STAGE III REPORT

Prepared by

ARIZONA PROJECTS OFFICE
BUREAU OF RECLAMATION

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CENTRAL ARIZONA WATER CONTROL STUDY

STAGE III REPORT

April 1983

Prepared by

Arizona Projects Office
Bureau of Reclamation

This report was prepared pursuant to Public Law 90-537, the Colorado River Basin Project Act. Publication of the findings and recommendations contained herein should not be construed as representing either the approval or disapproval of the Secretary of the Interior. The purpose of this report is to provide information and alternatives for further consideration by the Bureau of Reclamation, the Secretary of the Interior, and other Federal agencies.

SUMMARY

The objective of the Central Arizona Water Control Study (CAWCS) was to examine all reasonable alternatives to provide regulatory storage for Central Arizona Project (CAP) water and flood control along the Salt and Gila Rivers and then recommend a plan.

Concurrent with the CAWCS, but under separate authority, consideration relative to the safety of the existing dams in the study area were being analyzed. These considerations become very important in alternative development in the latter stages of the CAWCS.

CAWCS followed a three-stage plan formulation process. Stage I was exploratory in nature; problems, needs, and issues were identified. A wide array of possible solutions (elements) were developed and studied on an initial level to determine those elements which warranted further study.

During Stage II, the planning focus shifted from problem identification to formulation and testing of alternative solutions. Elements from Stage I were screened to identify the best elements, which were then combined into systems which provided for both flood control and regulatory storage.

In Stage III, the final planning stage, the focus of the planning effort shifted from alternative formulation to thorough impact assessment and evaluation.

From the elements remaining at the end of Stage II, 104 plans were formulated and evaluated during Stage III. From these 104 plans, eight plans, including a No Action plan, were identified that would best meet the objectives of CAWCS and provide a safety of dams (SOD) solution on the Salt and Verde Rivers. Table 1, Description of Plans, is a listing of those eight plans. Intensive study of these eight plans led to the recommendation of one proposed action for feasibility level studies and designs, Plan 6.

During Stage III, data were developed for factors which could be used to evaluate the impacts and effects of each plan. From this data, and with the comments and recommendations received from public meetings, 21 evaluation criteria were developed which provided a framework for determining which of the eight plans were appropriate for consideration as candidate plans. Once the data for the 21 evaluation criteria were displayed and analyzed, it was determined that although all criteria were critical to the plan evaluation process, only certain factors were significant in the discrimination of plans.

These criteria were as follows: yield, energy management, flood control, total construction cost, benefit/cost (B/C) ratio, threatened and endangered species, riparian habitat, cultural resources, and Indian relocation.

In October 1981, using these criteria, the CAWCS planning team evaluated the eight plans and made the following recommendations.

- Plans 4 and 5 should be eliminated from further consideration because although these two plans could eventually meet the primary objectives of CAWCS, they do not do so efficiently.

Table 1

Description of Plans

CLIFF + NEW/ENLARGED ROOSEVELT + STEWART MOUNTAIN[1/]

Plan 1: Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain
Plan 2: Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain + Nonstructural

CONFLUENCE + CLIFF + NEW/ENLARGED ROOSEVELT + STEWART MOUNTAIN[1/]

Plan 3: Confluence + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

Plan 4: Confluence with a Large Spillway + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

Plan 5: Confluence with Small Service Spillway and Auxilary Spillway + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

NEW WADDELL + CLIFF + NEW/ENLARGED ROOSEVELT + STEWART MOUNTAIN[1/]

Plan 6: New Waddell + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

Plan 7: New Waddell + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain (environmental emphasis)

CAWCS NO ACTION

Plan 8: No CAWCS project; SOD studies continue to select a preferred dam safety solution

1/ Stewart Mountain Dam need only be reconstructed to meet SOD requirements.

- Plans 1, 2, 3, 6, 7, and 8 should be displayed in the draft EIS as candidate plans.

- Plans 1, 3, and 6 are appropriate for consideration as the proposed action.

Table 2 provides a comparative display of the advantages and disadvantages of Plans 1, 2, 3, 6, 7, and 8 relative to the significant evaluation criteria.

After reviewing the three recommended plans, the Secretary of the Interior selected Plan 6 as the agency proposed action in November 1981 because it meets project objectives, has strong public support, and does not have severe social and environmental impacts.

At the time of the selection, the agency recognized that although the plans had been analyzed in sufficient detail to make such a selection, more planning was needed before the proposed action could be implemented. This planning has continued in the following areas: New Waddell sizing and operation, Roosevelt and Stewart Mountain Dams stability, recreation planning, and mitigation.

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 resouces 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 endanagered 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

Table 2 (Continued)

	Advantages	Disadvantages
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 Insignificant impacts to endangered species Strong broad-based public support	High cost Adverse impacts to riparian 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

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I. PURPOSE OF REPORT

The objective of the Central Arizona Water Control Study (CAWCS) is to examine all reasonable alternatives to provide regulatory storage of Central Arizona Project (CAP) water and flood control along the Salt and Gila Rivers and then recommend a plan. As CAWCS is part of the advance planning effort for CAP, the authority for the study is derived from the Lower Colorado River Basin Project Act (Public Law 90-537).

The purpose of this report is two-fold, to describe the process used to arrive at the November 1981 selection of Plan 6 as the agency recommended action, and to provide plan formulation support for the draft environmental impact statement (EIS).

The section SELECTION of the PROPOSED ACTION describes the process used to arrive at the November 1981 decision. It provides study background information, a description of the plan formulation process, and a discussion of the candidate plans formulated and studied during the third phase of CAWCS. The information displayed in this section is appraisal level information and was subject to change, but the changes that have occurred have not changed the recommendation of the proposed action. This information has been made public in the CAWCS Factbook of October 1981.

The section CURRENT PLANNING presents the information displayed in the draft EIS on the impacts and effects of the plans. It also describes the planning which took place after the November 1981 decision. After selection of the proposed action, planning continued and additional data for Plan 6 were developed. Areas of additional study included energy management, new vs. modified Roosevelt, new vs. modified Stewart Mountain, and others.

This Stage III Report is supported by several documents. Information contained in these documents has been greatly abbreviated in the Stage III Report and the Environmental Impact Statement. Readers wishing to consult the supporting documentation for details of the alternative plans, affected environment, assessment methodologies, and plan impacts and effects should contact the Bureau of Reclamation, Arizona Projects Office, Suite 2200, Valley Center, Phoenix, Arizona 85073.

The following briefly describes the contents of these supporting documents.

-- Designs and Estimates: This document includes information on the designs and estimates used in making the November 1981 decision to choose Plan 6 as the agency proposed action. It also contains supporting designs and estimates for the draft EIS.

-- Plan Formulation: This report documents the activities undertaken in the CAWCS which led to the selection of a proposed action. It includes study background information, a description of the plan formulation process, a discussion of the candidate plans formulated and studied during Stage III, and a display of the proposed action (Plan 6).

-- New Waddell Sizing Study: This report documents the activities undertaken by the Bureau of Reclamation (Bureau) after the November 1981 decision to develop and evaluate options to determine the New Waddell Dam size that would be appropriate for feasibility design. The report contains a description of alternatives, costs, benefits, and environmental and social effects. It also covers areas such as pump-generator sizing, sediment distribution, pumped storage potential, and flood control for the Agua Fria River.

-- Recreation Planning: This document identifies the recreational planning processes that were involved in the CAWCS Stage III work, both before and after the November 1981 decision. It displays the resulting conceptual plans which were developed and the anticipated facility costs and recreation days provided by each site. The document includes, a discussion of the Corps of Engineers (COE) and the Bureau's planning efforts to determine potential impacts of the plans, summaries of anticipated use by facilities and site, and a discussion of the economic aspects of the recreational plans.

-- Safety of Dams (SOD): This document contains two sections, one covering the Salt River dams and the other covering the Verde River dams. The report identifies the dam safety deficiencies on each river system, evaluates alternative solutions, and recommends the most favorable alternatives for further study.

-- Nonstructural Flood Damage Reduction: This report documents a study completed by the COE on nonstructural flood mitigation measures. It includes a definition of the flood problem, possible nonstructural mitigation measures, and an evaluation of these measures.

-- Economics - Financial: This report documents the economic analyses which occurred during CAWCS Stage III. It includes analysis of flood control benefits, water supply benefits, and hydropower benefits.

-- Hydrology: This document presents the hydrologic analysis of the Gila River drainage basin for CAWCS. It also includes data on water requirements, water rights, water quality, sedimentation, and flood control. A hydraulic analysis of the Salt and Gila Rivers is also presented.

-- Social Impacts and Effects of CAWCS Plans: This report documents the social impacts and effects of Stage III plans, describes existing and future conditions for the affected populations, provides a summary of findings in the Social Well-Being (SWB) Account, and describes the social assessment process in CAWCS. It also provides a description of the methodology used for the social assessment.

-- Second Level Environmental Inventory: This document is a working paper that provides an inventory of environmental resources in the CAWCS study area. The inventory describes resources in biology, geology/ soils, acoustics, water, air, land use, recreation, prehistoric and historic cultural resources, and visual quality. This report is the result of extensive literature reviews and agency

contacts in all disciplines, and field studies in biology and cultural resources. The data were developed for the purpose of assessing the impacts of alternative plans.

-- Biological Assessment of Endangered Species: This report documents effects of CAWCS plans on Federal-designated threatened and endangered species in the CAWCS study area. The species include bald eagle, Yuma clapper rail, peregrine falcon, Gila topminnow, and Turk's head and Arizona hedgehog cacti.

-- Stage III Methodology for Environmental Quality Assessment: This document describes the methodology for assessing impacts to environmental quality in Stage III of the CAWCS. Impact assessment measures and criteria for determining effects are described for the following factors: biological resources, water quality, air quality, sound quality, visual quality, land quality, geological resources, cultural resources, and recreation.

-- Regional Future Without the Project: This document forecasts the most likely future conditions in central Arizona without CAP regulatory storage or flood control along the Salt and Gila Rivers through the Phoenix area. The purpose of this forecast is to provide a framework for assessing the impacts of alternative plans.

-- Summary and Evaluation of CAWCS Public Involvement Program: This report includes a summary and evaluation of public involvement activities conducted in the CAWCS from January 1979 to October 1981. The report describes these activities, details the results of major Stage III public involvement efforts, and presents an evaluation of public involvement activities from the perspective of CAWCS and participants in the public involvement process.

-- Environmental Impacts and Effects of Plans (7 Volumes and Appendices): These reports document the environmental impacts and effects of CAWCS Stage III plans. They describe existing and future conditions for the disciplines of biology, water quality, air quality, sound quality, visual quality, land quality, geology/soils, prehistoric and historic cultural resources, and recreation. A separate appendix accompanies each plan; included in these are descriptive data, by plan component, for each discipline.

II. BACKGROUND

A. Authorization

The CAP was authorized for construction under Public Law 90-537 (82 Stat. 885) approved September 30, 1968. Its primary objective is to deliver most of Arizona's remaining entitlement to Colorado River water to cities, farms, and industries in central Arizona.

Other project benefits are:

-- To reduce overdraft of ground water in central Arizona to the maximum extent possible by substituting Colorado River water for a portion of the current ground-water overdraft.

-- To provide a supply of water for municipal and industrial use areas that have little or no surface water rights available and are presently using an overdrafted ground-water source or sources of lower quality.

-- To provide supplemental water for sustaining the agricultural resources over a longer period of time than would otherwise be possible. Agricultural users will be required to reduce ground-water pumping in amounts equal to their CAP water deliveries.

-- To conserve floodflows on the Gila River system to the maximum extent practicable by inclusion of conservation capacity in CAP reservoirs.

-- To provide flood protection to various developments located downstream from the authorized dams or their suitable alternatives.

-- To provide the central Arizona Indian communities with socioeconomic stimulation which will accompany project deliveries of water.

-- To provide sediment control to those water systems diverting from the Salt and Gila Rivers that are now subject to high operating expenses at diversion works, canal systems, and water treatment plants.

-- To alleviate the current geographical imbalance and the anticipated future demand of readily available water-oriented recreational opportunities and to promote effective fish and wildlife management areas through water exchange.

-- To provide exchange water to Arizona users for additional Gila River depletions in New Mexico as authorized under Public Law 90-537.

About 70 percent of CAP costs are reimbursable and will be repaid to the U.S. Treasury. All costs allocated to non-Indian irrigation are reimbursable without interest. Costs allocated to municipal and industrial (M&I) water and to commercial power, including any interest during construction, are also reimbursable and will be repaid with interest on the unpaid balance. Some costs allocated to recreation and fish and wildlife enhancement purposes are repaid by public agencies such as State and county parks departments and State fish and game departments.

Costs allocated for flood control are not reimbursable since they reflect such widespread benefits as protection of people, property, and productive lands.

Project costs allocated to developing features for Indian lands are deferred or nonreimbursable in accordance with provisions detailed in the Leavitt Act.

The total CAP estimated cost, based on October 1982 price levels, is $2.4 billion. CAP completion, based on expenditures compared to projected costs, was about 36 percent on June 1, 1982. Appropriations for CAP, through fiscal year 1982, totalled $938,358,550.

B. Project Description

1. Identified Features

CAP is a conveyance system made up of concrete-lined canals, siphons, tunnels, dams, power transmission lines, and pumping plants being built by the Bureau to bring water from the Colorado River into central and southern portions of Arizona to help alleviate severe ground-water overdraft. The aqueduct is divided into three major sections: the Granite Reef Aqueduct, the Salt-Gila Aqueduct, and the Tucson Aqueduct (see figure 1).

The Granite Reef Aqueduct begins with the Havasu Pumping Plant on the Colorado River in western Arizona just above Parker, angles southeasterly about 190 miles ending northeast of Phoenix. Its major features include the Havasu Pumping Plant, three additional relift pumping plants, three tunnels (Buckskin Mountains, Burnt Mountain, and Agua Fria), seven siphons, plus the concrete-lined canal. CAP water for Maricopa County and the Phoenix area is scheduled for diversion from the Granite Reef Aqueduct beginning in 1985.

The Salt-Gila Aqueduct continues the CAP 58 miles from the Phoenix area southeast to a point 15 miles south of Florence. The major features of the Salt-Gila Aqueduct are the Gila River Siphon and the Salt-Gila Pumping Plant. Water from this aqueduct is scheduled for diversion to eastern Maricopa County and Pinal County in 1986.

The Tucson Aqueduct joins the Salt-Gila Aqueduct near Florence and continues southerly to the San Xavier Indian Reservation southwest of Tucson. The aqueduct is scheduled for 1990 deliveries and will serve northern Pima County.

The power required for CAP operations will come from the Navajo Generating Station near Page, Arizona. This coal-fired steamplant has been in full operation since 1976. Ownership is shared by private utilities and the Federal Government represented by the Bureau. Energy from Navajo, in excess of that needed for CAP pumping energy requirements will be sold and will help repay reimbursable Project costs.

2. Advance Planning

Advance planning studies currently are underway for six authorized features of the CAP not yet under construction. The status of these studies is described in the following paragraphs except for CAWCS which will be discussed later in this report.

-- Tucson Division: In 1980, planning of the Tucson Aqueduct was divided into two phases. Phase A is approximately 42 miles long and extends from the terminus of the Salt-Gila Aqueduct located near Picacho Reservoir in Pinal County to the town of Rillito. Phase B, as scoped

for planning purposes, is approximately 39 miles long and extends from Rillito around the Tucson Mountains to the south boundary of the San Xavier Indian Reservation.

Advance planning for Phase A of the Tucson Aqueduct is complete, and the final EIS was filed with the Environmental Protection Agency in July 1982.

Advance planning for Phase B of the Tucson Aqueduct was initiated in May 1981 and is currently being conducted. The major issues yet to be resolved for Phase B are the need for storage, the aqueduct alinement, and the location point for the city of Tucson deliveries.

