. Flood control and additional water conservation would be provided at Roosevelt Dam. Horseshoe and Bartlett Dams would be modified for SOD purposes. This plan would reduce the 200-year flood at the airport to 215,000 cfs and the 100-year flood to 170,000 cfs. Conceptual recreation plans include additional sites at New Waddell and Roosevelt Reservoirs.

7. Plan 8: No CAWCS Action

The No Action alternative provides the baseline against which all other plans are compared (future-without-the project). With this option, CAP would be constructed, but no CAWCS regulatory storage or flood control would be provided. SOD studies would, however, continue; SOD solutions may differ from the Cliff/Roosevelt combination in CAWCS/SOD plans. Plan 8 also includes the following assumptions: Twelve bridges in metropolitan Phoenix would be constructed or modified by state and local governments to withstand flows of 200,000 cfs. Floodplain management would occur, including enforcement of existing laws and regulations. Channelization around existing facilities at the airport would be conducted. Limited channel clearing in the Gila River would be undertaken. Flood warning systems would be improved. Several control facilities on area rivers would be constructed. A Tempe Rio Salado Project would be implemented; the overall Rio Salado concept was assumed not to be developed because it is dependent upon upstream flood control.

C. Comparative Analysis of Alternatives

Twenty-one evaluation criteria were developed during the CAWCS Stage III to provide a framework for determining which candidate plans were appropriate for consideration as the proposed action. Although all of the criteria were critical to the plan evaluation process, the CAWCS planning team identified the factors which most significantly discriminated among alternatives, and aggregated them into the following categories: performance (ability to meet CAWCS objectives), economics, environmental impacts, social impacts, and public acceptability. Performance of the plans has been discussed in the earlier description of alternatives. Public acceptability is discussed below in Section D. The environmental, social, and economic impacts of alternatives are presented in more detail in Chapter IV.

Table 2 provides a comparative display of the advantages and disadvantages of each plan relative to the significant evaluation criteria identified by the CAWCS study team.

As shown in Table 2, Plans 1, 3, 6, and 7 provide high levels of flood protection and solve dam safety problems. Plans 2 and 9 also solve dam safety problems but provides less flood protection. Plan 8 does not meet objectives for flood protection, but it does provide for continued studies to develop a plan to make Salt and Verde River dams safe.

Table 2

COMPARATIVE EVALUATION OF PLANS

	Advantages	Disadvantages
Plan 8 (No CAWCS action)	No project-related cost No project-related impacts to Fort McDowell Indian Community No project-related impacts to endangered species, riparian habitat, or cultural resources Moderate public support	No increased flood protection No additional water supply beyond CAP baseline Significantly less power revenues than regulatory storage plans No flexibility in CAP operations Dam safety studies continue
Plan 1	Relatively low cost No impacts to Fort McDowell Indian Community High level of flood protection Moderate increase in CAP yield Solves dam safety problems Moderate public support	Less reliable water supply than regulatory storage plans Significantly less power revenues and other economic benefits than regulatory storage plans No flexibility in CAP operation Adverse impacts to endangered species, riparian habitat, and cultural resources
Plan 2	Lowest cost of all action plans Solves dam safety problems No impacts to Fort McDowell Indian Community Insignificant impacts to endangered species Provides moderate increase in flood protection	Insignificant increase in CAP yield Less reliable water supply than regulatory storage plans Minimal power revenues and other economic benefits No flexibility in CAP operations Adverse impacts to riparian habitat and cultural resources Minimum public support
Plan 3	Highest increase in CAP yield High level of flood protection Significant increase in power revenues and other economic benefits Provides flexible CAP operations Provides reliable water supply Significant increase in lake recreation	Highest cost of all action plans Severe impacts to Fort McDowell Indian Community Severe impacts to endangered species, riparian habitat, and cultural resources Severe impacts to stream recreation Potential for reservoir eutrophication and degradation of water quality Highly controversial - divided public support
Plan 6 (Agency proposed action)	Significant increase in CAP yield High level of flood protection Highest increase in power revenues and other economic benefits Provides reliable water supply Provides flexible CAP operations Significant increase in lake recreation No impacts to Fort McDowell Indian Community Strong broad-based public support	High cost Adverse impacts to endangered species habitat and cultural resources*
Plan 7	Moderate increase in CAP yield High level of flood protection Significant increase in power revenues and other economic benefits Provides flexible CAP operations Provides reliable water supply Significant increase in lake recreation Provides opportunities for fish and wildlife enhancement Provides opportunities for development of Salt River recreation through Phoenix No impacts to Fort McDowell Indian Community Moderate public support	High cost Adverse impacts to endangered species, riparian habitat, and cultural resources

*Jeopardy Biological Opinion under Section 7 of the Endangered Species Act was issued by the Fish and Wildlife Service for the Proposed Action.

Table 2 (continued)

COMPARATIVE EVALUATION OF PLANS

	Advantages	Disadvantages
Plan 9	Provides reliable water supply Significant increase in power revenue and other economic benefits Moderate increase in CAP yield Significant increases in lake recreation No impacts to Fort McDowell Indian Community Reduced environmental impacts	Lower level of flood protection than with some of the other plans Adverse impacts to cultural resources High cost

Regulatory storage advantages are strongest with Plans 3, 6, and 7 because they include regulatory storage reservoirs to provide increased CAP yield, added flexibility in the operation of CAP, and energy management benefits. Plan 1 provides some increased yield because of water exchanges but does not have the flexibility or energy management benefits that are associated with a reservoir. Mainly because of energy management opportunities associated with New Waddell Reservoir, Plan 6 provides the highest annual economic benefits of any plan. Plan 8 does not meet project objectives for regulatory storage.

Costs of the action alternatives in rank order from highest to lowest are: Plan 3, 6, 7, 9, 1, and 2. Plan 8 has no construction costs at this time, but planning for dam safety would continue and ultimately the solution could involve dam construction.

Environmental impacts associated with construction, operation, and maintenance are most severe with Plan 3 because the plan includes Confluence Dam and Reservoir. The reservoir would inundate sensitive habitat and areas of human use, leading to severe impacts to endangered species, riparian habitat, perennial stream habitat, stream recreation, water quality, and cultural (prehistoric and historic) resources. Environmental impacts of Plan 6 include losses of riparian habitat and cultural resources and adverse impacts to the bald eagle; these same impacts would occur with Plans 1 and 7, which would also adversely affect endangered species. Plan 2 and 9 would have lesser impacts to riparian habitat and cultural resources than Plan 6. Plan 8 would have no project related impacts, but the dam safety solution found in continued studies could result in impacts that cannot be predicted at this time.

Social impacts are primarily the consequences of relocation because of land acquisition for dams and reservoirs. The most severe social impacts of relocation occur with Plan 3, which would require the relocation of the Fort McDowell Indian Community. No other plans would require the relocation of the community. With all of the action plans, some residents who currently live around the perimeter of Roosevelt Lake and a family who operate a ranch near Horseshoe Dam on the Verde River would be required to relocate. Although all action plans require Roosevelt Lake relocations, Plan 2 requires the fewest number of people to relocate.

Quantification of impacts is provided in Chapter IV, where the impacts, effects, and mitigation are summarized in Tables 4, 5, and 6.

D. The Proposed Action - Plan 6

Plan 6 has been selected as the agency proposed action for CAWCS because the plan meets project objectives, has strong public support, and does not have many of the severe social and environmental impacts associated with Plan 3. In particular, Plan 6 avoids impacts to the Fort McDowell Indian Community while still providing high performance for flood protection and CAP regulatory storage. While Plans 1, 2, 7, and 9 also avoid impacts to the Fort McDowell Community, they do not perform as well as does Plan 6. Plan 9 reduces the impacts on riparian vegetation and has less flood control benefits.

Strong, broad-based public support for Plan 6 was identified by the CAWCS public involvement program in Stage III, and included support of groups who participated in public values assessment workshops, speakers at three public meetings held in September 1981, comments received from response forms in a CAWCS publication, the CAWCS Governor's Advisory Committee, and the Central Arizona Water Conservation District.

In October 1981, the CAWCS planning team participated in a "tradeoff" meeting to review all available information on the alternatives and to formulate recommendations. Alternatives were evaluated based on performance, cost, economic benefits, public acceptability, engineering feasibility, environmental impacts, social impacts and implementability. As a result of these analyses, the Arizona Projects Office of the Bureau of Reclamation recommended that Plans 1, 3, and 6 were appropriate for consideration as the proposed action. After reviewing the three recommended plans, the Secretary of the Interior selected Plan 6 as the agency proposed action in November 1981, citing the plan's high performance, public support, and avoidance of impacts to the Fort McDowell Indian Community.

At the time of the Secretary's decision, both New and Modified Roosevelt and Stewart Mountain were included in the proposed action. After technical analysis and public review, modified in both cases have been selected as the option to be included in the proposed action.

III. AFFECTED ENVIRONMENT

A. General Description of CAWCS Area Significant Resources

1. Biological Resources

Six resource factors within the CAWCS area have been identified as having importance with respect to action-related impacts:

1. Riparian/Wetland Biotic Communities
2. Other Terrestrial Biotic Communities
3. Perennial Stream/Riverine Aquatic Communities
4. Reservoir Aquatic Communities (Lakes and Lacustrine Communities)
5. Threatened and Endangered Plants and Wildlife
6. Management and Special Use Areas

Acreage and percent ranges of the major biotic communities occurring in the CAWCS study area are shown in Table 3.

2. Water Quality

The water quality of local surface water sources in the CAWCS area is measured by concentrations for 45 constituents including a number of elements and compounds, fecal coliforms, dissolved solids, and phenolics, as well as by measures of alkalinity, hardness, specific conductance, and sodium absorption ratio. Safe levels of some constituents are prescribed by law for

Table 3

ACREAGE AND PERCENT RANGE OF
BIOTIC COMMUNITIES IN CAWCS AREA

Biotic Community	Acres	Percent of Study Area
Temperate Uplands		
including Montane conifer forest, Pinyon-juniper series, Oak-pine series, Interior chapparal, Sonoran savanna grassland	1,167,000	13.6
Riparian and Wetland Communities		
including warm-temperate, tropical-subtropical, and riparian forests	59,000	.7
Desert Uplands		
including Creosotebush-bursage series, Paloverde-mixed cacti series, Saltbush series	5,957,000	69.4
Aquatic Communities		
including lakes, rivers, and reservoirs	75,000	.9
Human Dominated Communities		
including agricultural and developed urban lands	1,318,000	15.4

various water uses; the levels of water quality constituents in surface water sources in the CAWCS area vary considerably from season to season and from one source to another. These local sources could be either improved or degraded by regulatory storage mixing.

3. Recreation

Significant water-related recreation resources and facilities are described as either stream-oriented or reservoir-oriented. The five-county region of Maricopa, Pima, Pinal, Gila, and Yavapai Counties was defined as the affected area to assess recreation impacts of CAWCS plans. Existing recreation resources and facilities in the five-county region include over 9,000 campsites, 11,600 picnic sites, 51 improved swimming sites, 985 miles of fishable stream, 34 miles of stream suitable for tubing (river floating), and 35,000 water surface acres suitable for boating.

4. Cultural Resources

Prehistoric resources in the CAWCS area date from the area's occupation from about 11000 B.C. to the advent of recorded history in the mid-1600s A.D. Some of the more significant sites in the study area reflect the highly-developed Hohokam tradition and culture, and present an opportunity to examine different models for the development of complex social, political, and agricultural systems. Larger archaeological sites are popular tourist attractions such as Tonto National Monument, Casa Grande National Monument, and Pueblo Grande Museum.

Historic resources in the study area date from Arizona's pre-territorial (to 1863) through territorial and statehood (after 1912) periods. Several of these sites, such as Theodore Roosevelt Dam, have been recognized as nationally significant resources.

5. Social Resources

CAWCS plans would affect the communities, individuals, families, and businesses who are currently subject to flooding along the Salt and Gila Rivers through metropolitan Phoenix, and the people who would be relocated because of construction and reservoir inundation associated with alternative action plans.

B. Description of Affected Site Areas

1. Modified Stewart Mountain Site Area

This site area is entirely included within the Confluence site area, and is describe in Section 4.

2. Cliff Site Area

The Cliff Dam and Reservoir site area is located on the Verde River between Horseshoe and Bartlett Dams. All of the land within the Cliff site area, with the exception of the KA Ranch, is owned and managed by the U.S. Forest Service, Tonto National Forest.

Significant biological resources include mature cottonwood-willow and mesquite woodlands, 20 miles of flowing stream with associated native and introduced fish species, and a bald eagle (Federal-listed endangered species) breeding area. Horseshoe Reservoir and the flowing stream are used for recreational activities.

Cultural resources within the Cliff site area include an estimated 1,465 prehistoric sites composed of artifact scatters, pueblo sites, and several special features such as trash mounds. Nine significant historic sites include the Verde River Sheep Bridge, which was placed on the National Register of Historic Places in 1978.

There are no communities in the Cliff site area, but the family who lives at the KA Ranch would be relocated under CAWCS action plans. Approximately 130 acres of prime farmland are located at the KA Ranch.

3. Verde River Dams Modifications Site Area

The Verde River Dams Modifications Site Area includes all of the Cliff site area and the Bartlett Dam and Reservoir area. All of the land within the Verde River Dams Modifications Site with the exception of KA Ranch is owned and managed by the U.S. Forest Service, Tonto National Forest.

Biological resources are the same as those of the Cliff site area with the addition of 1 mile of flowing stream at Bartlett Reservoir, one of Arizona's major sports fisheries, and an additional bald eagle breeding area.

In addition to the cultural resources of the Cliff site area, an estimated 290 sites are predicted to be within the area surrounding Bartlett Dam and Reservoir. There are three additional historic sites.

Social resources are the same as those at the Cliff site area.

4. Roosevelt Site Area

The site area surrounds the existing Roosevelt Dam and Roosevelt Lake, the largest lake in the study area. Most of the land in the Roosevelt site area is publicly-owned, and is managed by the Tonto National Forest for recreation, grazing, and wildlife habitat.

Important biological resources include 15 miles of flowing stream, self-sustaining fisheries, a bald eagle breeding area, a waterfowl refuge, and a managed wildlife area. Stream and lake recreational resources and facilities are heavily used.

Cultural resources are estimated to include 1,480 prehistoric sites similar to sites found in the CAWCS area in general. Of 57 significant historic sites, the most important is Theodore Roosevelt Dam, a National Historic Landmark.

Four communities at Roosevelt Lake would be affected by CAWCS alternatives. Some residents of Roosevelt Lake Estates, Rockhouse Farm, Roosevelt Gardens East, and North Bay Estates would be relocated under all alternative action plans. Many of the residents of these communities are retired and prefer to live in a rural setting.

5. Confluence Site Area

The Confluence site area is located around the confluence of the Salt and Verde Rivers approximately 25 miles northeast of Phoenix. Lands within the area are mainly controlled by public agencies and Indian communities. Private holdings include several residential communities such as Fountain Hills.

Biological resources include important riparian and wetland community types such as cottonwood-willow and mature mesquite forests, 31 miles of flowing stream with native and introduced fish species, 3 bald eagle breeding areas and associated preferred habitat, Yuma clapper rail (Federal-listed endangered species) and several species of Arizona special status wildlife, and a cottonwood habitat rehabilitation site. The flowing stream is used intensively for tubing, fishing, and other recreational activities.

About 265 prehistoric sites are estimated to be present. These are generally much larger than sites at the other affected site areas and include 13 ball courts, features indicative of large villages. The most significant historic site of 97 significant sites in the Confluence area is Fort McDowell.

The Fort McDowell Indian Community would be affected by one CAWCS alternative. Residents of this Yavapai Indian reservation would be relocated by dam construction. There are approximately 400 residents in the community, which is highly cohesive and maintains the traditional Yavapai culture, religion, and customs. The reservation also contains commercially-mined sand and gravel resources and approximately 680 acres of prime farmland.

6. New Waddell Site Area

The New Waddell site area is located around Waddell Dam and Lake Pleasant on the Agua Fria River approximately 45 miles northwest of Phoenix. The land in the area is mainly controlled by state, federal, and county agencies.

Tule Creek and Morgan City Wash are perennial streams in the site area. There are no special use and management areas in the site area. Recreation resources and facilities include Lake Pleasant and Lower Lake Pleasant, both used intensively by area residents, mainly for sailing, fishing and motorboating. The lakes are within Lake Pleasant Regional Park.

Cultural resources include an estimated 120 prehistoric sites. Eleven significant historic sites representative of agricultural, water control, and transportation activities are present.

No people in the New Waddell site area would be affected by CAWCS plans. The area contains approximately 70 acres of prime farmland.

7. Downstream Area

For purposes of CAWCS analysis the area affected by flooding is considered the Salt and Gila River floodplain from the Granite Reef Diversion Dam through metropolitan Phoenix to Gillespie Dam. Areas downstream of Waddell Dam on the Agua Fria River were not included in this analysis but are the subject of other flood control studies by the Corps of Engineers.

Biological resources in the downstream area include Yuma clapper rail habitat, and state and federally-managed wildlife areas. The streams or lakes in the downstream area support various recreational uses, including fishing and nature study. While records of prehistoric and historic sites exist for the area, these sites are generally not identifiable or are in poor condition due to previous flooding.