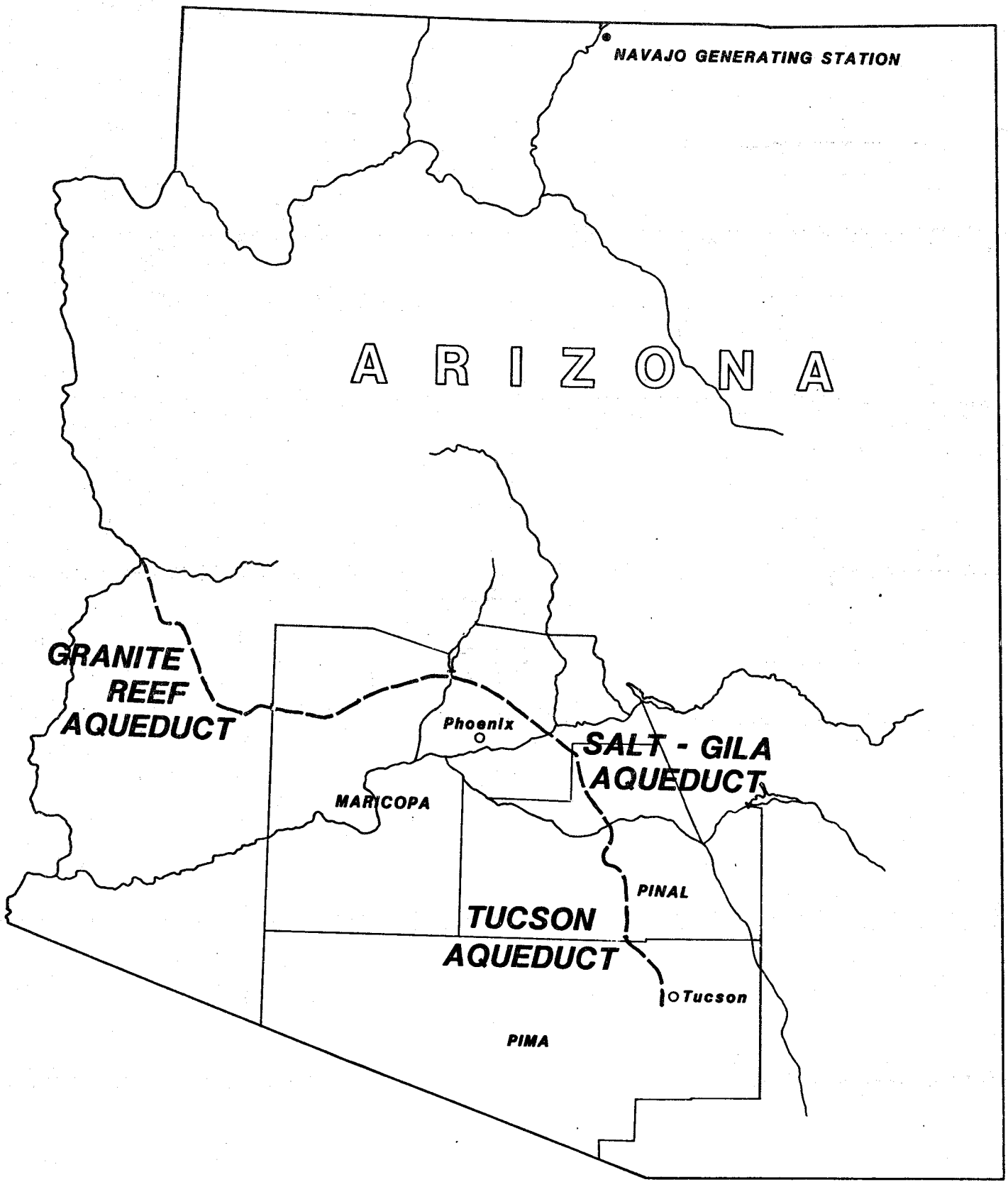
-- Indian Distribution Division: Studies have been conducted since 1978 on the distribution systems necessary to deliver agricultural water to the five central Arizona Indian tribes who received a 1976 allocation. These studies have been conducted to determine the most acceptable plans for delivery of water from the main CAP aqueducts to the reservations, including joint-use facilities with non-Indian water users.

As a result of the activities surrounding the review of the Secretarial decision on Indian water allocations, schedules are currently being developed for completing the necessary studies, filing the EIS's, and delivering the water.

-- Buttes Alternatives Study: In 1968, Buttes Dam was included as one of the proposed features of the CAP. During the past few years considerable work has been done on Buttes in conjunction with CAWCS, which investigated Buttes Dam as a possible regulatory storage alternative. In November 1981, work on Buttes Dam as an independent feature of CAP continued.

The object of the current study, the Buttes Alternatives Study, is to develop solutions to the water supply and sediment control problems in the San Carlos Project area. Any opportunities to provide flood control, develop recreation and hydropower facilities, and enhance the environment will also be considered. As a result of Buttes being included in CAP, any water supply that is developed will become a part of the total CAP supply and will benefit all CAP users.

-- Upper Gila Water Supply Study (UGWSS): Water in the upper Gila area is in limited supply. The Gila River, one of the principle water supply sources for the area, is totally appropriated. The supply of additional Gila River water to New Mexico is made possible through an exchange of CAP water with water rights holders in central Arizona. CAP authorization includes Hooker Dam or suitable alternative to provide 18,000 acre-feet of water to New Mexico without causing downstream economic injury or cost. Since these diversions could affect the CAP allocations which have been recommended for the mines in the Safford area and contracts signed with the San Carlos-Apache Indian Reservation, plans will also have to be formulated to partially meet these Arizona CAP needs.



CENTRAL ARIZONA PROJECT

Figure 1

-- Non-Indian Distribution System: The construction of water distribution and drainage facilities for non-Indian lands to obtain optimal water development and use through improved efficiences was authorized as part of CAP. Currently seven loan applicants have committed to obtain repayment contracts for distribution systems. Three addendum planning reports have been received to date. Five additional entities have also indicated an interest in repayment contracts, while other potential water service subcontractors anticipate using private or municipal funding sources.

3. Central Arizona Water Control Study

CAWCS was borne out of an effort to provide a consensus on what should be done to solve central Arizona's water problems of flooding and water conservation. Figure 2 is a map displaying the CAWCS study area.

One of the proposed features of CAP was Orme Dam and Reservoir, or a suitable alternative, to be located at the confluence of the Salt and Verde Rivers. The reservoir was envisioned as a storage facility to provide both seasonal storage and regulation of Colorado River water and flood control for the Phoenix area. A draft EIS was prepared for Orme Dam in 1976. Public response to the statement identified major environmental and social concerns relating to the impacts on wildlife habitat and the Fort McDowell Indian Reservation. These concerns and others caused the Bureau to delay the preparation of the final EIS. Then, in April 1977, as a result of the Water Projects Review, President Carter recommended that Orme Dam be deleted from the CAP.

Flooding along the Salt River in 1978 resulted in renewed efforts by local agencies and citizens to obtain flood control. The Bureau initiated the CAWCS in July 1978 to investigate all Orme Dam alternatives.

Additional flooding in 1979 and 1980 reinforced the public interest in seeking successful resolution to water control issues. This report documents the findings of CAWCS.

In July 1978, the Bureau requested that the COE (which, in light of the Orme Dam deletion was investigating flood control through its Phoenix Urban Study) participate in a coordinated study to develop plans for the solution of flood problems along the Salt and Gila Rivers and for regulatory storage of CAP waters.

Planning for flood control along the Salt and Gila Rivers did not begin until 1957 when the Los Angeles District of the COE issued an Interim Report on Survey for Flood Control, Gila and Salt Rivers, Gillespie Dam to McDowell Damsite, Arizona. This report resulted in the authorization in 1960 of a project under the Gila River and Tributaries Authority for channel improvements along the Gila and Salt Rivers from Gillespie Dam to the confluence of the Salt and Verde Rivers. The project, however, has not been implemented because of environmental concerns and failure of the local sponsor to provide necessary backing. The Flood Control Act of 1944 (Public Law 78-534) assigns to the COE responsibility to prescribe regulations for use of storage allocated for flood control at all reservoirs constructed with Federal funds. Therefore,

based on this authority, the Gila River and Tributaries Authority and the Phoenix Urban Study, the COE has assisted the Bureau by formulating and evaluating alternative plans for flood control.

The relationship between the Bureau and the COE was formalized through a Memorandum of Understanding entered into by the Regional Director, Lower Colorado Region, Bureau of Reclamation, and the District Engineer, Los Angeles District, Corps of Engineers, in December 1978.

Other local and Federal agencies assisted greatly in the CAWCS planning effort such as the U. S. Fish and Wildlife Service, Tonto National Forest, and others.

During the course of the CAWCS, the importance of dam safety increased significantly. The Reclamation Safety of Dams Act (Public Law 95-578) was passed by Congress in 1978 to preserve the structural safety of Bureau of Reclamation dams and related facilities. The Act authorizes the Secretary of the Interior to perform such modifications as he determines (and Congress approves) to be reasonably required.

Study findings indicate that the six Salt River Project (SRP) dams, which are located within the CAWCS study area, would be overtopped in the event that the inflow design flood (IDF) occurs. The consequences of this overtopping would be possible loss of reservoirs and disastrous downstream consequences. The analysis of the structures' ability to withstand large seismic (earthquake) activity is also being evaluated. Preliminary results indicate that serious problems may exist at some of the structures[1/].

Since both the CAWCS and SOD investigations are considering dams and reservoirs on the same watershed, although for different primary purposes, a situation exists where planning could successfully be interfaced. In some cases common solutions could be the result, while in other cases some options could be precluded.

Because of the direct relationship between SOD and CAWCS alternatives, all plans formulated during the CAWCS, with the exception of the No-Action plan, include SOD alternatives. Therefore, the CAWCS proposed action will provide a solution to the safety problems associated with the six SRP dams, in addition to meeting the original CAWCS objectives. Because of this, two cost authorities will be used in determining the allocation of cost for the plan. Currently, costs allocated to dam safety are nonreimbursable.

1/ Bureau of Reclamation, Memorandum Report on Safety of Dams Program - Salt River Project, January 1981.)

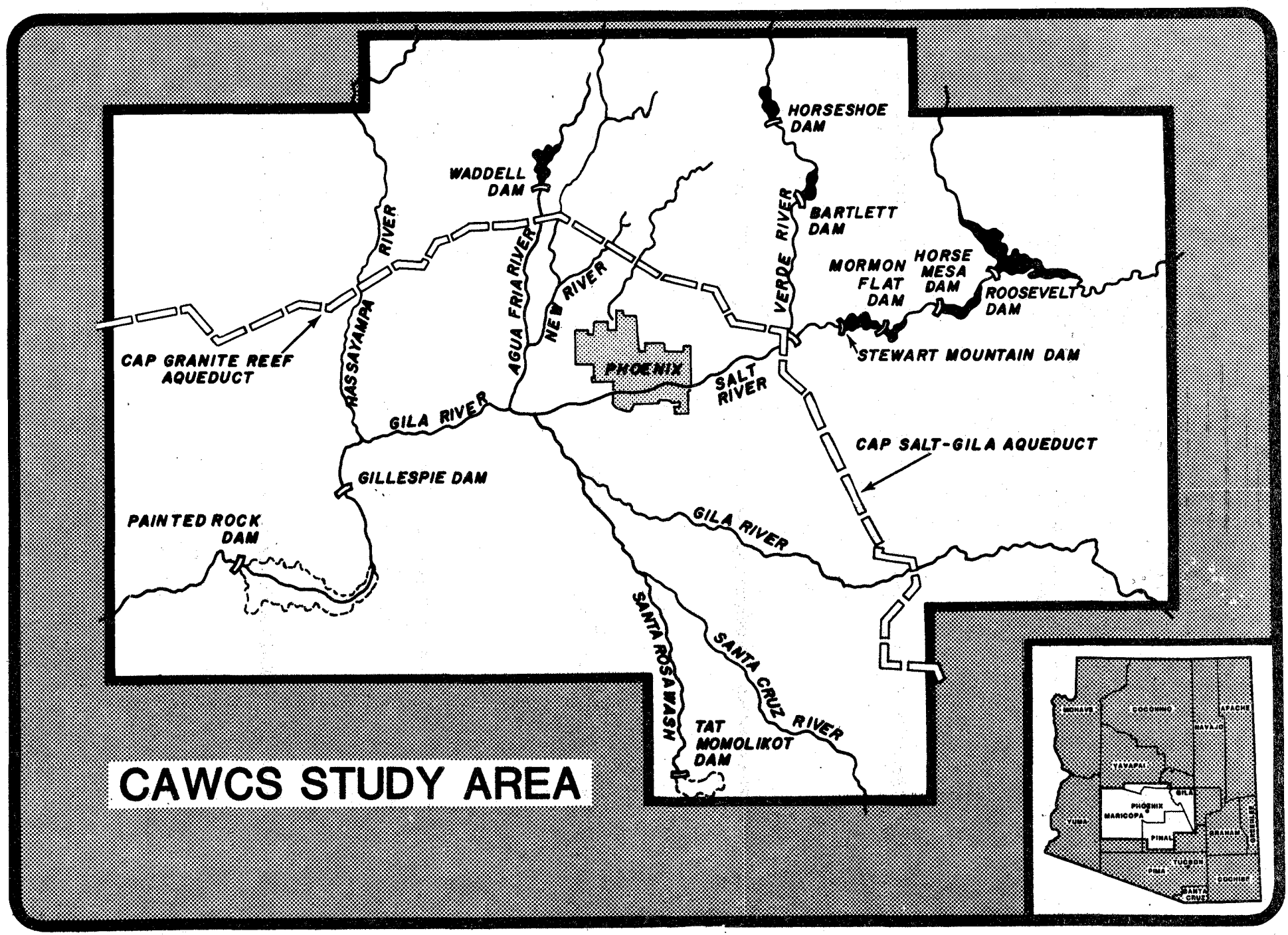

HORSESHOE DAM
WADDELL DAM
BARTLETT DAM
VERDE RIVER
AGUA FRIA RIVER
NEW RIVER
HASSAYAMPA RIVER
MORMON FLAT DAM
HORSE MESA DAM
ROOSEVELT DAM
STEWART MOUNTAIN DAM
CAP GRANITE REEF AQUEDUCT
PHOENIX
SALT RIVER
GILA RIVER
CAP SALT-GILA AQUEDUCT
GILLESPIE DAM
PAINTED ROCK DAM
GILA RIVER
SANTA ROSA WASH
SANTA CRUZ RIVER
TAT MOMOLIKOT DAM
CAWCS STUDY AREA
MOHAVE
COCONINO
APACHE
NAVAJO
YAVAPAI
GILA
PHOENIX
MARICOPA
YUMA
PINAL
GRAHAM
GREENLEE
TUCSON
PIMA
COCHISE
SANTA CRUZ

Figure 2

SUMMARY OF PROCESS

USED TO ARRIVE

AT THE

PROPOSED ACTION

information as of 1981 out dated - background

III. SELECTION OF THE PROPOSED ACTION

A. Planning Process

CAWCS followed a three-stage plan formulation process. While the basic tasks within each stage were similar, the level of detail and reliability of data and analysis increased with each stage (figure 3).

Stage I was exploratory in nature. Problems, needs, and issues of the CAWCS area were identified and a wide array of possible solutions (elements) were developed that, singly or in combination, could provide flood control and/or regulatory storage. Originally 34 separate actions were screened at an initial level of study to determine those elements that warranted further study during Stage II. Recommendations made by the Bureau and the COE were based on three factors: geology (site suitability), location, and economics.

Comparative data on the elements studied in Stage I are summarized in the following Element Evaluation Table (table 1).

At the end of Stage I, a Plan of Study[1/] was prepared which documented alternatives for further study and outlined a management program for the remainder of the study.

During Stage II, the planning focus shifted from problem identification to formulation and testing of alternative solutions. An extensive series of workshops was also held to inform the public of the study process and get initial reaction to the alternatives. The factors which workshop participants indicated would be most important were: flood damage reduction, protection of Indian communities, environment, project cost, and transportation. In the metropolitan areas traffic disruption was also a significant factor in the impact of flooding.

The elements from Stage I were then screened and the best of the "competing" elements were selected for further study (figure 4). Some of the remaining elements provided both regulatory storage and flood control while others provided only one as shown below. Even those that provided both, did so in varying degrees of effectiveness.

In order to optimize the ability to provide both flood control and regulatory storage, single-purpose and multipurpose systems were developed. To facilitate system building and evaluation, the most technically feasible systems were grouped into a number of "concepts," each concept representing a type of solution with a number of possible variations to each type. Engineering, economic, environmental, and social analysis, and an evaluation of systems resulted in the recommendation of a limited number of possible solutions to be carried forward for detailed study in Stage III (see table 2 - System Evaluation Summary). Recommendations at this stage of alternative development were largely based on operations (performance), optimization, economics, environmental and social impacts, and institutional factors[2/].

1/ Plan of Study, CAWCS, January 1980, Prepared by BOR and COE

2/ Refer to the Stage II Report, March 1981 and the November-December 1980 Factbook - Public Forums for further details on the elements and system concepts.

Table 1

ELEMENT EVALUATION

Element	Purpose		Further Study	
	Flood Control	CAP Storage	Warranted	Unwarranted
VERDE RIVER				
Tangle Creek	o	o		o
Modified Horseshoe	o	o	o	
Cliff Site	o	o	o	
New Bartlett	o	o	o	
SALT RIVER				
Carrizo Creek	o			o
Klondike Buttes	o			o
Modified Roosevelt	o	o	o	
Coon Bluff		o		o
Confluence	o	o	o	
Granite Reef	o	o	o	
Rio Salado Lows Dams		o		o
AGUA FRIA RIVER				
Lake Pleasant		o	o	
New Waddell		o	o	
Agua Fria Siphon		o		o
Calderwood Butte		o		o
North Phoenix Dams (for CAP)		o		o
GILA RIVER, SANTA ROSA WASH				
Coolidge		o		o
Florence		o	o	
Buttes		o	o	
Tat Momolikot		o	o	
Painted Rock Reservoir		o		o
CHANNELS				
Granite Reef to Country Club	o			o
Country Club to 35th. Ave.	o		o	
35th. Ave. to Gillespie Dam	o			o
LEVEES				
Granite Reef to Country Club	o			o
Country Club to 35th. Ave.	o		o	
35th. Ave. to Salt-Gila	o			o
Salt-Gila to Gillespie Dam	o		o	
CHANNEL CLEARING	o		o	
WATER EXCHANGE		o	o	
SRP REOPERATION	o		o	
NONSTRUCTURAL	o		o	
GROUND WATER RECHARGE	o	o	o	
NO ACTION			o	

CAWCS PLANNING PROCESS

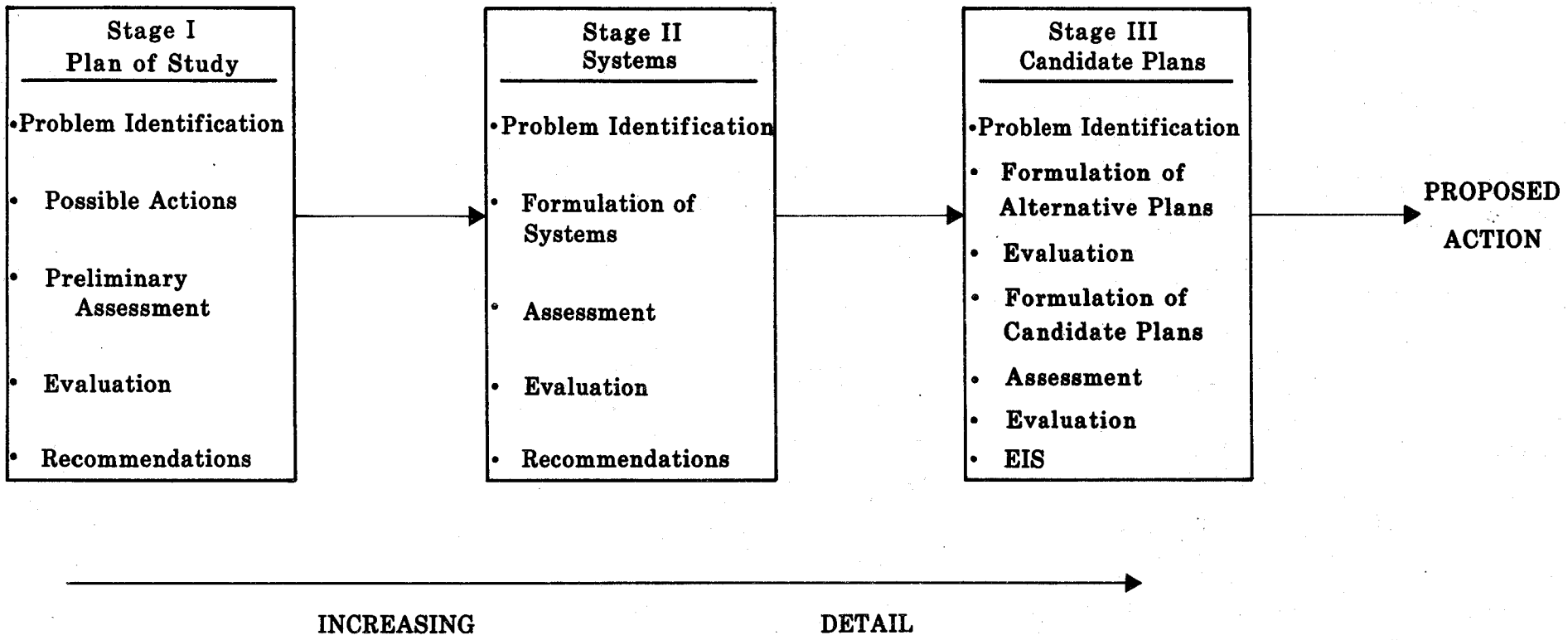


Figure 3

ELEMENT SCREENINGS

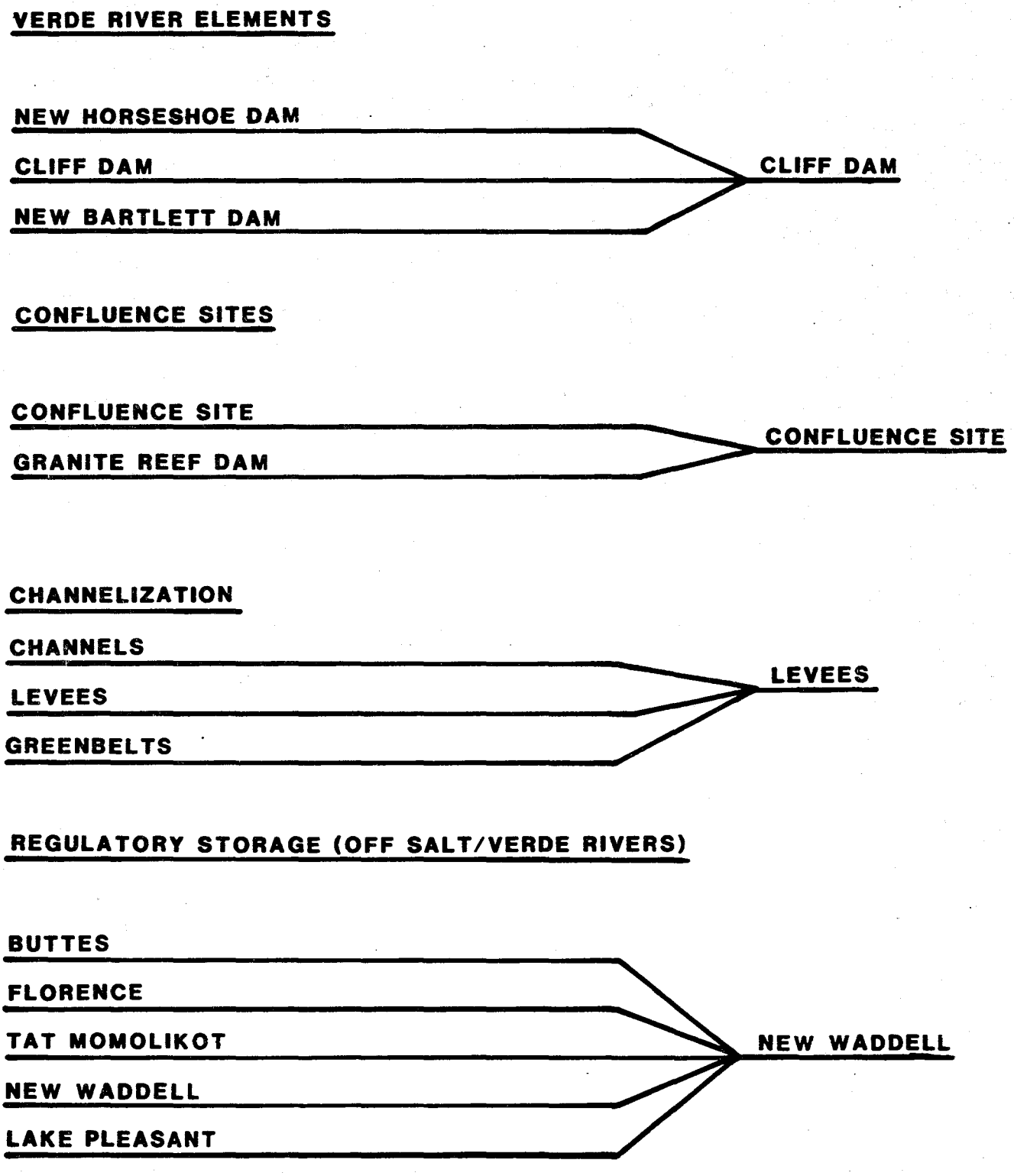


Figure 4

Table 2

SYSTEM EVALUATION SUMMARY

		Regulatory Storage Avg. Annual Increase in CAP Water Supply (ac-ft)	Projected Flood Control at Confluence (ft^3/s)	DAM SAFETY		Costs (million $)* (rounded to the nearest million)				IMPACTS		
						Construction		Annual Cost				
				Problems Solved by the System	Problems Not Solved by the System	7 3/8%	3 1/4%	7 3/8%	3 1/4%	Environmental	Social	Institutional
1A	Cliff + Water Exchange	46,000	150,000	Bartlett Horseshoe	Roosevelt, Horse Mesa Mormon Flat, Stewart Mt.	254	232	20	10	Biological Resources; T&E species; cultural resources	No significant impacts	Need SRP AGREEMENT for exchange-unlikely
1B	Modified Roosevelt + Direct Connection	121,000 (47,000 w/water exchange instead)	200,000	Roosevelt, Horse Mesa, Mormon Flat	Bartlett, Horse Mesa, Stewart Mountain	557	526	45	22	Archaeological & Historical sites.	Relocations	Impacts on institutional arrangements
1C	New Stewart Mt. + Direct Connection	82,000 (46,000 w/water exchange instead)	200,000	Stewart Mt.	Horseshoe, Bartlett, Roosevelt, Mormon Flat, Horse Mesa	660	602	51	23	Archaeological resources	No significant impacts	Same as 1B
2A	Confluence	112,000	50,000	None	All dams on Salt and Verde	598	546	46	21	Biological Resources; T&E species; recreation; cultural resources	Relocations	Institutional Arrangements
2B	Cliff + Modified Roosevelt + Water Exchange	56,000	50,000	All dams on Salt and Verde except Stewart Mountain	Stewart Mountain	421	389	33	16	Biological Resources; T&E species; cultural resources	Relocations	Need SRP agreement for exchange-unlikely
2C	Confluence + Modified Roosevelt + Direct Connection	141,000	50,000	Roosevelt, Horse Mesa, Mormon Flat	Horseshoe, Bartlett, Stewart Mountain	715	658	55	25	Same as 2A and 2B	Same as 2A and 2B	Same as 2A
2D	Cliff + New Stewart Mt. + New Waddell	100,000	50,000	Bartlett, Horseshoe, Stewart Mountain	Roosevelt, Mormon Flat, Horse Mesa	788	720	62	28	T&E species; archaeological sites; recreation	Loss of some recreation	Same as 2A
3	Levees + New Waddell	100,000	300,000	None	All dams on Salt and Verde	1546	1466	154	90	Archaeological sites; recreation	Loss of some recreation of Lake Pleasant	Local Funding needed
4A	Modified Roosevelt + Levees + Direct Connection	121,000	200,000	Roosevelt, Horse Mesa, Mormon Flat	Horseshoe, Bartlett, Stewart Mountain	1682	1600	158	88	Archaeological/Historical sites	Relocations	Local Funding Needed
4B	New Stewart Mt. + Levees + Direct Connection	82,000	200,000	Stewart Mt.	Horseshoe, Bartlett, Roosevelt, Mormon Flat, Horse Mesa	1785	1676	164	89	Archaeological sites	No significant impacts	Same as 4A
5A	SRP Regulation (w/o modifications + Underground Storage	63,000 (reduces SRP water by 88,000 ac-ft	270,000	None	All dams on Salt and Verde	112	106	16	11	Biological Resources; Loss of SRP water	None	Ownership of ground water replacement of lost water
5B	SRP Reregulation (w/modifications + Underground Storage)	63,000 (reduces SRP water by 113,000 ac-ft	210,000	None	All dams on Salt and Verde	200	189	23	15	Same as 5A	None	Same as 5A
6	Nonstructural + SRP Exchange	14,500	NA	None	All dams on Salt and Verde	13	13	2	2	Potential adverse impacts on biological resources	None	Agreement w/SRP for exchange highly unlikely

* Costs reflect exchange only. Additional costs could be incurred depending on the final plan.

NOTE: Minor modifications required at existing Stewart Mountain even with upstream Storage on Salt for dam safety.

In Stage III, the final planning stage, the focus of the planning effort shifted from alternative formulation (although alternatives were continually being modified) to thorough impact assessment and evaluation. During this stage plans were studied in detail, these studies provided the basis for development of candidate plans and selection of the proposed action.

From the elements remaining at the end of Stage II, 104 plans were formulated and evaluated during Stage III. Eight candidate plans, including a No-Action plan, were developed that would best meet the objectives of the CAWCS; flood control, regulatory needs, and provide SOD solutions on the Salt and Verde Rivers (table 3).

Intensive study of these eight plans led to the recommendation of one proposed action for feasibility level studies and designs. The methods and procedures used in formulating candidate plans, evaluating those plans, and selecting the proposed action, will be described in later sections of this report.

B. Public Involvement

Due to public concerns over Orme Dam and the flooding problems in the CAWCS study area, a very high level of public interest existed in the CAWCS study. It was essential that the CAWCS be conducted with extreme political sensitivity and also with a visibility and openness which would lend credibility to the final conclusions. Public involvement, therefore, was absolutely crucial to the conduct of the CAWCS.

The major objective of the CAWCS public involvement program was to provide timely information to the public so that individuals and groups could participate in the planning process and so that the planning process would be responsive to public needs and preferences. Obviously, not every citizen can be in a position of evaluating the technical adequacy and objectivity of a study. Therefore, the CAWCS public involvement program was designed to recognize different kinds of publics.

Various types of activities and techniques were utilized throughout the CAWCS to meet the objectives of the public involvement program. These included technical or appointed groups, interest groups, workshops, community meetings, and other activities such as brochures, newsletters, press and media coverage. Prior to each stage of the CAWCS, public involvement techniques employed during the previous stage were evaluated and plans for public participation were formulated for the next stage. These activities were conducted in order to meet more closely the needs of the public and to provide the CAWCS planning staff with public input pertinent to the plan formulation process.

1. Technical or Appointed Groups

Community leadership on CAWCS was organized with the formation by Arizona Governor Bruce Babbitt of the Governor's Advisory Committee to advise on CAWCS issues. The 28-member Committee, which represented the interests of political, environmental, business, Indian tribes, media, and labor and citizen groups, provided two-way communication between CAWCS and the public by identifying needs and concerns of their constituents and conveying information

Table 3

Description of Plans

CLIFF + NEW/ENLARGED ROOSEVELT + STEWART MOUNTAIN[1/]

Plan 1: Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain
Plan 2: Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain + Nonstructural

CONFLUENCE + CLIFF + NEW/ENLARGED ROOSEVELT + STEWART MOUNTAIN[1/]

Plan 3: Confluence + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

Plan 4: Confluence with a Large Spillway + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

Plan 5: Confluence with Small Service Spillway and Auxilary Spillway + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

NEW WADDELL + CLIFF + NEW/ENLARGED ROOSEVELT + STEWART MOUNTAIN[1/]

Plan 6: New Waddell + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain

Plan 7: New Waddell + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain (environmental emphasis)

CAWCS NO ACTION

Plan 8: No CAWCS project; SOD studies continue to select a preferred dam safety solution

1/ Stewart Mountain Dam need only be reconstructed to meet SOD requirements.

back to the public. The Committee advised CAWCS on the acceptability of alternative plans from political and legal viewpoints, and offered suggestions on how to make alternatives more acceptable. This group aided in demonstrating to the public that all concerns have been considered in the development and selection of the plan. Membership of the Governor's Advisory Committee is listed in Appendix A.

The Technical Agency Group (TAG) was organized and consisted of representatives of local, State, and Federal agencies which have an interest in CAWCS. TAG met periodically during the study and interacted with the Bureau and the COE on a continuing basis. Specifically, the group assisted in the collection of existing information and development of new data, reviewed and analyzed information, assisted in plan formulation, and participated in development of public workshops and meetings. Membership of TAG is listed in Appendix A.

Some members of TAG were organized into the Recreation Technical Subcommittee to TAG. This group assisted in the formulation, development, and review of CAWCS recreation plans.

Two other groups that were organized were the CAP Ad Hoc Committee on Cultural Resources and the Arizona Archaeological Council CAP Committee. These groups assist the Bureau on all aspects of the CAP.

2. Special Interest Groups

Several special interest groups were identified throughout the course of the study. Periodic meetings between CAWCS planning and technical staff and special interest groups helped to provide these groups with accurate, up-to-date information on the study's progress and the decisionmaking process. Each group had special informational needs and the public involvement program helped to insure that these needs were met. Periodic face-to-face interaction occurred to insure that these group members had the opportunity to express their concerns, make suggestions, ask specific questions, and aid planners in incorporating their views into the plan formulation process. Following are some of the special interest groups which participated in CAWCS:

-- Indian Inter-Tribal Council of Arizona.

-- Orme Alternatives Coalition.

-- Citizens for Flood Control - NOW.

-- Salt River Project.

-- Maricopa Audubon Society.

-- Citizens Concerned About the Project.