Communities in the downstream area affected by flood control provided by CAWCS alternatives are the cities of Mesa, Tempe, and Phoenix; the Salt River Pima-Maricopa and Gila River Indian Communities and the Buckeye and Holly Acres subdivision areas. Numerous infrastructure and transportation networks and facilities are also located in the flood plain area.

IV. ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

Tables 4, 5, and 6 provide a description of the environmental consequences of the alternative plans, focusing on the significant resource categories identified during scoping. These tables summarize the analysis in a large number of CAWCS supporting documents, including Stage III Methodology for Environmental Quality Assessment, Environmental Impacts and Effects of Plans (7 vols.), Social Impacts and Effects of CAWCS Plans, and Economics-Financial Supporting Document.

A. Methodology

1. Impact Assessment

The procedure for assessing impacts of the plans involved aggregating impacts of the elements (Cliff, New/Modified Roosevelt, New/Modified Stewart Mountain, Confluence, and New Waddell Dams and Verde River Dams Modifications) that compose the plans. The impact assessment methodology consisted of a series of steps whereby environmental conditions without the project were compared to conditions with the project. The measured difference between the two conditions for a factor (i.e., stream-oriented recreation) is the impact. The baseline condition without the project is a projection of all the relevant environmental factors into the

year 2000. This future-without condition would occur if there were no project action and is therefore the condition associated with Plan 8, the No Action Alternative. The condition that would occur with each of the action alternatives (Plans 1, 2, 3, 6, 7, and 9) was compared against this future-without condition to arrive at the impact.

All aspects of project action were considered in assessing impacts, including construction, reservoir inundation, operation/maintenance, and secondary use.

2. Effects Evaluation

While the impact is the measured difference between future-without and future-with conditions for a factor, the effect is the interpretation of the significance of the impact. Effects were determined on the basis of the impact's direction (beneficial or adverse), duration (short-term or long-term), magnitude (degree of change), and the quality of the affected resource. Beneficial effects indicate that the quality of the resource is improved; adverse effects indicate the quality is degraded. Depending on the characteristics of the impact, one of the following effect levels has been assigned:

- Insignificant (I): small, ephemeral change, usually affecting a low-quality resource
- Significant Beneficial (SB): major improvement in a condition, usually long-term and affecting a high-quality resource
- Beneficial Flag (BF): extraordinary beneficial change in a unique, protected, or very high-quality resource
- Significant Adverse (SA): major degradation of a condition, usually long-term and affecting a high-quality resource
- Adverse Flag (AF): extraordinary adverse change in a unique, protected, or very high-quality resource.

3. Mitigation

Mitigation measures shown on Tables 4 and 5 represent mitigation concepts which were developed for the impacts in each of the resource areas. These concepts are workable mitigation measures that could reduce or avoid impacts if implemented. They are conceptual, rather than specific, because they were developed to apply equally to impacts of all plans. These conceptual measures were used for comparison purposes only.

After the selection of Plan 6 as the proposed action, Reclamation has developed and is committed to a mitigation program.

B. Impacts and Effects of Alternatives

Six resource categories are shown in the tables presented in this chapter, as are the important factors within each category which would be affected by project actions. Resources determined to be significant during the EIS scoping process are:

- Biological Resources
- Water Quality
- Recreation
- Cultural Resources
- Social Resources
- Economics

Resources which would be affected by project actions but were determined not to be significant to the choice among the alternatives are air quality, aesthetics, noise, geology/soils, and land resources. Impacts to these resources are not shown in the following tables, but are described in the supporting documents Environmental Impacts and Effects of Plans, Volumes 1-7.

1. Environmental Consequences

Table 4 summarizes the environmental consequences of Plans 8, 1, 2, 3, 6, 7, and 9. Environmental impacts and effects are displayed for significant resource factors, as are mitigation measures to reduce or avoid impacts where impacts are adverse. The unmitigated and mitigated effects are shown, separated by a slash (unmitigated/mitigated).

2. Social Consequences

Table 5 displays the social impacts and effects of relocations and of flood reduction. Where applicable, mitigation measures are described and the unmitigated and mitigated effects are shown. Social impacts and effects of plans are described in greater detail in the supporting document Social Impacts and Effects of CAWCS Plans.

3. Economic Consequences

Economic costs and benefits of plans are shown in Table 6. The benefits measure the provision of energy management (Plans 3, 6, 7, 9), flood control (all plans), recreation (Plans 1, 3, 6, 7, 9), water supply (all plans), SOD (all plans). Details of the economic analysis are presented in Economics-Financial Supporting Document. Options for New or Modified Roosevelt and Stewart Mountain Dams are displayed in Table 6. The determination to modify existing dams or construct new dams will be based upon the results of stability analyses and operations studies currently being

conducted by Reclamation; the environmental and social impacts and effects of new or modified structures are nearly identical and will not, therefore, be considered in the determination.

Table 4

SUMMARY OF ENVIRONMENTAL IMPACTS AND EFFECTS OF PLANS

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7	Plan 8
BIOLOGICAL RESOURCES							
Threatened/Endangered Plants and Wildlife							
Loss of acres of preferred habitat in typical year (bald eagle in all plans and Yuma clapper rail in Plan 3)	+300 (2,260 acres in site areas)	-440	-430	-1,030	-440	-440	-170
Number of bald eagle breeding areas with disrupted productivity as a result of loss of stream miles (see Perennial Stream/Riverine Communities factor)	0 (5 breeding areas in site areas, of which 3 most productive are at Confluence; 6 breeding areas in CAWCS area; 13 breeding areas in southwestern U.S.)	1	0	2	3	1	0
Conceptual Mitigation		Establish 230 acres preferred habitat	None proposed	Establish 370 acres preferred habitat	Section 7 reasonable and prudent alternatives will be implemented	Establish 280 acres preferred habitat	None proposed
Typical Year Unmitigated/ Mitigated Effect		SA/I	I	AF/AF	SA/I	SA/I	I
Riparian/Wetland Biotic Communities							
Loss or gain of high quality habitat in typical year	-2,260 (9,970 acres in site areas)	-930	-900	-3,330	-1,140	-1,140	-740
Loss or gain of low-quality habitat in typical year	-90 (1,940 acres in site areas)	+420	+860	+1,040	+1,030	+1,020	+740
Total loss or gain of acres of habitat in typical year	-2,350 (11,910 acres in site areas)	-510	-40	-2,290	-110	-120	0
Conceptual Mitigation		Establish 480 acres of high quality habitat	Establish 790 acres of high quality habitat	Establish 1,060 acres of high quality habitat	Establish 1,060 acres of high quality habitat	Establish 1,060 acres of high quality habitat	Establish 120 acres of high quality habitat
Typical Year Unmitigated/ Mitigated Effect (on high quality habitat)		SA/SA	SA/SA	AF/AF	SA/I	SA/SA	I/I

Table 4 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7	Plan 9
BIOLOGICAL RESOURCES Cont'd							
Perennial Stream/ Riverine Communities							
Loss of miles of perennial stream in typical year	0 (70 miles in site areas; 137 miles in CAWCS area)	-3	+1	-16	+1	-2	0
Change in flow characteristics of Salt and Verde Rivers	No change (on average, 106 days/ year ≤ 50 cfs in Salt, 61 days/year ≤ 50 cfs in Verde)	No change	No change	No change	No change	Guaranteed minimum flows of 200 cfs in Salt and Verde	No change
Conceptual Mitigation		None proposed	None proposed	Stream losses not mitigatable	None proposed	None proposed	None Proposed
Typical Year Unmitigated/ Mitigated Effect		I	I	AF/AF	I	SB	I
Reservoir Aquatic Communities							
Gain or loss of surface acres of habitat in typical year	0 (13,640 acres in site areas; 30,000 acres in CAWCS area)	+400	-360	+3,080	+1,900	+3,690	+1,770
Gain of guaranteed minimum pool(s)	0 (no guaranteed minimum pools at SRP lakes or Lake Pleasant)	0	0	+1 minimum pool at Confluence	+1 minimum pool at New Waddell	+2 minimum pools at Cliff and New Waddell	0
Drawdown rates greater than 2 inches/day during spawning season	No change (drawdown rates 1.3 in/day at Roosevelt, 9.2 in/day at Horseshoe, 1.6 in/day at Lake Pleasant)	4.6 in/day at Cliff (decrease from current condition)	9.2 in/day at Cliff (no change from current condition)	4.0 in/day at Cliff and 2.6 in/day at Confluence (increase over current condition)	4.0 in/day at Cliff and 4.7 in/day at New Waddell (increase over current condition)	4.5 in/day at Cliff and 4.7 in/day at New Waddell (increase over current condition)	4.7 in/day at New Waddell
Conceptual Mitigation		None proposed	None proposed		Reduction in drawdown rates to 2 in/day during spawning season		
Typical Year Unmitigated/ Mitigated Effect		I	I	SA/SB	SA/SB	SA/BF	SA/SB

Table 4 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7	Plan 9
WATER QUALITY							
Constituents	CAP water in local systems at locations and times chosen by users. Local surface water sources maintain quality independent of CAP influence. CAP water known to have high levels of dissolved organics	Average of 70,000 af of SRP (Verde River) water exchanged w/CAP each year. Comparison of Water Sources[a] (mg/l) Ca 42.5 / 85.6 D Cd 0.00156 / <0.000286 T Cd 0.00619 / <0.00462 T Fe 0.192 / 0.159 Hard 212. / 339. Na 30.5 / 107. D Pb 0.00300 / 0.00144 T Pb 0.0714 / 0.0408 D Se 0.000750 / <0.00300 T Se 0.000600 / <0.00279 SO^4 52.9 / 309. TDS 314. / 722. After-exchange maximum concentrations reach new highs for numerous constituents. Degradation of some SRP water during period when only Verde River water is normally delivered. Possible short-term impacts to M&I and agricultural users. Short exchange period affects only 8% of SRP surface water.	No change from future-without condition.	Annual average of 845,000 af of SRP surface water mixed with 250,000 af of CAP water at Confluence site. 30-35% of SRP water treated for M&I use. Changes in Average Verde River Concentrations[a] (mg/l) Ca 42.5 to 61.4 (+44%) D Cd 0.00156 to 0.00100 (-36%) T Cd 0.00619 to 0.00550 (-11%) T Fe 0.192 to 0.178 (-7%) Hard 212. to 268. (+26%) Na 30.4 to 64.0 (+111%) D Pb 0.00300 to 0.00232 (-23%) T Pb 0.0714 to 0.0580 (-19%) D Se 0.000750 to 0.00174 (+132%) T Se 0.000600 to 0.00156 (+160%) SO_4 52.9 to 165. (+212%) TDS 314. to 493. (+57%) After-mix maximum SRP concentrations reach new highs for numerous constituents. All of SRP surface water degraded and possible increased M&I treatment costs with short-term maximum CAP concentrations. Possible changes in agricultural operation only during period when Verde River water is normally delivered. High dissolved organic levels in CAP water reach water treatment plants which otherwise would receive only SRP water.	Annual average of 25,000 af of MCMWCD#1 surface water mixed with 701,800 af of CAP water at Waddell site. None of the MCMWCD#1 water treated for M&I uses. Changes in Average MCMWCD#1 Concentrations[a] (mg/l) Ca 50.8 to 84.4 (+66%) D Cd <0.00300 to 0.000378 (-87%) T Cd <0.00150 to 0.00451 (+201%) T Fe 2.04 to 0.223 (-89%) Hard 215. to 335. (+56%) Na 37.8 to 105. (+178%) D Pb 0.00200 to 0.00146 (-27%) T Pb 0.00425 to 0.0396 (+832%) D Se <0.00100 to 0.00293 (+193%) T Se <0.00100 to 0.00273 (+173%) SO_4 85.0 to 301. (+254%) TDS 358. to 710. (+98%) After-mix maximum MCMWCD#1 concentrations reach new highs for numerous constituents with no significant effect on agricultural users.		
Conceptual Mitigation		None proposed	Not applicable	None proposed	None proposed	None proposed	
Typical Year Unmitigated Effect		I	No effect	SA	I	I	

Table 4 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7	Plan 9
WATER QUALITY Cont'd							
Eutrophication							
Potential for eutrophic conditions to occur in reservoirs which store CAP Colorado River water in CAWCS study area[b].	No Colorado River water storage reservoir in study area.	Same as Future Without Condition		Confluence Reservoir has high potential for eutrophication with high probability for blue-green algal dominance. Probable aesthetic impacts on Verde arm in most years. Eutrophication provides potential for increased levels of dissolved organics in Confluence Reservoir water.	New Waddell Reservoir has low to moderate potential for eutrophication with no projected problems		
Conceptual Mitigation		------- Not applicable --------		Downstream impacts mitigatable with different disinfection process for SRP M&I water.	None proposed		
Typical Year Unmitigated/ Mitigated Effect		--------- No Effect ---------		SA/I	I	I	
Salt Loading							
Increased amount of dissolved salts imported in Colorado River water.	Baseline CAP imports average of 1,020,000 tons of dissolved salts each year.	10.6% increase in average annual imported salt volume.	1.6% increase in average annual imported salt volume.	16.2% increase in average annual imported salt volume.	13.3% increase in average annual imported salt volume.	11.3% increase in average annual imported salt volume	
Conceptual Mitigation		None proposed	None proposed	None proposed	None proposed	None proposed	
Typical Year Unmitigated/ Effect		I	I	I	I	I	

[a]Prefix D means dissolved fraction while T means total recoverable. All values shown rounded to three significant figures. Constituents shown on this table were selected to show some significant impacts; a more complete list of constituents and their impacts is included in Chapter IVB2.

[b]Eutrophication potentials were computed using the Canfield and Bachman equations described in the USBR Technical Memorandum titled "Guidelines for Studies of Potential Eutrophication" Denver, Co., 1981. Risk of eutrophication under normal operating conditions is based on phosphorus concentration which is assumed uniform over the studied area.

Table 4 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7	Plan 9
CULTURAL RESOURCES							
Prehistoric Cultural Resources							
Number of sites destroyed by construction activities/total number of sites potentially affected in dam site areas[c]	0 sites in site areas)	132/2,942	72/2,942	156/3,208	158/3,062		53/3603
Acres of archaeological deposits affected	0 acres of deposits in site areas)	4,272	4,272	12,015	4,374		4688
Effects Factor (for total sites affected)[d]		-5,760	-4,747	-14,665	-5,887		-5456
Conceptual Mitigation		Avoiding resource; partial data recovery (e.g., mapping sites, collection of surface artifacts, use of remote sensing techniques, test excavations, partial site excavations); site protection (e.g., fencing around site, policing, site monitoring, enforcement of laws against vandalism). Complete mitigation of impacts not possible.					
Unmitigated/ Mitigated Effect		AF/AF	AF/AF	AF/AF	AF/AF		AF/AF
Historic Cultural Resources							
Number of sites destroyed by construction and related activities/ total number of sites potentially affected in dam site areas[c]	0 (192 sites in site areas)	29/64	29/64	73/90	39/73		36/67
Effects Factor (Range)[d]		-73 to -320	-173 to -370	-438 to -798	-225 to -422		-207 to -383
Conceptual Mitigation		Avoiding resource; partial data recovery; site protection; site documentation (e.g., recording surface architecture or structural features); additional historical research.					
		Roosevelt Dam and Verde River Sheep Bridge impacts only partially mitigable		Fort McDowell, Roosevelt Dam, and Verde River Sheep Bridge impacts only partially mitigable	Roosevelt Dam and Verde River sheep Bridge impacts only partially mitigable		Roosevelt Dam impacts only partially mitigable
Unmitigated/ Mitigated Effect		AF/AF	AF/AF	AF/AF	AF/AF		AF/AF

[c]Affected areas include all reservoir pool zones plus a secondary impact zone that extends approximately 1 mile beyond the maximum water surface elevation.

[d]This factor incorporates both the quality of the resource and the severity of the impacts. See Stage III Methodology for Environmental Quality Assessment (Dames & Moore, 1981) for details.

Table 4 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7	Plan 9
RECREATION							
Stream-Oriented Recreation							
Net loss or gain of miles of perennial stream/loss of tubing miles in typical year	0/0 (70 stream miles in site areas; 986 miles in 5-county region)	-3/0	+1/0	-16/17	+1/0	-2/0	0/0
Net loss or gain in maximum annual recreation days for stream-oriented activities in typical year	0/0 (2,280,000 stream-oriented recreation days in site areas; 8,236,000 in 5-county region)	+5,850	+696	-1,504,802	+7,992	+6,386	0
Conceptual Mitigation		None proposed	None proposed	Loss of stream miles not mitigatable	None proposed	None proposed	None proposed
Typical Year Unmitigated/ Mitigated Effect		I	I	AF/AF	I	I	I
Reservoir-Oriented Recreation							
Net loss or gain in usable surface acres in typical year	0 (16,600 acres in site areas; 35,000 in 5-county region)	+683	-853	+5,243	+4,222	+5,095	+4,233
Net loss or gain in maximum annual recreation days for reservoir-oriented activities in typical year	0 (822,000 reservoir-oriented recreation days in site areas; 6,479,000 for 5-county region)	+670,520	-48,647	+3,537,383	+1,066,005	+1,085,873	+884,000
Conceptual Mitigation		None proposed for this factor					
Typical Year Unmitigated Effect		SB	I	SB	SB	BF	SB