-- Arizona Archaeological Council

3. Government Agencies

In accordance with CAWCS objectives and the requirements inherent in Bureau and COE planning policy, numerous agencies at the Federal, State, and local levels have been directly involved in CAWCS. One forum for intergovernmental coordination was participation in the Governor's Advisory Committee or TAG as previously described.

In addition, an Interagency Executive Committee was established at the outset of CAWCS and met bimonthly to provide coordination, information exchange, and status briefings at the agencies' executive levels. The following agencies were represented on the Committee:

-- Arizona Department of Water Resources.

-- Flood Control District of Maricopa County.

-- City of Phoenix.

-- Central Arizona Water Conservation District.

-- Salt River Project.

-- Bureau of Reclamation.

-- U.S. Army Corps of Engineers.

Periodic briefings also were given to State and local legislators to keep them abreast of the study's progress and to address questions which arose during the briefings.

4. Public Information/Communication Techniques

To stimulate public awareness and inform the general public about CAWCS, several public information and communication techniques were utilized throughout the duration of CAWCS.

Workshops and community meetings were held at key decision points in the study in order to involve the more active public in the planning process. A regular monthly newsletter, "Extra's," and periodic brochures kept the public informed of CAWCS progress and discussed issues pertinent to the CAWCS area. Other techniques included presentations to community groups and organizations, news releases, bulletins and flyers, newspaper and magazine articles, and television and radio coverage.

5. Future Opportunities for Public Expression

Following selection of the proposed action, a draft EIS was prepared. Upon its publication, the public will have the opportunity to review and comment on it. Written comments will be received within a 90-day time period, which begins immediately after the document is made available to the public. In addition, a public hearing will be held after publication of the draft EIS in order to receive oral statements from interested individuals and organizations relating to the environmental impacts of the proposed action.

After the final EIS is filed, a 30-day public comment period will also be available. In addition to these mandatory requirements, a summary of Stage III will be mailed to the general mailing list. Also, meetings with TAG and other government agencies will continue on a regular basis.

C. Formulation of Plans

With dam safety as an increasingly important area of consideration, at the end of Stage II, initial Stage III planning activities were devoted to identification of alternative combinations that would reduce flood damages, provide regulatory storage, and meet the objective of the SOD study. Alternative combinations were derived from the elements recommended for further study in Stage II and from those dam safety alternatives which could be most reasonably implemented with other CAWCS alternatives. In order to facilitate their display and evaluation, element combinations were placed into five categories. A list of these combinations appear in table 4.

After the combinations were identified and placed into categories, planning activities were focused on the development of alternatives (plans) which would provide solutions for the regulatory storage, flood control, and dam safety needs of the study area. In order to insure thorough consideration of all combinations of alternatives, a two-step process, or first-added analysis, was instituted.

The first portion of the analysis focused on formulating plans using CAWCS alternatives (flood control and regulatory storage) as primary factors. Therefore, CAWCS alternatives were "first-added". All possible CAWCS alternatives were developed from the list contained in table 4. These alternatives were then analyzed to determine to what degree they solved the dam safety problems. Dam safety combinations were then added to the original alternatives, if necessary to solve the entire problem.

The second step of the process focused on dam safety solutions as the "first-added" or primary factor. Thus, the process was reversed. Dam safety alternatives were analyzed to determine how they could be modified in order to meet CAWCS objectives as well. Next, CAWCS combinations were added to the original alternatives, when necessary, to develop plans which would meet fully both the CAWCS and SOD objectives.

As a result of this first-added analysis, 104 plans were formulated which provided dam safety and CAWCS solutions. In reviewing the plans, it was determined duplicate plans had been developed even though they had been derived differently because of the first-added analysis. This enabled the number of plans which were actually evaluated to be reduced.

In preparation for evaluation of these 104 plans, eight performance criteria were developed:

-- Annual Cost

-- Water Supply Yield

Table 4

List of Stage III Combinations

CAWCS + Safety of Dams

A. Confluence (flood control + regulatory storage)

1. Confluence

B. Upstream Alternatives (flood control + regulatory storage)

1. Cliff
2. Cliff + Roosevelt
3. Cliff + New Stewart Mountain
4. Cliff + New Waddell
5. Cliff + Roosevelt + New Waddell
6. Cliff + New Stewart Mountain + New Waddell

C. Nonstructural Alternatives

1. Nonstructural (flood damage reduction only)
2. Nonstructural + New Waddell (flood damage reduction + regulatory storage)
3. Nonstructural + Roosevelt (flood damage reduction + limited regulatory storage)
4. Nonstructural + Cliff (flood damage reduction + limited regulatory storage)
5. Nonstructural + New Stewart Mountain (flood damage reduction + limited regulatory storage)

D. Safety of Dams

1. Cliff + Roosevelt + New Stewart Mountain Modification
2. Roosevelt + Enlarged Spillways at Verde River Dams + New Stewart Mountain Modification
3. Roosevelt + Confluence (to replace storage at Verde River dams and Stewart Mountain dams, which would be breached)
4. Roosevelt + Confluence (to replace storage at Verde River dam and Stewart Mountain Dam, which would be allowed to fail)

E. No Action (no CAWCS or SOD project action)

1. No Action

-- Flood Control Target

-- Safety of Dams

-- Hydropower Potential

-- Social Impacts

-- Energy Management

-- Environmental Impacts

The first four criteria were identified as the initial plan performance parameters. A 10-point scale with an accompanying range of effects was developed for these criteria and plans were assigned a rating of 1 to 10. The extremes for each of these criteria are shown below:

Annual Cost: High = $92.6 million; Low = $32.7 million

Water Supply Yield: High = 157,000 ac-ft/year; Low = 10,000 ac-ft/year

Flood Control Target: High = 150,000 cfs; Low = 50,000 cfs

Safety of Dams: High = 850,000 cfs (+); Low = 300,000 cfs

The elements which comprise the candidate plans were also ranked according to each of the remaining criteria. These criteria and the scales used are shown below:

Hydropower Potential: 1 = most potential, 10 = least potential

Social Impacts: 1 = fewest impacts, 10 = most impacts

Energy Management Potential: 1 = yes, 10 = no

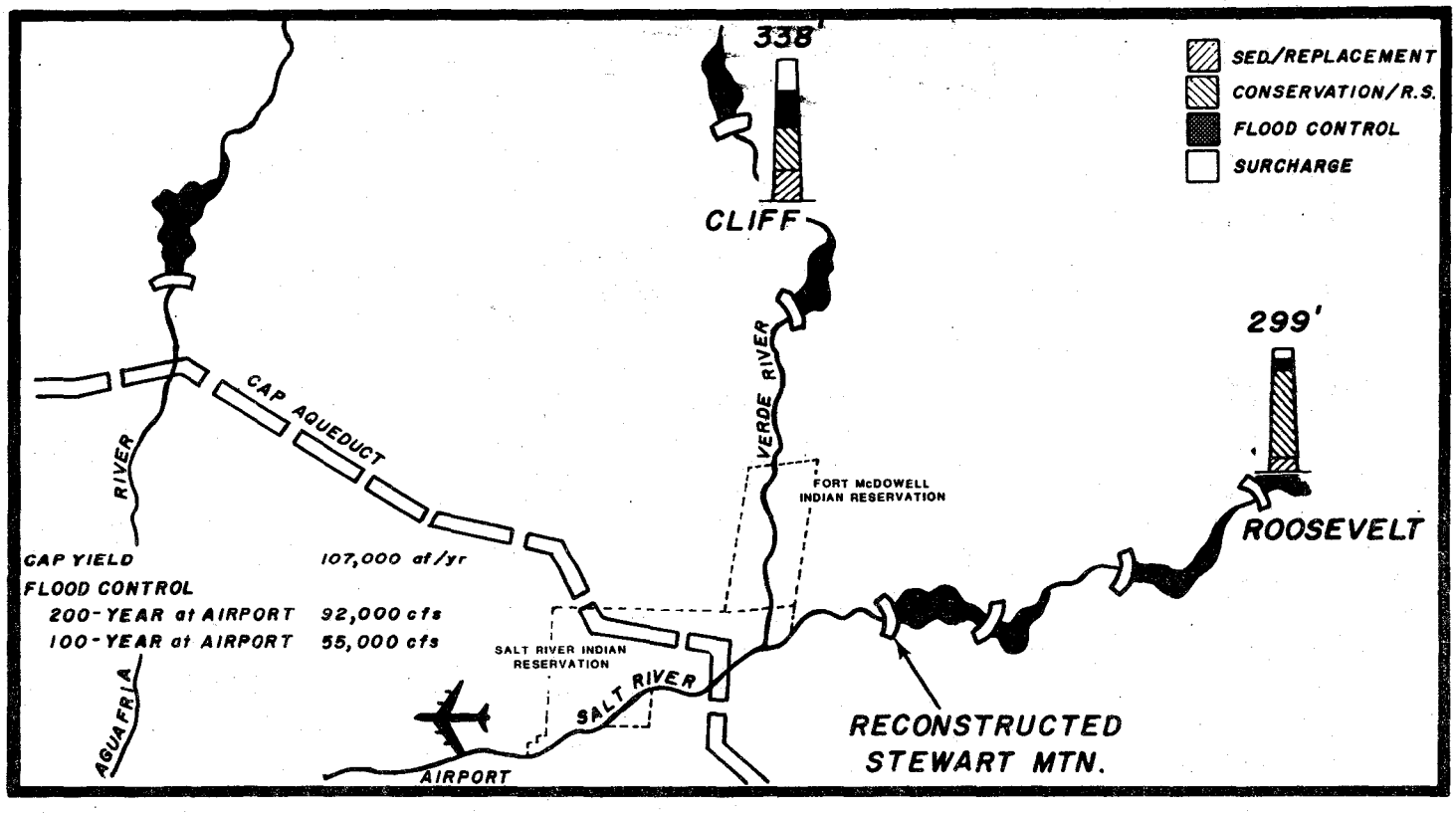
Environmental Impacts: 1 = fewest impacts, 10 = most impacts

Based on the initial evaluation of plans and technical analysis, eight candidate plans were identified for further study and evaluation with a No-Action plan identified to serve as a basis for comparison in the evaluation of the candidate plans. Although only one plan was selected as the proposed action, six of the eight candidate plans were determined to be viable alternatives and are included in the CAWCS draft EIS.

The following pages contain maps showing the location of the candidate plans with a short review of the major points on each, as they were described in the October 1981 Factbook. Tables 5 through 11 also provide information on each plan.

Chart 1

Plan 1: Cliff + Roosevelt + Reconstructed Stewart Mtn. Dam



Under this plan, Roosevelt and Cliff would be constructed to provide flood control, regulatory storage, and hydropower, in addition to SOD. Stewart Mountain Dam would be reconstructed (enlarging the size of the spillway) for SOD purposes. Because this plan would not connect directly with the CAP, there is no potential for energy management.

Table 5

DESIGN AND COST - PLAN 1

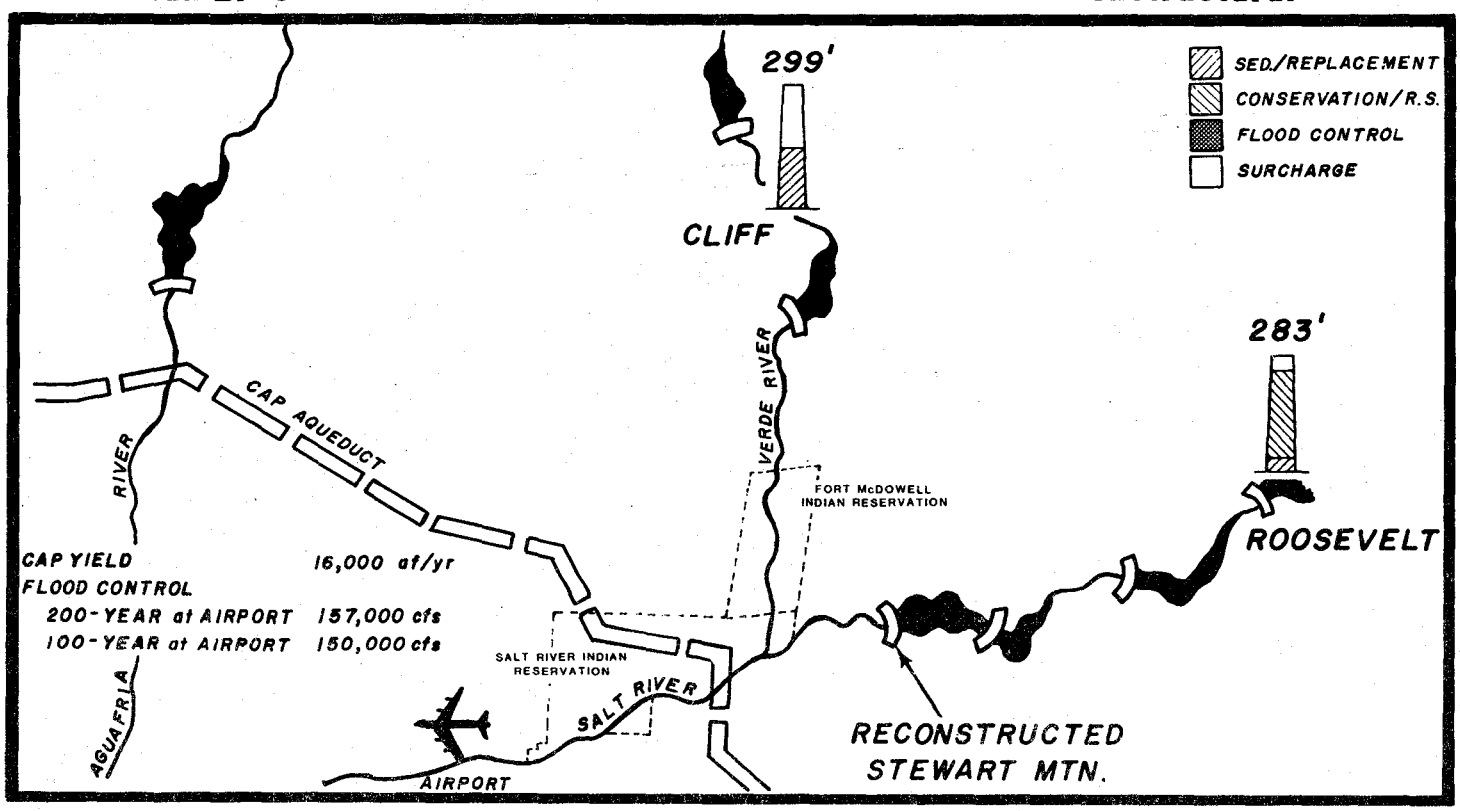
	CLIFF			ROOSEVELT			RECONSTRUCTED STEWART MOUNTAIN		
	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD
FUNCTION	X	X	X	X*	X	X			X
DAM STRUCTURE									
Height		338 feet			299 feet				
Crest Length		2,900 feet			1,110 feet			as required for SOD	
Embankment Volume		15,000,000 cubic yards			340,000 cubic yards (Concrete)				
SPILLWAY		(Ungated)			(Gated)				
Crest Length		125 feet			100 feet				
Head		47 feet			29 feet				
Capacity		150,000 cfs			150,000 cfs				
APPURTENANT WORKS									
Hydropower Plant		4,130 KW							
Pumping Plant (for Cliff and Roosevelt)				1,600 cfs					
Service Outlet		4,000 cfs			3,160 cfs			as required for SOD	
Flood Outlet									
Capacity in Flood Pool		25,000 cfs			25,000 cfs				
Capacity at Maximum Water Surface		36,000 cfs			35,000 cfs				

STORAGE ALLOCATION	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)			
Conservation											
Streambed	0	0	0	1,810	0	0	0	1,902			
Sediment	5,000	5,000	-	-	241,000	241,000	-	-			
Inactive	-	-	-	-	-	-	-	-	as required for SOD		
Replacement	139,000	144,000	2,912	1,952	1,381,000	1,622,000	20,933	2,147			
Regulatory Storage	200,000	344,000	5,328	2,001	-	-	-	-			
Flood Control	445,000	789,000	8,713	2,066	565,000	2,187,000	25,256	2,172			
Surcharge	861,000	1,650,000	14,246	2,143	820,000	3,007,000	30,004	2,201			
Dam Crest				2,148				2,201			
ESTIMATED COST (JANUARY 1981 $)											
Construction		252,700,000				133,200,000			30,000,000 (Spillway Only)		
Dam Structure		95,400,000				44,800,000					
Spillway		5,100,000				13,000,000					
Outlets		50,100,000				15,100,000					
Pumping Plant		23,300,000				11,800,000					
Hydropower Plant		4,800,000				-					
Recreation		Not Available				Not Available					
Miscellaneous **		74,000,000				47,600,000					
Interest During Construction @ 7 3/8%		37,270,000				19,650,000			3,320,000		
Total Construction ***		289,970,000				152,850,000			33,320,000		
Annual OM&R		3,000,000				2,970,000			0		
Total Annual Cost @ 7 3/8%		24,400,000				14,250,000			2,460,000		

*Joint use of the dedicated sediment space would provide increased water supply from Roosevelt for an interim period.
**Includes land acquisition and relocation, except at Roosevelt, and all engineering and contingencies.
***Does not include mitigation costs.