Table 5

SUMMARY OF SOCIAL IMPACTS AND EFFECTS OF PLANS

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Plan 8 CAWCS No Action (Future Without the Project)	For 374 Fort McDowell Indian Community residents: Normal incidence of physical and mental health problems. High satisfaction with way of life. High levels of personal automony. High potential for increased financial self-sufficiency. High levels of extended family ties. Normal incidence of family problems. High community cohesion and viability. High potential for increased tribal economic self-sufficiency. Moderate levels of unemployment. High potential for sustaining Yavapai culture.	For 596 Roosevelt Lake area residents: Normal incidence of physical and mental health problems. High levels of personal automony. High satisfaction with way of life. High potential for financial self-sufficiency. Low levels of informal support networks in all communities except Roosevelt Gardens. Low to moderate community cohesion in all communities except Roosevelt Gardens. Community development likely to remain at present low level.	For 46,560 people living in the flood prone areas by the year 2000 (conditions occur with a 200-year flood of 275,000 cfs) COMMUNITIES AFFECTED: Mesa, Tempe, Phoenix, Salt River Pima Maricopa Indian Community (SRPMIC), Gila River Indian Community (GRIC), Buckeye, Holly Acres: Potential for inundation for 46,560 individuals. High probability for large numbers of flood-related deaths. Projected $87,292,000 in residential property damage. Temporary lifestyle disruption for 46,560 individuals subjected to inundation by floodwaters. Permanent changes in lifestyle for majority of 525 sequential disaster victims in Holly Acres. Damages to roads and bridges projected to be $15,800,000. Transportation delay costs projected to be $39,694,000. Air and rail facility damages projected to be $7,021,000. Damages of $6,400,000 to power facilities. >$275,000 in damages to treatment plants. Temporary delays in telephone service. Business losses of $68,713,000; combined with both short- and long-term revenue losses, costs could be in excess of $150 million. Short- and long-term losses to tourism. Civil defense warning system fully activated. Emergency costs of $1,109,000. No additional land available for development.

Table 5 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Plan 1	Same as Future-Without conditions.	IMPACTS For 347 Roosevelt Lake area residents: Slight increase in incidence of physical and mental health problems. Substantial decrease in personal automony. Substantial decrease in satisfaction with way of life. Moderately reduced financial capacity. Moderate decrease in informal support networks. Moderate decrease in community cohesion. Substantial decrease in community viability. MITIGATION: Relocate only those people who live within the 200-year flood pool, with no relocation of people in the IDF area. Provide Forest Service land in the Roosevelt Lake area for relocations, allowing enough space so neighbors may relocate near each other if they wish. Provide monetary compensation for all relocation expenses incurred by residents. Provide special services to meet needs that are unique to these communities. Provide an accurate and reliable system for disseminating information to residents so that they are constantly informed about relocation proceedings; provide a means by which residents can participate in the relocation planning process. UNMITIGATED/MITIGATED EFFECT: SA/I	IMPACTS For 46,560 people living in the flood prone areas by the year 2000 (conditions occur with reduction of a 200-year flood to 70-92,000 cfs at airport): Potential for inundation for less than 100 individuals in Holly Acres area. Projected $602,000 in residential property damage. Temporary lifestyle disruption for <100 individuals; permanent lifestyle disruption for majority of sequential disaster victims in Holly Acres. 15 bridge crossings remain operable. Damages to roads and bridges totalling <$5,000,000. No significant delays in transportation. Damages to electrical transmission towers and power lines would be well below $1 million. Possibility of delays in telephone service for some. No delays in delivery schedules of newspapers, mail, etc. Business losses totaling $6,194,000; majority of damages occurring to sand and gravel operations. No significant disruption to tourist trade. Emergency costs would be below $60,000. Approximately 3,563 additional acres valued at $107,311,000 available for higher urban uses. MITIGATION: Not required UNMITIGATED EFFECT: BF

Table 5 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Plan 2	Same as Future-Without conditions.	IMPACTS For 247 Roosevelt Lake area residents: Slight increase in incidence of physical and mental health problems. Substantial decrease in personal automony. Moderate decrease in satisfaction with way of life. Moderately reduced financial capacity. Moderate decrease in informal support networks. Moderate decrease in community cohesion and slight decrease in social organization. Substantial decrease in potential for sustained community viability. MITIGATION: Relocate only those people who live within the 200-year flood pool, with no relocation of people in the IDF area. UNMITIGATED/MITIGATED EFFECT: SA/No effect	IMPACTS For 46,560 people living in the flood-prone areas by the year 2000 (conditions occur with a reduction of 200-year flood to 157,000 cfs at airport): Potential for inundation of approximately 525 individuals. Low probability of flood-related deaths. Projected $5,684,000 in residential property damage. Temporary lifestyle disruption for 525 individuals inundated; permanent lifestyle disruption for many sequential disaster victims in Holly Acres. 15 bridge crossings remain operable. Closure of all dip crossings. Damages to roads and bridge crossings totalling >$5,000,000. No significant delays in transportation. Damages totaling $1,500,000 to electrical transmission towers and power lines. Approximately $80,000 in damages to sewage and wastewater treatment plants. Temporary delays in telephone service in some areas. No delays in delivery schedules of newspapers, mail, etc. Business losses totalling $6,977,000; majority of damages to sand and gravel operations. No significant disruption in tourist trade. Civil defense warning system fully activated. Emergency costs in excess of $505,000. 2,248 acres valued at $66,026,000 available for higher urban uses. MITIGATION: Not required. UNMITIGATED EFFECT: SB

Table 5 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Plan 3	IMPACTS: For 290 Fort McDowell Indian Community residents: High incidence of physical and mental health problems which is expected to result in increased illness and mortality. Extreme decline in levels of personal autonomy. Extreme decrease in satisfaction with way of life. Substantial decrease in potential for sustained financial self-sufficiency. Substantial decrease in extended family ties. Substantial increase in incidences of family problems. Extreme decrease in community cohesion and viability. Substantial decrease in potential for tribal economic self-sufficiency; substantial increase in unemployment. Extreme decrease in potential to sustain Yavapai culture. MITIGATION: Relocate the entire community together. Provide land of the highest available quality contiguous to the reservation. Monetary compensation should cover all expenditures. Provide for participation of the entire community in all decisions and plans. Provide a system for disseminating information to residents. UNMITIGATED/MITIGATED EFFECT: AF/AF	Impacts and effects same as Plan 1.	Impacts and effects same as Plan 1.
Plan 6 (Agency Proposed Action)	Same as Future-Without conditions.	Impacts and effects same as Plan 1.	Impacts and effects same as Plan 1.
Plan 7	Same as Future-Without conditions.	Impacts and effects same as Plan 1.	Impacts and effects same as Plan 1.

Table 5 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Plan 9	Same as Future-Without conditions.	Impacts and effects same as Plan 1.	IMPACTS For 46,560 people living in the flood-prone areas by the year 2000 (conditions occur with a reduction of 200-year flood to 215,000 cfs at airport): Potential for inundation of >525 individuals. Low probability of flood-related deaths. Projected $18,954,000 in residential property damage. Temporary lifestyle disruption for >525 individuals inundated; permanent lifestyle disruption for many sequential disaster victims in Holly Acres. 3 bridge crossings remain operable. Closure of all dip crossings. Damage to roads and bridge crossings totalling $9,100,000. Significant delay in transportation. Damages totalling $4,800,000 to electrical transmission towers and power lines. Greater than $135,000 in damages to sewage and wastewater treatment plants. Temporary delays in telephone service in some areas. Delays in delivery schedules of newspapers, mail, etc. Business losses totalling $21,761,000; majority of damages to sand and gravel operations. Short-term disruption in tourist trade. Civil defense warning system fully activated. Emergency costs in excess of $809,000 MITIGATION: Not required. UNMITIGATED EFFECT: B

Table 6

SUMMARY OF ECONOMIC COSTS AND BENEFITS OF PLANS

ECONOMICS	Plan	Total Construction Cost ($ Range)[a]	Total Annual Cost ($ Range)[a]	Total Annual Benefits ($)	Net Economic Benefits ($ Range)[a]
Plan 8	(No CAWCS Action)	0	0	0	0
Plan 1		694,940,000 to 874,230,000	58,060,000 to 71,300,000	89,040,000	30,980,000 to 17,740,000
Plan 2[b]		541,570,000 to 627,460,000	41,870,000 to 48,210,000	53,310,000	11,440,000 to 5,100,000
Plan 3		1,116,250,000 to 1,295,540,000	93,970,000 to 107,200,000	125,970,000	32,000,000 to 18,770,000
Plan 6	(Agency Proposed Action)	978,430,000 to 1,157,720,000	82,710,000 to 95,940,000	174,290,000	91,580,000 to 78,350,000
Plan 7		same as Plan 6	same as Plan 6	168,160,000	85,450,000 to 72,220,000
Plan 9		931,790,000 to 1,111,080,000	76,030,000 to 89,260,000	143,089,000	53,829,000 to 60,169,000

[a]Costs range from Modified Roosevelt/Modified Stewart Mountain options to New Roosevelt/New Stewart Mountain options. Net economic benefits correspond to these options. Costs of plans would be allocated among several funding sources; for this analysis 2 sources were assumed: Reclamation Safety of Dams Act and Colorado River Basin Project Act.