Chart 2

Plan 2: Cliff + Roosevelt + Reconstructed Stewart Mtn. + Nonstructural



This plan was developed with the objective of limited construction and minimizing impact on people. Through Stage II and initially in Stage III, reregulation was considered as a way to provide flood control. Further analysis of reregulation, taking advantage of Cliff and Roosevelt as the CAWCS SOD solution, showed that by operating the dams for SOD only (no dedicated flood control space), incidental flood control at a level comparable to that of reregulation could be obtained. Also the institutional problems and water losses associated with reregulation were avoided. On this basis, SRP Reregulation was no longer considered as a means of flood control and Plan 2 was modified.

This plan limits construction at Cliff and Roosevelt to that necessary for SOD purposes.

Table 6

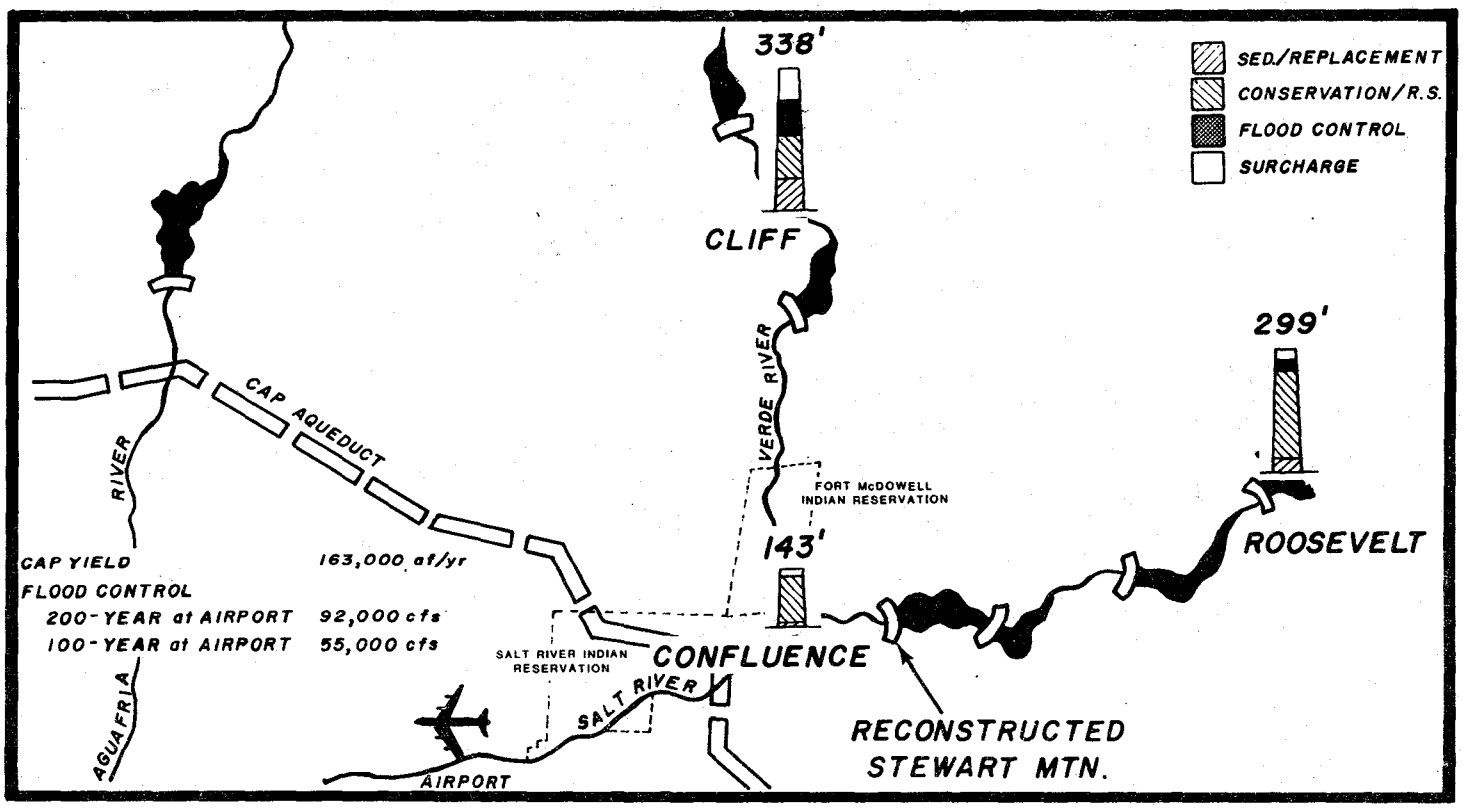
DESIGN AND COST - PLAN 2

FUNCTION	CLIFF			ROOSEVELT			RECONSTRUCTED STEWART MOUNTAIN		
	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD
			X	X*		X			X
DAM STRUCTURE									
Height		299 feet			283 feet			As required for SOD	
Crest Length		2,550 feet			1,110 feet				
Embankment Volume		11,000,000 cubic yards			310,000 cubic yards (concrete)				
SPILLWAY		(ungated)			(gated)				
Crest Length		125 feet			140 feet				
Head		44 feet			38 feet				
Capacity		131,000 cfs			150,000 cfs				
APPURTENANT WORKS									
Hydropower Plant		--			--				
Pump Plant		--			300 cfs				
Service Outlet		4,000 cfs			3,160 cfs			As required for SOD	
Low-level Outlet									
Capacity at Top of Conservation		37,500 cfs			--				
Capacity at Maximum Water Surface		55,000 cfs			--				
STORAGE ALLOCATION	Increased Storage (af)	Total Storage (af)	Surface Area (acres) / Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres) / Elevation (feet)			
Conservation	0	0	0 / 1,810	0	0	0 / 1,902			
Streambed	5,000	5,000	-- / --	241,000	241,000	-- / --			
Sediment	--	--	-- / --	--	--	-- / --		As required for SOD	
Inactive	139,000	144,000	2,912 / 1,952	1,381,000	1,622,000	20,933 / 2,147			
Replacement	--	--	-- / --	--	--	-- / --			
Regulatory Storage	--	--	-- / --	--	--	-- / --			
Flood Control	1,022,000	1,166,000	10,970 / 2,104	926,000	2,548,000	27,391 / 2,185			
Surcharge			/ 2,109			/ 2,185			
Dam Crest									
ESTIMATED COST (Jan '81 $)									
Construction		210,500,000			116,500,000			30,000,000 (Spillway Only)	
Dam Structure		68,800,000			41,700,000				
Spillway		4,900,000			19,500,000				
Outlets		67,100,000			2,900,000				
Pump Plant		--			8,400,000				
Hydropower Plant		--			--				
Recreation		Not Available			Not Available				
Miscellaneous**		69,700,000			44,000,000			3,320,000	
Interest During Construction @ 7 3/8%		31,050,000			17,180,000			33,320,000	
Total Construction Cost***		241,550,000			133,680,000			0	
Annual OM&R		840,000			840,000			2,460,000	
Total Annual Cost @ 7 3/8%		18,670,000			10,710,000				

*Joint use of the dedicated sediment space would provide increased water supply from Roosevelt for an interim period.
**Includes land acquisition and relocation, except at Roosevelt, and all engineering and contingencies.
***Does not include mitigation costs.

Chart 3

Plan 3: Confluence+Cliff+Roosevelt+Reconstructed Stewart Mtn. Dam



This plan was developed under the assumption that CAWCS and SOD were implemented at the same time. Under the plan, Cliff, Roosevelt, and a low Confluence Dam would be constructed concurrently. Because analysis indicated that it is less expensive to put flood control in upstream structures, Cliff and Roosevelt would provide flood control on the Salt and Verde, new conservation space, hydropower, and SOD.

Table 7

DESIGN AND COST - PLAN 3

FUNCTION	CONFLUENCE			CLIFF			ROOSEVELT			RECONSTRUCTED STEWART MOUNTAIN		
	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD
	X			X	X	X	X*	X	X			X
DAM STRUCTURE												
Height		143 feet			338 feet			299 feet				
Crest Length		4,200 feet			2,900 feet			1,110 feet				
Embankment Volume		12,000,000 cubic yards			15,000,000 cubic yards			340,000 cubic yards (concrete)				
SPILLWAY		(ungated)			(ungated)			(gated)				
Crest Length		520 feet			125 feet			100 feet				
Head		26 feet			47 feet			29 feet				
Capacity		240,000 cfs			150,000 cfs			150,000 cfs				
APPURTENANT WORKS												
Hydropower Plant		12,220 KW			4,130 KW			--				
Pump-Generator Plant		3,000 cfs			--			--				
Service Outlet		4,700 cfs			4,000 cfs			3,160 cfs				
Flood Outlet												
Capacity in Flood Pool		--			25,000 cfs			25,000 cfs				
Capacity at Maximum Water Surface		--			36,000 cfs			35,000 cfs				
Reversible Canal												
Capacity		3,000 cfs			--			--				
Length		4 miles			--			--				

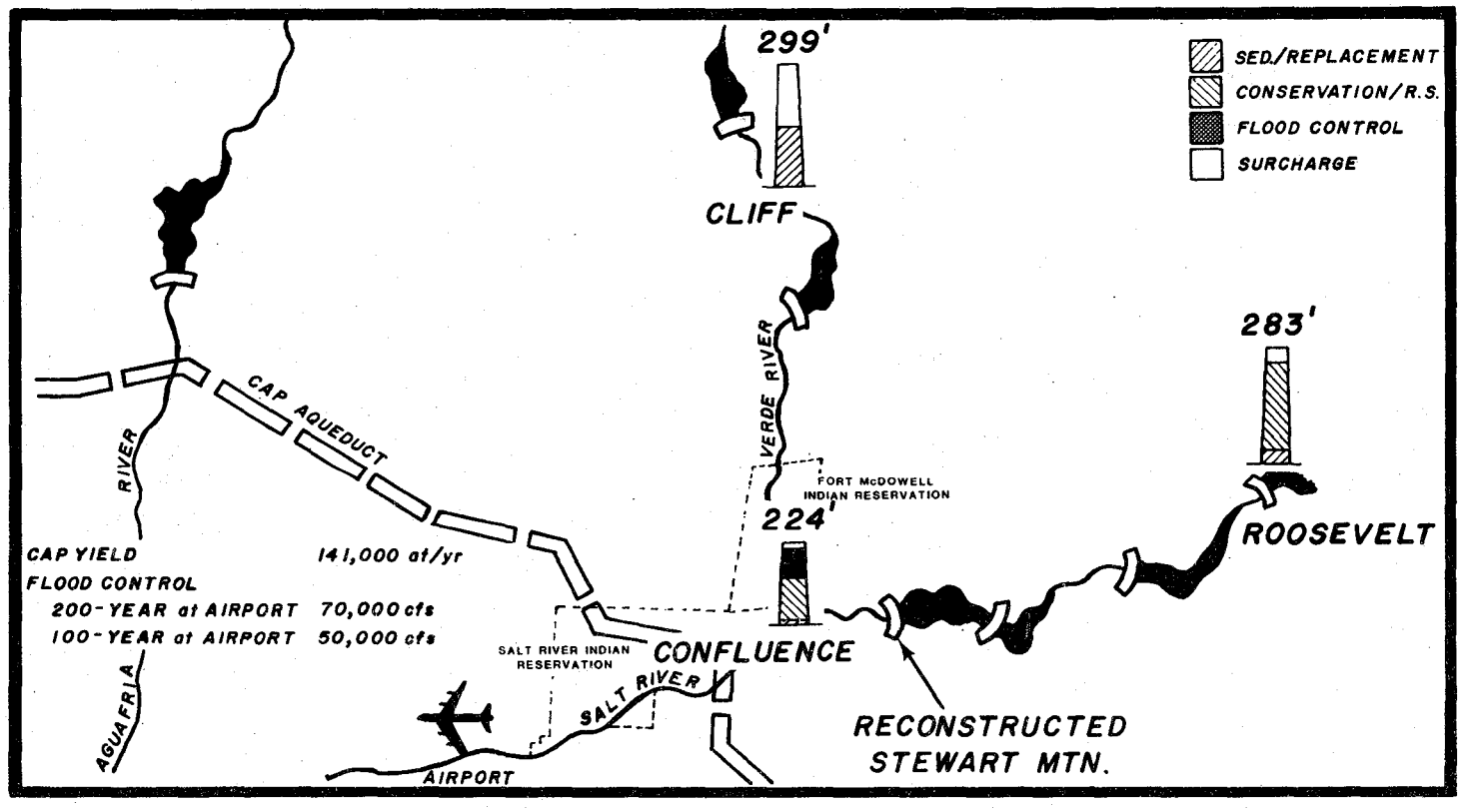
STORAGE ALLOCATION	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	
Conservation	0	0	0	1,320	0	0	0	1,810	0	0	0	1,902	
Streambed	50,000	50,000	--	--	5,000	5,000	--	--	241,000	241,000	--	--	
Sediment	7,000	57,000	2,731	1,378	--	--	--	--	--	--	--	--	
Inactive	--	--	--	--	139,000	144,000	2,912	1,952	1,381,000	1,622,000	20,933	2,147	As required for SOD
Replacement	300,000	357,000	8,853	1,431	200,000	344,000	5,328	2,001	--	--	--	--	
Regulatory Storage	--	--	--	--	445,000	789,000	8,713	2,066	565,000	2,187,000	25,256	2,172	
Flood Control	279,000	636,000	12,975	1,457	861,000	1,650,000	14,246	2,143	820,000	3,007,000	30,004	2,201	
Surcharge				1,463				2,148				2,201	
Dam Crest													

ESTIMATED COST (Jan '81 $)				
Construction	277,600,000	229,400,000	121,400,000	30,000,000 (Spillway Only)
Dam Structure	38,600,000	95,400,000	44,800,000	
Spillway	31,800,000	5,100,000	13,900,000	
Outlets	17,600,000	50,100,000	15,100,000	
Pump-Generator Plant	28,500,000	--	--	
Hydropower Plant	9,800,000	4,800,000	--	
Reversible Canal	14,400,000	--	--	
Recreation	Not Available	Not Available	Not Available	
Miscellaneous**	136,900,000	74,000,000	47,600,000	
Interest During Construction @ 7 3/8%	51,170,000	33,840,000	17,910,000	3,320,000
Total Construction***	328,770,000	263,240,000	139,310,000	33,320,000
Annual OM&R	3,850,000	3,200,000	3,160,000	0
Total Annual @ 7 3/8%	28,120,000	22,630,000	13,440,000	2,460,000

*Joint use of the dedicated sediment space would provide increased water supply from Roosevelt for an interim period.
**Includes all land acquisition and relocation at Cliff only; Indian land acquisition and relocation at Confluence; and all engineering and contingencies.
***Does not include mitigation cost.

Chart 4

Plan 4: Confluence (large spillway) + Cliff + Roosevelt + Reconstructed Stewart Mtn. Dam



Plan 4 was developed on the premise that SOD is delayed (assumed to be 10 years delay for purposes of analysis), and therefore, the Confluence Dam, as it is downstream of all other dams, would have to withstand a large IDF until the SOD solution was implemented upstream. The Confluence Dam would be constructed first with a large service spillway (gated) to ensure the safety of the structure, and include flood control storage and regulatory storage capacity and a hydropower facility. Cliff and Roosevelt Dams would be constructed later for SOD purposes only.

Table 8

DESIGN AND COST - PLAN 4

FUNCTION	CONFLUENCE			CLIFF			ROOSEVELT			RECONSTRUCTED STEWART MOUNTAIN		
	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD
	X	X				X			X			X
DAM STRUCTURE												
Height		224 feet			299 feet			283 feet				
Crest Length		5,750 feet			2,550 feet			1,110 feet				
Embankment Volume		15,500,000 cubic yards			11,000,000 cubic yards			310,000 cubic yards (concrete)				
												As Required for SOD
SPILLWAY		(ungated)			(ungated)			(gated)				
Crest Length		1,500 feet			125 feet			140 feet				
Head		39 feet			44 feet			38 feet				
Capacity		1,280,000 cfs			131,000 cfs			150,000 cfs				
APPURTENANT WORKS												
Hydropower Plant		12,220 KW			-			-				
Pumping Generator Plant		3,000 cfs			-			-				
Service Outlet		4,700 cfs			4,000 cfs			3,160 cfs				
Flood Outlet												
Capacity in Flood Pool		50,000 cfs			-			-				
Capacity at Maximum Water Surface		73,000 cfs			-			-				
Low Level Outlet												
Capacity at Top of Conservation		-			37,500 cfs			-				
Capacity at Maximum Water Surface		-			55,000 cfs			-				
Reversible Canal												
Capacity		3,000 cfs			-			-				
Length		4 miles			-			-				

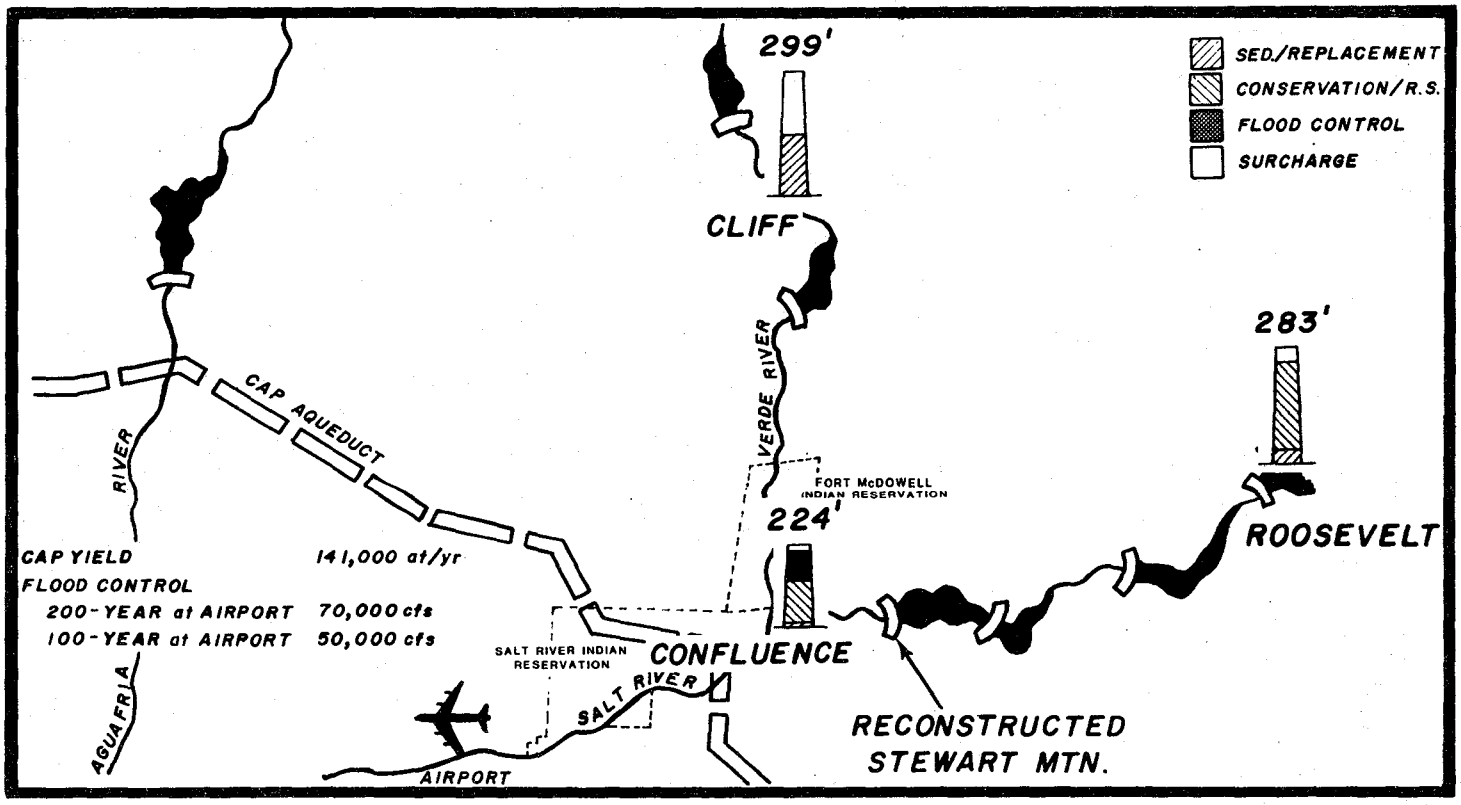
STORAGE ALLOCATION	Increased Storage (af)	Total Storage (af)	Surface Area (Acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (Acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (Acres)	Elevation (feet)	
Conservation	0	0	0	1320	0	0	0	1810	0	0	0	1902	
Streambed	50,000	50,000	-	-	5,000	5,000	-	-	241,000	241,000	-	-	
Sediment	7,000	57,000	2,731	1378	-	-	-	-	-	-	-	-	As Required for SOD
Inactive	-	-	-	-	139,000	144,000	2,912	1952	1,381,000	1,622,000	20,933	2147	
Replacement	300,000	357,000	8,853	1431	-	-	-	-	-	-	-	-	
Regulatory Storage	970,000	1,327,000	20,780	1498	-	-	-	-	-	-	-	-	
Flood Control	974,000	2,301,000	30,273	1537	1,022,000	1,166,000	10,970	2104	926,000	2,548,000	27,391	2185	
Surcharge				1544				2109				2185	
Dam Crest													

ESTIMATED COST (January 1981 $)				
Construction	654,300,000	210,500,000	108,100,000	30,000,000 (Spillway Only)
Dam Structure	192,200,000	68,800,000	41,700,000	
Spillway	73,500,000	4,900,000	19,500,000	
Outlets	54,300,000	67,100,000	2,900,000	
Pump-Generator Plant	28,500,000	-	-	
Hydropower Plant	10,200,000	-	-	
Reversible Canal	14,400,000	-	-	
Recreation	Not Available	Not Available	Not Available	
Miscellaneous*	281,200,000	69,700,000	44,000,000	
Interest During Construction @ 7 3/8%	120,600,000	31,050,000	15,940,000	3,320,000
Total Construction Cost**	774,900,000	241,550,000	124,040,000	33,320,000
Annual OM&R	3,650,000	2,820,000	2,820,000	0
Total Annual Cost @ 7 3/8%	60,840,000	20,650,000	11,980,000	2,460,000

*Includes all land acquisition and relocation at Cliff only; Indian land acquisition and relocation at Confluence; and all engineering and contingencies.
** Does not include mitigation cost.

Chart 5

Plan 5 Confluence (small spillway and emergency spillway)+Cliff +Roosevelt+Reconstructed Stewart Mtn. Dam



Based on the same premise as Plan 4 (SOD delay), the Confluence Dam would be constructed first. However, instead of a large service spillway, the Confluence Dam would include a smaller service spillway (gated) and an auxiliary spillway (ungated) used only in large flooding events to ensure the safety of the structure. It would include regulatory storage, flood control storage, and a hydropower facility and would perform as in Plan 4. Cliff and Roosevelt Dams would be constructed later for SOD purposes only.

Table 9

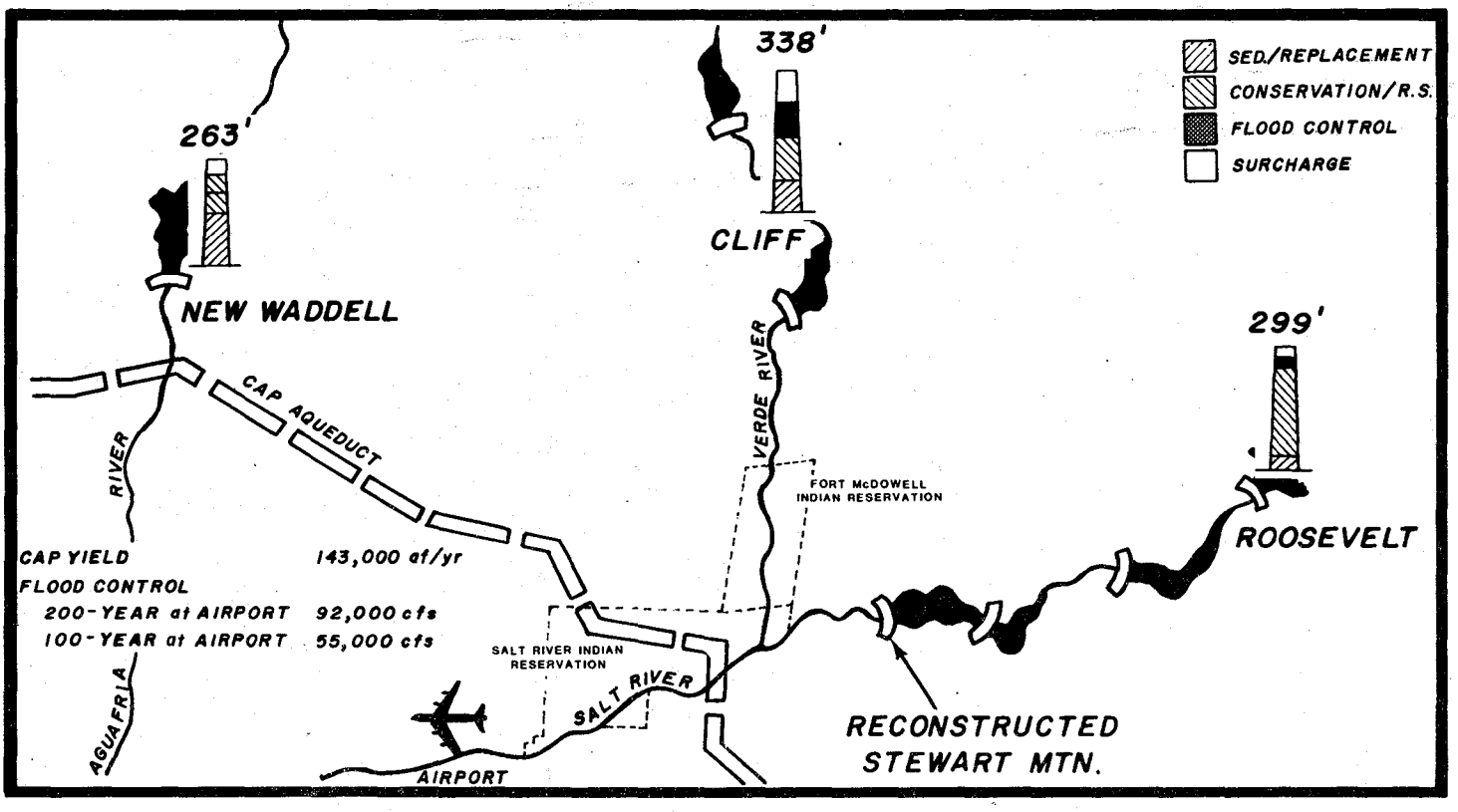
DESIGN AND COST - PLAN 5

FUNCTION	CONFLUENCE			CLIFF			ROOSEVELT			RECONSTRUCTED STEWART MOUNTAIN		
	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD
	X	X				X			X			X
DAM STRUCTURE												
Height		224 feet			299 feet			283 feet				
Crest Length		5,750 feet			2,550 feet			1,110 feet			as required for SOD	
Embankment Volume		19,000,000 cubic yards			11,000,000 cubic yards			310,000 cubic yards (concrete)				
SPILLWAY	Service (Ungated)	Auxiliary (Failure Dike Section)			(ungated)			(gated)				
Crest Length	590 feet	-			125 feet			140 feet				
Head	39 feet	39 feet			44 feet			38 feet				
Capacity	500,000 cfs	780,000 cfs			131,000 cfs			150,000 cfs				
APPURTENANT WORKS												
Hydropower Plant		12,220 KW			-			-				
Pump-Generator Plant		3,000 cfs			-			-				
Service Outlet		4,700 cfs			4,000 cfs			3,160 cfs				
Flood Outlet												
Capacity in Flood Pool		50,000 cfs			-			-			as required for SOD	
Capacity at Maximum Water Surface		73,000 cfs			-			-				
Low Level Outlet												
Capacity at Top of Conservation		-			37,500 cfs			-				
Capacity at Max. Water Surface		-			55,000 cfs			-				
Reversible Canal												
Capacity		3,000 cfs			-			-				
Length		4 miles			-			-				
STORAGE ALLOCATION	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation												
Streambed	0	0	0	1320	0	0	0	1810	0	0	0	1902
Sediment	50,000	50,000	-	-	5,000	5,000	-	-	241,000	241,000	-	-
Inactive	7,000	57,000	2,731	1378	-	-	-	-	-	-	-	-
Replacement	-	-	-	-	139,000	144,000	2,912	1952	1,381,000	1,622,000	20,933	2147
Regulatory Storage	300,000	357,000	8,853	1431	-	-	-	-	-	-	-	-
Flood Control	970,000	1,327,000	20,780	1498	-	-	-	-	-	-	-	-
Surcharge	974,000	2,301,000	30,273	1537	1,022,000	1,166,000	10,970	2104	926,000	2,548,000	27,391	2185
Dam Crest				1544				2109				2185
ESTIMATED COST (January 1981 $)												
Construction		578,300,000			210,500,000			108,100,000			30,000,000 (Spillway Only)	
Dam Structure		172,700,000			68,800,000			41,700,000				
Spillway		31,900,000			4,900,000			19,500,000				
Outlets		54,300,000			67,100,000			2,900,000				
Pump-Generator Plant		28,500,000			-			-				
Hydropower Plant		10,200,000			-			-				
Reversible Canal		14,400,000			-			-				
Recreation		Not Available			Not Available			Not Available				
Miscellaneous*		266,300,000			69,700,000			44,000,000				
Interest During Construction @ 7 3/8%		106,600,000			31,050,000			15,940,000			3,320,000	
Total Construction **		684,900,000			241,550,000			124,040,000			33,320,000	
Annual OM&R		3,640,000			2,820,000			2,820,000			0	
Total Annual Cost @ 7 3/8%		54,190,000			20,650,000			11,980,000			2,460,000	

*Includes land acquisition and relocation at Cliff only; Indian land acquisition and relocation at Confluence; and all engineering and contingencies.
**Does not include mitigation cost.

Chart 6

Plan 6: New Waddell + Cliff + Roosevelt + Reconstructed Stewart Mtn. Dam



New Waddell would be constructed for regulatory storage and would include a hydropower generation plant. Flood control, additional water conservation, hydropower, and SOD would be provided at Cliff and Roosevelt.

Table 10

DESIGN AND COST - PLAN 6

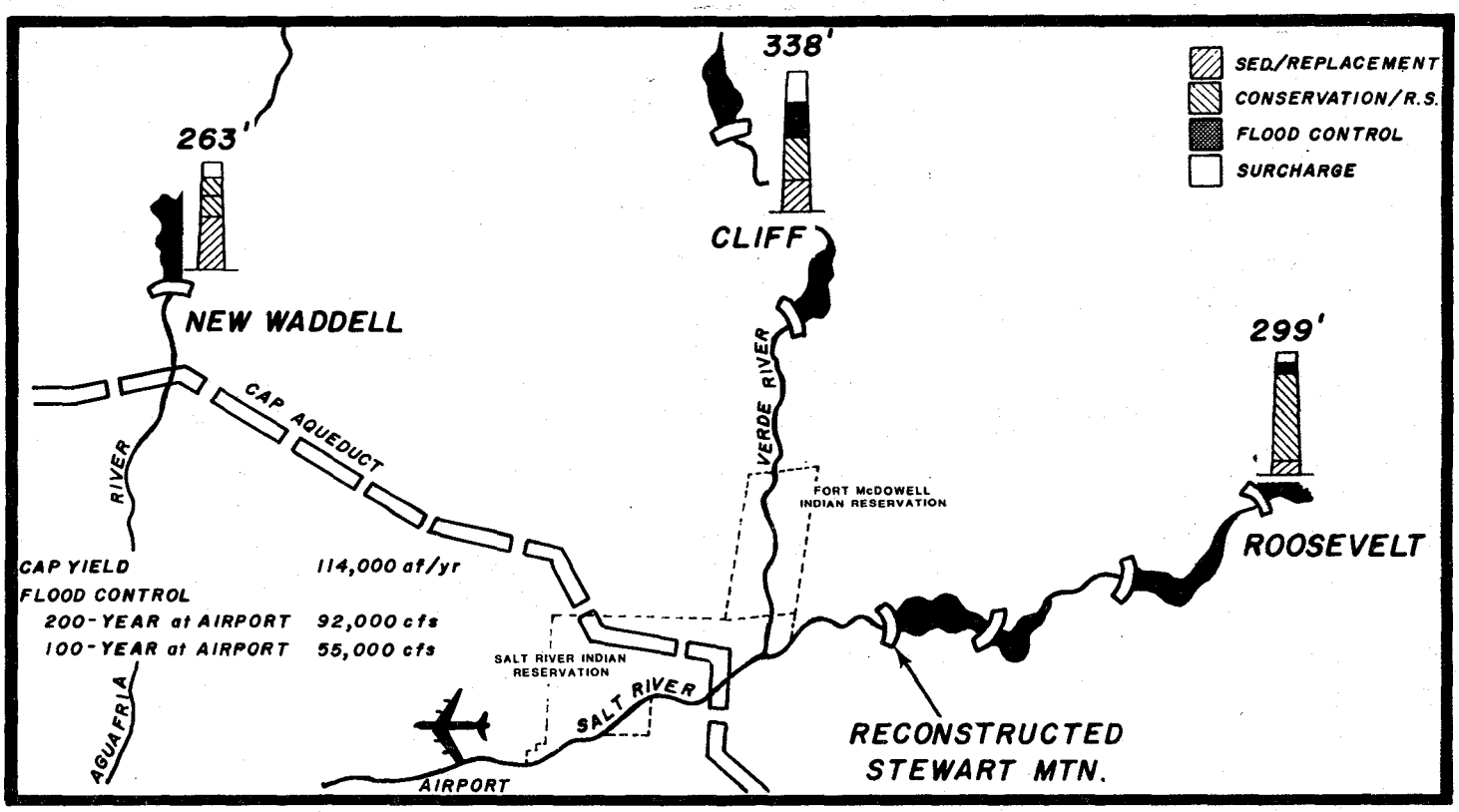
FUNCTION	NEW WADDELL			CLIFF			ROOSEVELT			RECONSTRUCTED STEWART MOUNTAIN		
	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD
	X			X	X	X	X*	X	X			X
DAM STRUCTURE												
Height		263 feet			338 feet			299 feet				
Crest Length		4,000 feet			2,900 feet			1,110 feet			as required for SOD	
Embankment Volume		17,700,000 cubic yards			15,000,000 cubic yards			340,000 cubic yards (Concrete)				
SPILLWAY		(ungated)			(ungated)			(gated)				
Crest Length		640 feet			125 feet			100 feet				
Head		33 feet			47 feet			29 feet				
Capacity		450,000 cfs			150,000 cfs			150,000 cfs				
APPURTENANT WORKS												
Hydropower Plant		1,400 KW			4,130 KW			--				
Pump Plant		3,000 cfs					1,000 cfs					
Service Outlet		600 cfs			4,000 cfs			3,160 cfs			as required for SOD	
Flood Outlet												
Capacity in Flood Pool		--			25,000 cfs			25,000 cfs				
Capacity at Maximum Water Surface		--			36,000 cfs			35,000 cfs				
Reversible Canal												
Capacity		3,000 cfs			--			--				
Length		5 miles			--			--				