[b]New Roosevelt is not included in Plan 2.

TABLE OF CONTENTS

VOLUME I

		Page
I.	PURPOSE AND NEED FOR THE ACTION	1
	A. Background	1
	B. Geographic Setting	2
	C. Purpose	3
	D. Need	3
	1. Regulatory Storage	3
	2. Flood Control	4
	3. Dam Safety	4
II.	ALTERNATIVES INCLUDING THE PROPOSED ACTION	5
	A. Alternatives Eliminated from Further Study	5
	1. Stage I Alternatives	5
	2. Stage II Alternatives	5
	3. Stage III Alternatives	11
	B. Alternatives Analyzed in Detail	12
	1. Major Project-Related Activities	14
	2. Plan 8: No CAWCS Action	16
	3. Plan 1: Cliff + Roosevelt + Stewart Mountain Dams	18
	4. Plan 2: Cliff + Roosevelt + Stewart Mountain Dams + Nonstructural Measures	30
	5. Plan 3: Confluence + Cliff + Roosevelt + Stewart Mountain Dams	34
	6. Plan 6: (Agency-Proposed Action): New Waddell + Cliff + Roosevelt + Stewart Mountain Dams	39
	7. Plan 7: New Waddell + Cliff + Roosevelt + Stewart Mountain Dams (environmental enhancement)	44
	8. Plan 9: New Waddell + Roosevelt + Stewart Mountain Dams + Verde River Dams Modifications	44
	C. Comparative Analysis of Alternatives	49
	D. The Proposed Action - Plan 6	53
III.	AFFECTED ENVIRONMENT	55
	A. Determination of Significant Resources	55
	B. General Description of Area Resources	56
	1. Significant Resources	56
	2. Other Resources	73

C. Description of Affected Site Areas---------- 77

1. New/Modified Stewart Mountain Site Area---------- 77
2. Cliff Site Area---------- 78
3. Verde River Dams Modifications Site Area---------- 85
4. New/Modified Roosevelt Site Area---------- 89
5. Confluence Site Area---------- 99
6. New Waddell Site Area---------- 109
7. Downstream Area---------- 116

IV. ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES---------- 123

A. Methodology---------- 123

1. Impact Assessment---------- 123
2. Effects Evaluation---------- 125
3. Conceptual Mitigation---------- 126

B. Impacts of Plans---------- 126

1. Biological Resources---------- 126
2. Water Quality---------- 156
3. Recreation---------- 172
4. Cultural Resources---------- 181
5. Social Resources---------- 195
6. Economics---------- 231
7. Other Impacts of Plans---------- 233
8. Summary of Impacts---------- 253

C. Mitigation Plan for the Proposed Action (Plan 6)---------- 253

1. Biological Resources---------- 266
2. Cultural Resources---------- 279
3. Social Resources---------- 281
4. Mitigation of Construction-Related Impacts---------- 282

D. Cumulative Impacts for the Proposed Action and Other Reclamation Projects---------- 286

1. Socioeconomic Resources---------- 287
2. Biological Resources---------- 289
3. Water Development and Availability---------- 291
4. Water Quality---------- 293

E. Energy Requirements and Conservation for the Proposed Action (Plan 6)---------- 297

F. Relationship between Short-Term Uses of the Environment and Long-Term Enhancement for the Proposed Action (Plan 6)---------- 300

G. Irreversible and Irretrievable Commitment of Resources---------- 300

1. Biolgoical Resources---------- 300
2. Cultural Resources---------- 300
3. Economics---------- 306
4. Aesthetics---------- 306
5. Geology/Soils---------- 306
6. Land Resources---------- 306

H. Conflicts with Other Agency Programs, Plans, and Policies---------- 306

1. Arizona Department of Transportation---------- 306
2. Maricopa County Department of Planning and Development---------- 307
3. Maricopa County Parks and Recreation Department-- 307
4. City of Mesa---------- 307
5. Rio Salado Development District---------- 307
6. Fish and Wildlife Service---------- 307
7. Arizona Game and Fish Department---------- 307

I. Plan 6 Compliance with Other Environmental Statutes--- 308

J. Environmental Commitments---------- 308

1. Construction Consideration---------- 308
2. Biological Resources---------- 315
3. Cultural Resources---------- 319
4. Social Resources---------- 319

V. LIST OF PREPARERS---------- 321

GLOSSARY---------- 325

BIBLIOGRAPHY---------- 333

INDEX---------- 339

APPENDICES VOLUME II

A. Distribution List---------- A-1
B. Consultation and Coordination---------- B-1
C. Relationship of Pool Elevations, Volumes, and Areas With Storage Levels Based on Elevation - Duration Curves---------- C-1
D. Impacts of the Alternatives on Flood Plains and Wetlands---------- D-1
E. Section 404 Evaluation---------- E-1
F. Endangered Species Act, Section 7 Consultation---------- F-1
G. Fish and Wildlife Coordination Act Report---------- G-1
H. Responses to Comments---------- H-1

LIST OF TABLES

II-1	Stage I Results of Element Evaluation	6
II-2	Stage II Results of Screening for Competing Elements	9
II-3	Stage II Systems	10
II-4	Construction Impact Areas	15
II-5	Design Details - Plan 1	20
II-6	Design Details - Plan 2	32
II-7	Design Details - Plan 3	36
II-8	Design Details - Plan 6	41
II-9	Design Details - Plan 7	45
II-10	Design Details - Plan 9	47
II-11	Comparative Evaluation of Plans	51
III-1	Acreage and Percent Range of Biomes and Biotic Series in the Study Area	57
III-2	Surface Water Quality, Colorado River Below Parker Dam	63
III-3	Surface Water Quality, Aqua Fria River at Rock Springs	65
III-4	Surface Water Quality, Verde River Below Bartlett Dam	66
III-5	Surface Water Quality, Salt River Below Stewart Mountain Dam	67
III-6	Surface Water Quality, Salt River Project Water	68
III-7	Ambient Sound Levels by Land Use Type	75
III-8	Acreage and Percent Range of Biotic Community Series and Association at the Cliff Site Area	79
III-9	Acreage and Percent Range of Biotic Community Series and Association at the Verde River Dams Modification Site Area	86
III-10	Acreage and Percent Range of Biotic Community Series and Association at the Roosevelt Site Area	90
III-11	Acreage and Percent Range of Biotic Community Series and Association at the Confluence Site Area	100
III-12	Acreage and Percent Range of Biotic Community Series and Associations at the New Waddell Site Area	110
IV-1	Conceptual Mitigation for Biological Resources	131
IV-2	Acreage of Riparian/Wetland Communities - Impacts of Plan 8	133
IV-3	Riparian/Wetland Communities - Impacts, Mitigation, and Residual Impacts by Site Area and Pool Level	134
IV-4	Other Terrestrial Communities - Impacts of Plan 8	136
IV-5	Other Terrestrial Communities - Impacts, Mitigation, and Residual Impacts by Site Area and Pool Level	137
IV-6	Perennial Stream/Riverine Communities - Impacts of Plan 8	138
IV-7	Perennial Stream/Riverine Communities - Impacts, Mitigation, and Residual Impacts by Site Area and Pool Level	139
IV-8	Reservoir Aquatic Communities - Impacts, Mitigation, and Residual Impacts by Site Area and Pool Level	141
IV-9	Productivity of Bald Eagle Breeding Areas	144