STORAGE ALLOCATION	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation												
Streambed	0	0	0	1,430	0	0	0	1,810	0	0	0	1,902
Sediment	62,400	62,400	--	--	5,000	5,000	--	--	241,000	241,000	--	--
Inactive	5,000	67,400	2,122	1,563	--	--	--	--	--	--	--	--
Replacement	157,600	225,000	4,649	1,610	139,000	144,000	2,912	1,952	1,381,000	1,622,000	20,933	2,147
Regulatory Storage	250,000	475,000	6,990	1,653	200,000	344,000	5,328	2,001	--	--	--	--
Flood Control	--	--	--	--	445,000	789,000	8,713	2,066	565,000	2,187,000	25,256	2,172
Surcharge	279,000	754,000	9,021	1,688	861,000	1,650,000	14,246	2,143	820,000	3,007,000	30,004	2,201
Dam Crest				1,693				2,148				2,201
ESTIMATED COST (Jan '81 $)												
Construction		247,400,000			244,700,000				129,100,000			30,000,000 (Spillway Only)
Dam Structure		73,900,000			95,400,000				44,800,000			
Spillway		36,900,000			5,100,000				13,900,000			
Outlets		14,900,000			50,100,000				15,100,000			
Pump Plant		49,500,000			15,300,000				7,700,000			
Hydropower Plant		2,000,000			4,800,000				--			
Reversible Canal		14,100,000			--				--			
Recreation		Not Available			Not Available				Not Available			
Miscellaneous**		56,100,000			74,000,000				47,600,000			
Interest During Construction @ 7 3/8%		36,500,000			36,090,000				19,040,000			3,320,000
Total Construction***		283,900,000			280,790,000				148,140,000			33,320,000
Annual OM&R		3,570,000			2,860,000				2,820,000			0
Total Annual Cost @ 7 3/8%		24,520,000			23,590,000				13,750,000			2,460,000

*Joint use of the dedicated sediment space would provide increased water supply from Roosevelt for an interim period.
**Includes land acquisition, except at Roosevelt and Waddell; relocation at Cliff only; recreation relocation at Waddell; all engineering and contingencies.
***Does not include mitigation costs.

Chart 7

Plan 7: New Waddell + Cliff + Roosevelt + Reconstructed Stewart Mtn. Dam (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 by the new conservation space at Cliff and Roosevelt and the regulatory storage at New Waddell 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 acre-feet per year, which is less than in Plan 6.

Table 11

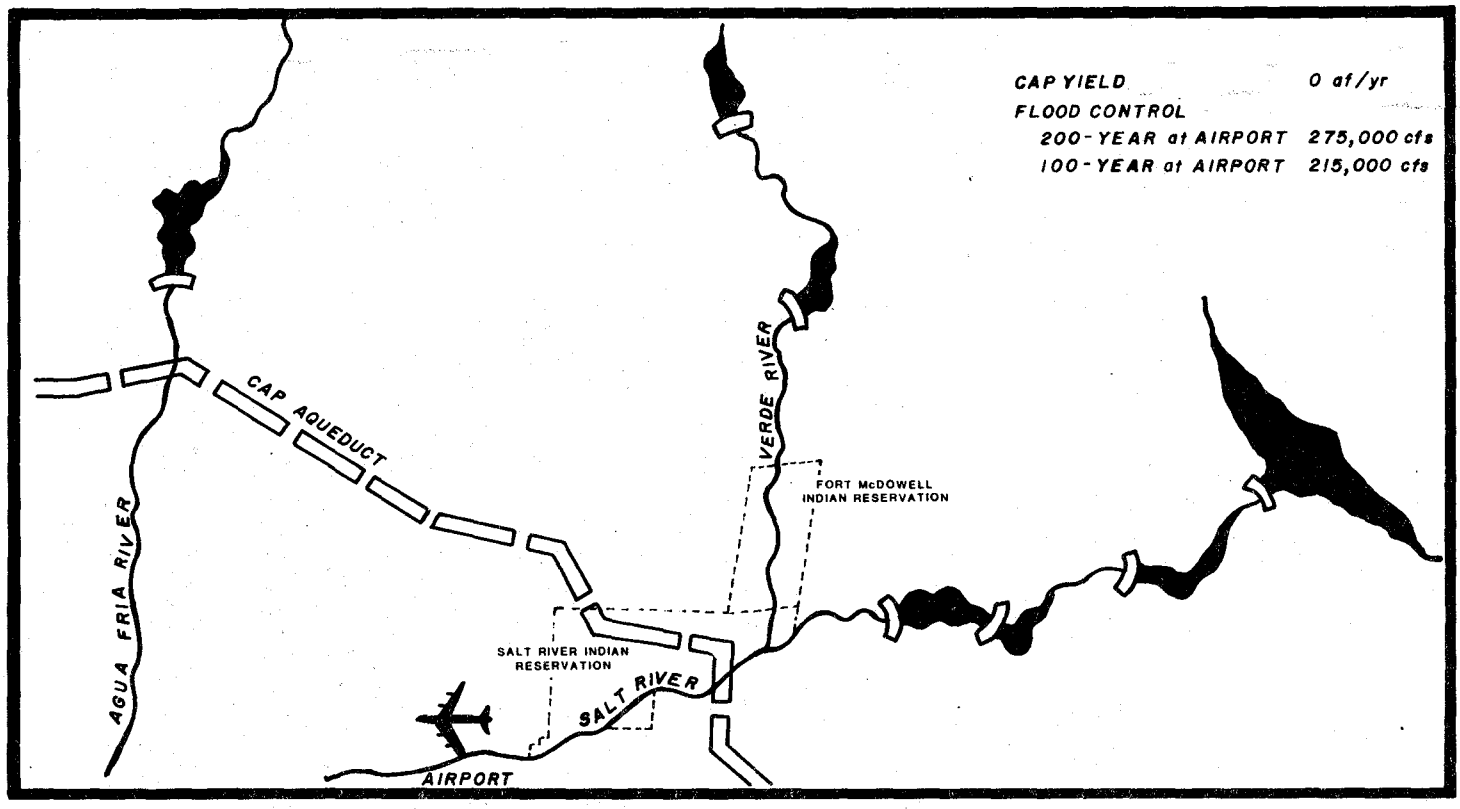
DESIGN AND COST - PLAN 7

FUNCTION	NEW WADDELL			CLIFF			ROOSEVELT			RECONSTRUCTED STEWART MOUNTAIN		
	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD	Regulatory Storage	Flood Control	SOD
	X			X	X	X			X			
DAM STRUCTURE												
Height		263 feet			338 feet			299 feet			As required for SOD	
Crest Length		4,000 feet			2,900 feet			1,110 feet				
Embankment Volume		17,700,000 cubic yards			15,000,000 cubic yards			340,000 cubic yards (Concrete)				
SPILLWAY		(ungated)			(ungated)			(gated)				
Crest Length		640 feet			125 feet			100 feet				
Head		33 feet			47 feet			29 feet				
Capacity		450,000 cfs			150,000 cfs			150,000 cfs				
APPURTENANT WORKS												
Hydropower Plant		1,400 KW			4,130 KW			--				
Pump Plant		3,000 cfs					1,000 cfs					
Service Outlet		600 cfs			4,000 cfs			3,160 cfs			As required for SOD	
Flood Outlet					25,000 cfs			25,000 cfs				
Capacity in Flood Pool		--			36,000 cfs			35,000 cfs				
Capacity at Maximum Water Surface		--										
Reversible Canal					--			--				
Capacity		3,000 cfs			--			--				
Length		5 miles										

STORAGE ALLOCATION	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation	0	0	0	1,430	0	0	0	1,810	0	0	0	1,902
Streambed	62,400	62,400	--	--	5,000	5,000	--	--	241,000	241,000	--	--
Sediment	5,000	67,400	2,122	1,563	10,000	15,000	638	1,873	--	--	--	--
Inactive	157,600	225,000	4,649	1,610	139,000	154,000	3,063	1,956	1,381,000	1,622,000	20,933	2,147
Replacement	250,000	475,000	6,990	1,653	200,000	354,000	5,421	2,003	--	--	--	--
Regulatory Storage	--	--	--	--	445,000	799,000	8,773	2,067	565,000	2,187,000	25,256	2,172
Flood Control	279,000	754,000	9,021	1,688	851,000	1,650,000	14,246	2,143	820,000	3,007,000	30,004	2,201
Surcharge				1,693				2,148				2,201
Dam Crest												
ESTIMATED COST (Jan '81 $)												
Construction		247,400,000			244,700,000				129,100,000			30,000,000 (Spillway Only)
Dam Structure		73,900,000			95,400,000				44,800,000			
Spillway		36,900,000			5,100,000				13,900,000			
Outlets		14,900,000			50,100,000				15,100,000			
Pump Plant		49,500,000			15,300,000				7,700,000			
Hydropower Plant		2,000,000			4,800,000				--			
Reversible Canal		14,100,000			--				--			
Recreation		Not Available			Not Available				Not Available			
Miscellaneous**		56,100,000			74,000,000				47,600,000			
Interest During Construction @ 7 3/8%		36,500,000			36,090,000				19,040,000			3,320,000
Total Construction***		283,900,000			280,790,000				148,140,000			33,320,000
Annual OM&R		3,100,000			2,380,000				2,340,000			0
Total Annual Cost @ 7 3/8%		24,050,000			23,110,000				13,270,000			2,460,000

*Joint use of the dedicated sediment space would provide increased water supply from Roosevelt for an interim period.
**Includes land acquisition, except at Roosevelt and Waddell; relocation at Cliff only; recreation relocation at Waddell; all engineering and contingencies.
***Does not include mitigation costs.

Chart 8
Plan 8 CAWCS NO ACTION



The No-Action alternative provides the baseline against which all other plans are compared. With this option, CAP would be constructed, but no CAWCS regulatory storage or flood control would be provided. SOD studies would however continue toward selection of a preferred SOD solution. This solution may differ from the Cliff/Roosevelt combination in CAWCS/SOD plans in that Plan 2 would provide 120,000 acre-feet of new conservation for CAP, sufficient flood control for a 200-year event flow of 157,000 cfs and a 100-year event of 150,000 cfs measured at Sky Harbor International Airport, as well as SOD at Cliff, Roosevelt, and Stewart Dams.

With no CAWCS action the following is assumed:

- The CAP will deliver Colorado River water to the study area, but there will be no regulatory storage in the system.
- No flood control measures or structures under study by CAWCS will be implemented by the Federal Government.
- Under the Dam Safety Act, SRP Dams will be modified, e.g., large spillways to pass flows or, similar to Plan 2, construction of Cliff and Roosevelt to suppress flows on the Salt and Verde Rivers.
- Thirteen bridges will be constructed or modified by State and local governments to withstand flows of 200,000 cfs.

(continued on following page)

- Buttes Dam, an authorized feature of CAP on the Gila River, will be constructed for development of additional CAP waters, flood control, and sediment control. But, there will be no regulatory storage as proposed by CAWCS. Other CAP features which will be constructed include the Granite Reef Aqueduct, Salt-Gila Aqueduct, the Tucson Aqueduct, and Hooker Dam or a suitable alternative.

- Flood plain management, including enforcement of existing laws and regulations is assumed. No existing structure would be abandoned, but new structures in 100-year flood fringes would be floodproofed to protect against a 100-year flood.

- Channelization around existing facilities at the airport will be conducted.

- Limited channel clearing from 91st Avenue to Gillespie Dam will be conducted by the Flood Control District of Maricopa County. Gillespie Dam will not be modified in conjunction with channel clearing.

- There will be an improved flood warning system, under an appropriation of $400,000.

- Several flood control facilities (New River, Cave Buttes, Dreamy Draw, and Adobe Dams, Arizona Canal Diversion Channel, Soil Conservation Service dams, and Indian Bend Wash) will be constructed.

- The U. S. Forest Service' Cottonwood Recovery Program on the Verde River, designed to improve wildlife habitat, will be implemented.

- A Tempe Rio Salado Project will be implemented. The overall Rio Salado concept was assumed not to be developed.

In order to evaluate the impacts and effects of each plan, data was developed for various factors during Stage III. These data are displayed on table 12. The items listed under each factor are those used to measure the impacts of that factor. 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), 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.

Table 12 displays a comparative evaluation of all candidate plans plus the No-Action alternative. The information displayed in this table is the best information that was available at the time the Secretary of the Interior made his announcement. This information was originally made public in the October 1981 Factbook. Since that time the information has been revised and updated to reflect the changes that have occurred in the plans since October 1981. This updated information is displayed later in this report. After a comparison of the information displayed in table 12 with the current information, it was determined that none of the changes would have changed the decisions made in November 1981, if anything, they have further reinforced those decisions.

D. Comparison of Candidate Plans

Prior to the comparison of candidate plans by the Bureau, public meetings were held and comments and recommendations were received on the eight plans and the data to be used in evaluating those plans. The majority of speakers at these meetings favored Plans 6, 7, and 8. Also the Governor's Advisory Committee reviewed the eight plans and voted 20 to 1 to recommend Plan 6 to Governor of Arizona as their preferred plan.

After the input from these meetings were obtained and evaluated, 21 evaluation criteria were developed which provided a framework for determining which of the eight candidate plans were appropriate for consideration as candidate plans. These criteria are as follows:

1. Yield

Table 12

COMPARATIVE EVALUATION OF PLANS

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
PERFORMANCE								
CAP Water yield (af/yr)								
-Total increased over the baseline	0 (1,006,000 af/yr CAP water)	107,000	16,000	163,000	141,000	141,000	143,000	114,000
Energy Management								
-Opportunity available	No	No	No	Yes	Yes	Yes	Yes	Yes
-Additional megawatts available for sale	0 (50)[a]	0	0	86[b]	86[b]	86[b]	86[b]	86[b]
Hydropower								
-Kilowatts produced (KW)	0 (0)	4,130	0	16,350	12,220	12,220	5,530	5,530
Safety of Dams								
-Dam safety requirements for existing dams accomplished	Cont'd SOD studies	Yes	Yes	Yes	Delayed	Delayed	Yes	Yes
Flood Control (cfs)								
-100-yr flood @ airport	215,000 (215,000)	55,000	150,000	50-55,000	50,000	50,000	55,000	55,000
-200-yr flood @ airport	275,000 (275,000)	92,000	157,000	70-92,000	70,000	70,000	92,000	92,000

[a]Winter only.
[b]Year-round.