IV-10	Threatened and Endangered Species Preferred Habitats - Impacts of Plan 8	144
IV-11	Threatened and Endangered Plants and Wildlife - Impacts, Mitigation, and Residual Impacts by Site Area and Pool Level	146
IV-12	Special Use and Management Areas - Impacts of Plan 8	148
IV-13	Special Use and Management Areas - Impacts, Mitigation, and Residual Impacts by Site Area and Pool Level	149
IV-14	Biological Resources Net Impact/Effect for Plan 1	151
IV-15	Biological Resources Net Impact/Effect for Plan 2	152
IV-16	Biological Resources Net Impact/Effect for Plan 3	153
IV-17	Biological Resources Net Impact/Effect for Plan 6	154
IV-18	Biological Resources Net Impact/Effect for Plan 7	155
IV-19	Biological Resources Net Impact/Effect for Plan 9	156
IV-20	State and Federal Regulated Water Constituents	161
IV-21	Water Quality Impacts, Plan 1	162
IV-22	Water Quality Impacts, Plan 1 (Special Case)	163
IV-23	Water Quality Impacts, Plan 3	165
IV-24	Water Quality Impacts, Plan 3 (Special Case)	166
IV-25	Water Quality Impacts, Plan 6 - Impacts from Regulatory Storage at Waddell	167
IV-26	Water Quality Impacts, Plan 6 - Impacts from Addition of SRP Water	168
IV-27	Total Number of Archaeological Sites in Affected Site Areas	187
IV-28	Impacts to Archaeological Resources, by Impact Type and Site Type	188
IV-29	Historic Site Impact/Effect by Plan	193
IV-30	Fort McDowell Indian Community Impacts and Effects of Relocation	198
IV-31	Roosevelt Lake Area, Aggregated Impacts and Effects of Relocation	204
IV-32	Cliff Site (KA Ranch), Impacts and Effects of Relocation	209
IV-33	Flood Damage Reduction Impacts of Plans 1, 3, 6, and 7 - Control of 200-Year Flood to Flow of 70,000 to 92,000 cfs	212
IV-34	Flood Damage Reduction Impacts of Plan 2 - Control of 200-Year Flood to Flow of 157,000 cfs	218
IV-35	Flood Damage Reduction Impact of Plan 9 - Control of 200-Year Flood to Flow of 215,000 cfs	224
IV-36	Ecomomic Costs and Benefits of Plans	234
IV-37	Ecomomic Benefits of Plans	235
IV-38	Future-Without Condition Total Suspended Particulates	236
IV-39	Visual Quality Impacts of Plans on the Natural Environment	239
IV-40	Acreage of Visual Interpretive Zones in Future Without Project	240
IV-41	Impacts to Sand and Gravel - Deposits on Verde, Salt, and Gila Rivers	246
IV-42	Impacts to Prime Farmland	248

IV-43 Summary of Environmental Impacts and Effects of Plans---------- 254
IV-44 Summary of Social Impacts and Effects of Plans-------- 260
IV-45 Summary of Economic Costs and Benefits of Plans------- 265
IV-46 Acreage and Habitat Units for the Future Without and the Future With the Project and; Mitigated Acreages, Habitat Units and Costs for Each Mitigation Measure in Each Community Type Affected in the Plan 6------- 268
IV-47 Sanitary Landfills in Vicinity of Plan 6 Construction Sites---------- 285
IV-48 Summary of Estimated Socioecomomic Impacts of Water Resource Development Projects, Planned or Under Construction, Lower Colorado River Basin, Year 2000---------- 288
IV-49 Biotic Communities of the Lower Colorado River Basin-- 290
IV-50 LCRB Water Availability Impacts---------- 290
IV-51 Annual Impacts to Water Quality---------- 294
IV-51A Water Quality Improvement Projects---------- 299
IV-52 Relationships and Tradeoffs Between Short-Term Uses of the Environment and Long-Term Enhancement for the Proposed Action---------- 301
IV-53 Status of Plan 6 Compliance With Other Environmental Statutes---------- 309

V-1 List of Preparers---------- 322

LIST OF FIGURES

Following Page

I-I CAWCS Study Area---------- 4

II-1 Plan 1 - Cliff + Roosevelt + Stewart Mountain Dam----- 18
II-2 Plan 2 - Cliff + Roosevelt + Stewart Mountain Dam Nonstructural---------- 30
II-3 Plan 3 - Confluence + Cliff + Roosevelt + Stewart Mountain Dam---------- 34
II-4 Plan 6 - New Waddell + Cliff + Roosevelt + Stewart Mountain Dam---------- 40
II-5 New Waddell + Roosevelt + Stewart Mountain Dam + Verde River Dams Modifications---------- 50
II-6 Horseshoe Dam Site and Location of Potential Construction Materials Site---------- 50
II-7 Bartlett Dam Site and Location of Potential Construction Materials Site---------- 50

III-1 Affected Site Areas in CAWCS Area---------- 56
III-2 Existing Generalized Land Use Patterns---------- 76
III-3 General Land Ownership Patterns---------- 76

IV-1 Reservoir Pools Use in Impact Assessment---------- 124
IV-2 National Economic Impacts Accounting Framework-------- 232
IV-3 Methodology for Economic Benefits Analysis---------- 234

IV-4A Framework For Cultural Resource Mitigation, Regulatory Storage Division, Central Arizona Project---------- 280
IV-4 Construction Waste Disposal---------- 284
IV-5 Reclamation Projects Under Construction or Proposed for the Lower Colorado River Basin---------- 286
IV-6 Biotic Communities of the Lower Colorado River Basin---------- 290
IV-7 Riparian Biotic Communities Associated With Perennial Streams of the Lower Colorado River Basin---------- 290

I. PURPOSE AND NEED FOR THE ACTION

I. PURPOSE AND NEED FOR THE ACTION

A. Background

This environmental impact statement (EIS) describes and evaluates the proposed construction and operation of the Regulatory Storage Division of the Central Arizona Project (CAP) by the U.S. Bureau of Reclamation. Construction of the CAP Regulatory Storage Division was authorized by Section 301(a)(3) of the Colorado River Basin Project Act (P.L. 90-537) of 1968. This feature of the CAP was investigated under the title Central Arizona Water Control Study (CAWCS).

The CAP was authorized under P.L. 90-537 on September 30, 1968. The primary purpose of the CAP is to furnish water for irrigation, municipal, and industrial use in central Arizona and western New Mexico. Because of its large size and complexity, the CAP is divided into several features serving separate but interrelated functions.

To achieve compliance with the National Environmental Policy Act (NEPA) of 1969, an overall EIS was filed for the entire CAP on September 26, 1972 (U.S. Bureau of Reclamation, 1972). This statement committed the Bureau of Reclamation (Reclamation) to prepare individual site-specific EIS's for major features of the CAP. Since that time six final EIS's have been filed by Reclamation for individual features of the project: Havasu Intake Channel, Havasu Pumping Plant, Buckskin Mountains Tunnel (January 1973); Granite Reef Aqueduct (January 1974); Granite Reef Aqueduct Transmission System (August 1975); Salt-Gila Aqueduct (November 1979); Tucson Aqueduct Phase A (July 1982); and Water Allocations and Water Service Contracting (March 1982). These features of the CAP are either completed or are under construction. Remaining authorized features of the CAP, in addition to the Regulatory Storage Division, that are in the planning stage are Tucson Aqueduct Phase B, Hooker Dam or a suitable alternative, Indian Distribution System, and Buttes Dam and Reservoir.

The seven alternative plans for the CAP regulatory Storage Division described in detail in this EIS address regulatory storage of Central Arizona Project water and flood control of the Salt and Gila Rivers through the metropolitan Phoenix area. The EIS also described concurrent and coincident aspects of the Safety of Dams (SOD) program. The 1978 Reclamation Safety of Dams Act (P.L. 95-578) directs the Secretary of the Interior to preserve the structural safety of Reclamation dams and related facilities by performing modifications that may be reasonably required. Since the construction and operation of the CAP Regulatory Storage Division and SOD features will involve common timing and locations, the purposes of both authorizing legislations have been combined in the CAWCS.

A number of alternatives have been evaluated in the CAWCS planning process which provide for the authorized Regulatory Storage Division and include means to insure the structural safety of Reclamation dams operated by the Salt River Project (SRP). Based on the development and ranking of preliminary plans, six "candidate" plans in the draft EIS, including a CAWCS "no action" alternative, were identified. A seventh plan was included in this document in response to public comments received on the Draft EIS.

The EIS is supported by 23 technical reports covering all aspects of CAWCS planning, designs, public involvement, social and environmental impact assessment, economics, and hydrological analyses (see listing in Bibliography). Because of the magnitude and detail of information contained in these documents, the EIS complies with the Council on Environmental Quality (CEQ) regulations for incorporating material into an EIS by reference when the effect will be to reduce bulk without impeding agency and public review of the action. In order to present relevant information and to focus on major issues, the EIS presents information from the supporting documents in a greatly abbreviated manner and references appropriate documents where more detail may be found.

B. Geographic Setting

The CAWCS study area encompasses approximately 13,400 square miles, or 8,576,000 acres, in central Arizona, including portions of Maricopa, Gila, and Pinal Counties. Figure I-1 shows the study area. The entire metropolitan Phoenix area is located within the CAWCS boundaries. Portions of the study area outside the metropolitan area are characterized by mountain ranges with steep slopes and rugged topography separated by broad, gently sloping valleys. The climate is marked by low annual rainfall, hot summers, and mild winters. Vegetation and wildlife are typical of the southwestern Sonoran Desert.

Water in the study area comes from four major streams and their tributaries supplemented by ground water. These streams are the Salt, Verde, Gila, and Agua Fria Rivers. Several dams are located on these rivers including six Salt River Project-operated dams on the Salt and Verde Rivers which impound water for distribution to municipal, residential, and agricultural users. The SRP-operated dams are Federally owned. Waddell Dam on the Agua Fria River, stores water for agricultural use by Maricopa County Municipal Water Conservation District #1 (MCMWCD#1), the owner and operator of the facility.

The population of the area is over 1.5 million people, almost 90 percent of whom reside in Maricopa County. There are six Indian communities in the study area: Fort McDowell Mohave-Apache (Yavapai), Gila River, Salt River Pima-Maricopa, Ak-Chin, Gila Bend, and Papago. The aggregated population of these Indian communities is just over 13,000.

Vast portions of the CAWCS area remain in their natural state, unaltered or only slightly modified by man's activities. About 75 percent of the area is rangeland. Agricultural lands, urban built-up lands, forest lands, barren lands, water bodies, and wetlands comprise the remainder. About 70 percent of the lands in the area remain in public ownership or are Indian reservations.

The CAWCS area is a major center for economic activity in the Southwest. Leading factors in the area's economy are manufacturing, mining, tourism, retail trade and services, government, and agriculture. Over the last twenty years, the Phoenix area has experienced unprecendented growth due to heavy immigration.

C. Purpose

The alternative actions described in this EIS have three principal purposes. These are:

1. To increase the operating efficiency of the CAP through the conservation of Salt, Verde, and Agua Fria River flows, and through regulation of Colorado River water deliveries from the Granite Reef Aqueduct.
2. To provide facilities and means to meet the flood control needs on the Salt and Gila Rivers through the Phoenix metropolitan area.
3. To provide for the structural safety of existing Bureau of Reclamation dams on the Salt and Verde Rivers.

In addition to these major project purposes, several planning objectives were adopted to aid in developing and evaluating plans. These included, among other things, opportunities for fish and wildlife enhancement, potential for recreational development and enhancement, opportunities for hydroelectric power production, opportunities to improve the management and protection of open space and the potential for multi-purpose projects such as the Rio Salado concept, and protection of unique archaeological and historical resources in the CAWCS study area. These objectives are addressed either in the design of the alternative plans or in initiatives for impact mitigation.

D. Need

1. Regulatory Storage

Construction of regulatory storage unit for CAP water would improve the operating flexibility and efficiency of the CAP and would allow the importation of greater quantities of Colorado River water in years when it is available. Without regulatory storage capacity, the CAP system could be operated only in direct response to demand. The demand for water is greatest during the summer and during the daytime hours. If regulatory storage space is available, water could be pumped and stored, irrespective of demand, during off-peak periods for delivery during peak periods.

A major advantage of flexible operation of the CAP system is more efficient energy management. With regulatory storage, water could be pumped during off-peak periods (for example, at night or during the winter) when energy is less valuable. The benefit resulting from this energy management would be the ability to use surplus power not needed for CAP pumping to meet peak loads of other power producers, such as utility companies (see Economics-Financial Supporting Document, USBR, 1982d).

Regulatory storage would increase the efficiency (increase water yield) of the CAP system during years when the local rivers have surpluses or the Colorado River supplies are above normal, and during possible interruptions in the system such as power failures. In the event of the latter occurrences, water from regulatory storage could continue to be delivered to at least part of the system. During the supply surpluses,

regulatory storage would allow for storage and use of water which would otherwise be spilled and wasted.

2. Flood Control

Flooding of the Salt and Gila Rivers has been a problem in the Phoenix metropolitan area since its early settlement. Most recently, a series of floods caused substantial damages in the form of income losses, emergency costs, and property damage. Severe impacts on transportation and on people living in the flood zone also resulted. Monetary damages resulting from the February 1978 floods were estimated at $31 million, with damages from the December 1978 and February 1980 floods set at $46 million and $64 million, respectively (U.S. Army Corps of Engineers, 1979a,b; 1981a). These floods created strong public and private-sector demand for flood control on the Salt River.

The worst of these floods in February 1980 peaked at 170,000 cubic feet per second (cfs) through Phoenix. By comparison, the U.S. Army Corps of Engineers (Corps) has calculated the flow for a 200-year event under present conditions as 275,000 cfs. The 100-year event would have a flow of 215,000 cfs.

3. Dam Safety

Hydrologic analyses based on revised calculations for the maximum probable flood (in the CAWCS this is the Inflow Design Flood or IDF) on the Salt and Verde Rivers indicate that all six SRP storage dams have inadequate storage and/or spillway and outlet capacity to contain and/or pass the IDF without overtopping (see Hydrology Supporting Document, USBR, 1982h). Such an occurrence could jeopardize the safety of the dams. The overtopping or failure of any of these dams is considered serious because of the potentially catastrophic consequences which would result for Phoenix and other downstream communities.

The Reclamation Safety of Dams Act provides for the least cost solution to solve SOD problems on existing dams. Further information on dam safety requirements and possible solutions on the Salt and Verde Rivers is contained in Safety of Dams Supporting Document, (USBR, 1982c).

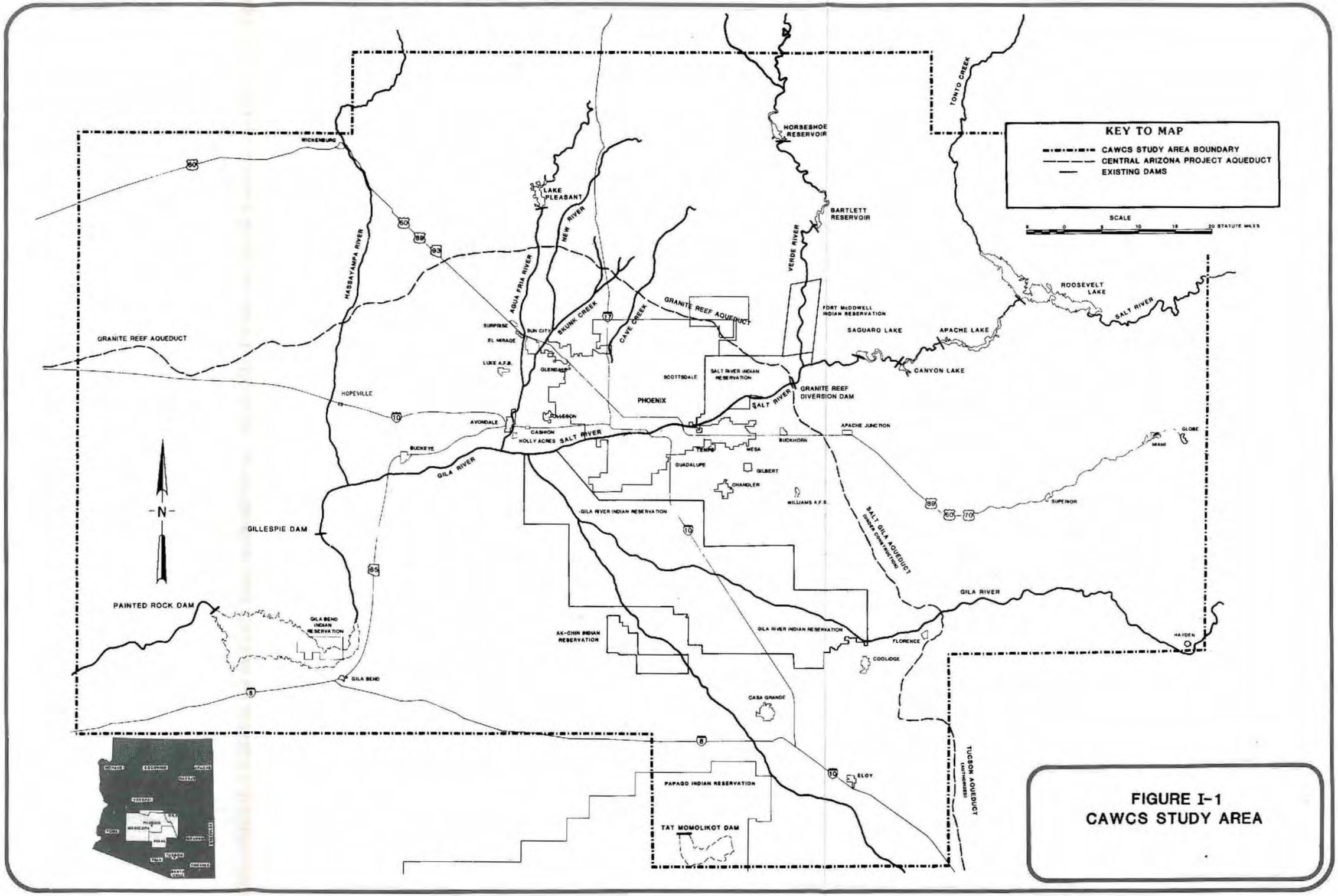

FIGURE I-1
CAWCS STUDY AREA