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
BIOLOGICAL RESOURCES								
Threatened/Endangered Plants and Wildlife								
-Loss of acres of preferred habitat/total acres potentially inundated by IDF (bald eagle and Yuma clapper rail)	0 (2,260 acres in site areas)	-280/730	-280/670	-870/1,320	-870/1,600		-280/740	
-Number of breeding areas (bald eagle) with disrupted productivity	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	1	3	3		1	
-Mitigation		+280 acres preferred bald eagle habitat	+280 acres preferred bald eagle habitat	+200 acres preferred bald eagle habitat	+200 preferred acres bald eagle habitat		+280 preferred acres bald eagle habitat	
-Unmitigated/ Mitigated Effect		SA/I	SA/I	AF/SA	AF/AF		SA/I	
Riparian/Wetland Biotic Communities								
-Loss/gain of acres of habitat/total acres potentially inundated by IDF	0 (11,890 acres in site areas)	+1,570/3,490	+2,110/3,390	-220/7,430	-160/9,020		+1,780/3,890	+1,200/3,890
-Mitigation		Enhancement of 2,200 acres	Enhancement of 2,740 acres	Enhancement of 2,680 acres	Enhancement of 2,680 acres		Enhancement of 2,680 acres	Enhancement of 2,200 acres
-Unmitigated/ Mitigated Effect		I/SB	I/SB	SA/I	SA/I		I/SB	I/SB

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
BIOLOGICAL RESOURCES								
Perennial Stream/ Riverine Community								
-Loss of miles of perennial stream/ total stream miles potentially inundated by IDF	0 (68 miles in site areas; 137 miles in CAWCS area)	-2/23	-2/22	-18/44	-19/53		-1/23	-2/23
-Change in flow characteristics of Salt and Verde Rivers	No change (on average, 106 days/ year $\leq$ 50 cfs in Salt, 61 days/year $\leq$ 50 cfs in Verde)	No change	No change	No change	No change		No change	Guaranteed minimum flows of 200 cfs in Salt and Verde
-Mitigation		Stream losses not mitigatable						
-Unmitigated/ Mitigated Effect		I/I	I/I	AF/AF	AF/AF		I/I	SB/SB
Reservoir Aquatic Community								
-Gain of surface acres of habitat	0 (13,640 acres in site areas; 30,000 acres in CAWCS area)	+90	0		+2,950		+730	+1,420
-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 New Waddell and Cliff
-Drawdown rates greater than 2 inches/day during spawning season	No change (drawdown rates 3.0 in/day at Roosevelt, 9.2 in/day at Horseshoe, 1.6 in/day at Lake Pleasant)	> 2 in/day at Cliff	> 2 in/day at Cliff	> 2 in/day at Cliff and Confluence			> 2 in/day at Cliff and New Waddell	> 2 in/day at Cliff and New Waddell; <2 in/day at Roosevelt
-Mitigation		Reduction in drawdown rates to < 2 in/day during spawning season						
-Unmitigated/ Mitigated Effect		I/SB	I/SB	I/SB	I/SB	I/SB	I/SB	SB/BF

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
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	Average of 70,000 af of SRP (Verde River) water exchanged w/CAP each year Comparison of Water Sources (mg/l) Verde / CAP Ca 42.5 / 85.0 Cl 18.8 / 94.5 Fe 0.021 / 0.158 Hard 212.1 / 339.3 Mg 25.7 / 30.8 Na 30.4 / 107.4 Pb 0.003 / 0.041 SO_4 52.9 / 309.3 TDS 264.0 / 722.3 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 (mg/l) Ca 42.5 to 61.1 (+44%) Cl 18.8 to 51.9 (+176%) Fe 0.021 to 0.081 (+289%) Hard 212.1 to 267.8 (+26%) Mg 25.7 to 27.9 (+9%) Na 30.4 to 64.1 (+110%) Pb 0.003 to 0.020 (+553%) SO_4 52.9 to 165.2 (+212%) TDS 264.0 to 464.7 (+76%) 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			Annual average of 25,000 af of MCMWCD#1 surface water mixed with 200,000 af of CAP water at Waddell site. None of the MCMWCD#1 water treated for M&I uses Changes in Average MCMWCD#1 Concentrations (mg/l) Ca 75.0 to 83.9 (+12%) Cl 30.5 to 84.1 (+176%) Fe 0.01 to 0.142 (+1316%) Hard 170.5 to 311.9 (+83%) Mg 30.9 to 30.8 (-1%) Na 32.7 to 95.7 (+193%) Pb 0.01 to 0.038 (+276%) SO_4 70.4 to 269.4 (+283%) TDS 265.9 to 650.0 (+142%) After-mix maximum MCMWCD#1 concentrations reach new high for numerous constituents with no significant effect on agricultural users	
-Mitigation		Notify users of exchange period	Not applicable	Aeration of water between reservoir and treatment plants			No mitigation recommended	
-Unmitigated/ Mitigated Effect		I/I	No Effect	SA/SA	SA/SA	SA/SA	I/I	I/I

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
WATER QUALITY								
Eutrophication								
-Potential for eutrophic conditions to occur	Low potential for SRP and MCMWCD#1 water. High organics in CAP water may produce trihalomethane in water treatment plants which receive CAP water	No eutrophication problems caused by project implementation. Increased potential for trihalomethane production at water treatment plants served by SRP during exchange period	No eutrophication problems caused by project implementation	Confluence Reservoir has high potential for eutrophication with high probability for blue-green algal dominance. Probable aesthetic impacts on Verde arm in most years. Increased potential for trihalomethane production at water treatment plants served by SRP			New Waddell Reservoir has low to moderate potential for eutrophication with no projected problems	
-Mitigation		Different disinfection process for SRP M&I water	Not applicable	Downstream impacts mitigatable with aeration and different disinfection process for SRP M&I water			No mitigation recommended	
-Unmitigated/ Mitigated Effect		I/I	No Effect	SA/I	SA/I	SA/I	I/I	I/I

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
CULTURAL RESOURCES								
Prehistoric Cultural Resources								
-Number of sites destroyed/total number of sites potentially affected	0 (3,296 sites in site areas)	134/2,906	57/2,906	158/3,151	77/3,169		160/3,033	
-Acres of archaeological deposits affected	0 (15,668 acres of deposits in site areas)	7,808	7,808	13,754	15,551		7,925	
-Effects Factor		-8,984	-8,210	-15,650	-19,600		-9,194	
-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	AF/AF	AF/AF
Historic Cultural Resources								
-Number of sites destroyed/total number of sites potentially affected	0 (175 sites in site areas)	21/44	21/38	66/116	64/127		33/44	
-Effects Factor		-260	-213	-698	-753		-260	
-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); site documentation (e.g., recording surface architecture or structural features); additional historical research.						
-Unmitigated/ Mitigated Effect		Roosevelt Dam impacts not mitigatable		Fort McDowell and Roosevelt Dam impacts not mitigatable			Roosevelt Dam impacts not mitigatable	
		AF/AF	AF/AF	AF/AF	AF/AF	AF/AF	AF/AF	AF/AF

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
RECREATION								
Stream-Oriented Recreation								
-Net loss of miles of perennial stream/ loss of tubing miles	0 (68 stream miles in site areas; 986 miles in 5-county region)	-2/0	-2/0	-18/16.8	-19/16.8	-19/16.8	-1/0	-2/0
-Net loss/gain in maximum recreation days per year for stream-oriented activities	0 (2,210,000 stream-oriented recreation days in site areas; 8,236,000 5-county region)	+43,000	-1,000	-1,469,000	-1,514,000	-1,514,000	+43,000	+43,000
-Mitigation		Loss of stream miles not mitigatable						
-Unmitigated/ Mitigated Effect		I/I	I/I	AF/AF	AF/AF	AF/AF	I/I	I/I
-Regional stream-oriented recreation needs met/intensified	Most needs not met except tubing	Negligible change	Negligible change	Tubing needs intensified by 94%			Negligible change	Negligible change
Reservoir-Oriented Recreation								
-Net gain in usable surface acres	0 (15,755 acres in site areas; 34,774 in 5-county region)	+845	0	+5,320	+5,320	+5,320	+1,781	+1,991
-Net loss/gain in maximum recreation days per year for reservoir-oriented recreation	0 (752,000 reservoir-oriented recreation days for site areas; 6,479,000 for 5-county region)	1,152,000	-9,000	+4,359,000	+2,875,000	+2,875,000	+1,564,000	+1,587,000

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
RECREATION								
Reservoir-Oriented Recreation								
-Regional reservoir-oriented recreation needs met/intensified	Most needs not met	Meets needs for swimming by 46%, developed camping by 190%	Insignificant intensification of lake boating needs	Meets needs for swimming by 343%, developed camping by 192%, picnicking by 37%	Meets needs for swimming by 256%, powerboating by 17%, picnicking by 32%		Meets needs for swimming by 61%, developed camping by 200%, picnicking by 28%	Meets needs for swimming by 61%, developed camping by 200%, picnicking by 28%. Potential for development of Rio Salado increased by provision of water supply for the project
-Mitigation		Not required for this factor						
-Unmitigated/ Mitigated Effect		SB	I	SB	SB	SB	SB	BF

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
SOCIAL IMPACTS								
Indian Relocations (Fort McDowell Indian Community)								
-Changes affecting individuals	1. Normal mortality and illness rates given the age distribution of the population 2. High levels of personal autonomy 3. High satisfaction with way of life 4. High potential for increased financial self-sufficiency	No change from without project condition		1. Substantial increase in illness and mortality rates 2. Extreme decline in levels of personal autonomy 3. Extreme decrease in satisfaction with way of life 4. Substantial decrease in potential for sustained financial self-sufficiency			No change from without project condition	
-Changes affecting families and small groups (INTERPERSONAL)	1. High levels of extended family ties; highly integrated support systems within the family 2. Normal incidence of family problems such as divorce, child abuse and neglect, and drug abuse; moderate incidence of alcohol abuse	No change from without project condition		1. Substantial decrease in extended family ties and family support systems 2. Substantial increase in incidence of family problems such as alcohol and drug abuse, divorce, child abuse and neglect			No change from without project condition	
-Changes affecting the community	1. High community cohesion; high levels of informal support networks 2. High community viability (significant increase from present condition); strong community leadership; high potential for tribal autonomy 3. High potential for increased tribal economic self-sufficiency; moderate levels of unemployment 4. High potential for sustaining Yavapai culture	No change from without project condition		1. Extreme decrease in community cohesion; substantial decline in number and efficacy of informal support networks 2. Extreme decrease in community viability; substantial decline in autonomy (ability to control the direction of the community) and in efficacy of tribal leadership; elimination of trend toward self-determination 3. Substantial decrease in potential for tribal economic self-sufficiency (increased dependency on government services); substantial increase in unemployment 4. Extreme decrease in potential to sustain Yavapai culture			No change from without project condition	

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
SOCIAL IMPACTS								
Indian Relocations (Cont'd)								
-Number of people relocated	0 (350 people in community)	0	0	290	350	350	0	0
-Mitigation		Not Applicable	Not Applicable	1. Relocate the entire community together; do not relocate on individual basis 2. Provide the tribe with additional land equal to or greater in size than that purchased and of the highest quality available which is contiguous to the reservation boundaries 3. Monetary compensation should cover all expenditures and new expenses incurred by the residents as a result of relocation and should be distributed according to the tribe's wishes 4. Provide special services to meet needs that are unique to this area 5. Initiate a plan that ensures the participation of the entire community in all decisions and plans relevant to the relocation 6. Provide an accurate, reliable system for disseminating information to residents so that they are constantly informed about the relocation proceedings 7. Guarantee that the land and water rights provided the tribe will never be revoked			Not Applicable	Not Applicable
-Unmitigated/ Mitigated Effect		No Effect	No Effect	AF/AF	AF/AF	AF/AF	No Effect	No Effect

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
SOCIAL IMPACTS								
Non-Indian Relocations (Roosevelt Lake)								
-Changes affecting individuals	1. Normal mortality and illness rates given age distribution of population 2. High levels of personal autonomy 3. High satisfaction with way of life 4. High potential for financial self-sufficiency	———	1. Slight increase in mortality rates and increased illness rates 2. Substantial decrease in personal autonomy 3. Substantial decrease in satisfaction with way of life 4. Moderately reduced financial capacity				———	
-Changes affecting families and small groups (INTERPERSONAL)	1. Low levels of informal support networks in all communities except Roosevelt Gardens; at Roosevelt Gardens, moderately developed informal support networks. Family interactions primarily within nuclear family at all locations 2. Incidence of family problems such as divorce, child abuse and neglect, alcohol and drug abuse	———	1. Slight decrease in informal support networks 2. No change			———		

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
SOCIAL IMPACTS								
Non-Indian Relocations (Cont'd)								
-Changes affecting the community	1. Low to moderate community cohesion in all communities except Roosevelt Gardens; high community cohesion at Roosevelt Gardens 2. Community development likely to remain at present low level, which is adequate to sustain viability. (Formal social organization emerges on temporary basis to meet needs and respond to immediate problems.) Low level community organization on day-to-day basis. (Emphasis on individuality more than community)		1. Slight decrease in community cohesion and social organization 2. Slight decrease in community viability					
-Number of people relocated	0 (650 people in affected communities)	325	275	325	275	275	325	325
-Mitigation		Mitigation for Plans 2, 4, and 5: 1. Relocate only those people who live within the area likely to be inundated more than once in 200 years, but not within the larger IDF area; provision of low-cost flood insurance to people residing in the IDF area. Mitigation for Plans 1, 3, 6, and 7: 1. Relocate only those people who live within the confines of the SPF take-line, with no relocation of people in the IDF area 2. Provision of low-cost flood insurance to people in the IDF area 3. Provision of Forest Service land in the Roosevelt Lake area for relocations, allowing enough space so neighbors may relocate near each other if they wish 4. Monetary compensation for all relocation expenses incurred by residents 5. Provide special services to meet needs that are unique to this area						
-Unmitigated/ Mitigated Effect		SA/I	SA/I	SA/I	SA/I	SA/I	SA/I	SA/I

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
SOCIAL IMPACTS (Cont'd)								
Flooding	Future-without project: 200-year flood (275,000 cfs at airport)	Impact of reduction of 200-year flood (275,000 cfs at airport) to 70-92,000 cfs at airport	Impact of reduction of 200-year flood (275,000 cfs at airport) to 157,000 cfs at airport	Impact of reduction of 200-year flood (275,000 cfs at airport) to 70-92,000 cfs at airport				
	(The conditions described have a probability of occurring approximately once every 200 years or one chance in 200 of occurring in any given year. In a flood of lesser magnitude, the conditions described in all plans would be less severe)							
-Individual Impacts								
Quality of life	Slight increase in mortality rates. Extensive health problems resulting from sewage and debris in inundated areas. High levels of stress and anxiety resulting from disruptions due to flooding. Substantial financial losses which could not be recovered, i.e., loss of businesses and employment opportunities, lost wages during extended clean-up period, property damages. Inconveniences and major disruptions in home and work routines	Normal mortality rates. Elimination of health problems resulting from sewage and debris in inundated areas. Elimination of high stress and anxiety levels and financial losses associated with flooding. Substantial reduction in inconveniences and disruptions to home and work routines	Holly Acres: No impact, i.e. continued widespread health problems resulting from flooding debris. High levels of stress and anxiety resulting from disruptions due to flooding and evacuation. Substantial financial losses which could not be recovered. Continued inconveniences and major disruptions in home and work routines. Other areas: Normal mortality rates. Substantial reduction in problems resulting from sewage and debris in inundated areas. Elimination of high stress and anxiety levels and financial losses associated with flooding. Substantial reduction in inconveniences and disruptions to home and work routines	Normal mortality rates. Elimination of health problems resulting from sewage and debris in inundated areas. Elimination of high stress and anxiety levels and financial losses associated with flooding. Substantial reduction in inconveniences and disruptions to home and work routines				

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
Flooding (Cont'd)								
- Regional Impacts								
Change in number of communities with residential properties likely to sustain floodwater damage and requiring evacuation	Inundation and massive evacuations in communities of Mesa, Tempe, Phoenix, Salt River Indian Community, Gila River Indian Community, Holly Acres and Buckeye areas during 200-year flood (200-year floodplain population in year 2000 projected to be 44,800)	Elimination of inundation and evacuations in downstream communities of Mesa, Tempe, Phoenix, Salt River Indian Community, Holly Acres and Buckeye areas during 200-year flood (projected population of 200-year floodplain in year 2000 is 44,800)	Inundation of Holly Acres area and evacuation of 525 residents (year 2000 projected population.) Elimination of inundation and evacuations in downstream communities of Mesa, Tempe, Phoenix, Salt River Indian Community, and Buckeye area during 200-year flood (projected population of 200-year floodplain in year 2000 is 44,800)	Elimination of inundation and evacuations in downstream communities of Mesa, Tempe, Phoenix, Salt River Indian Community, Holly Acres and Buckeye areas during 200-year flood (projected population of 200-year floodplain in year 2000 is 44,800)				
Number of automobile river crossings closed	Closing of all but one (Mill Avenue) of 29 crossings in total future crossing stock (Southern Pacific Railroad bridge would be open for rail transport)	Closing of 15 crossings: 14 of 29 in total future crossing stock remain open up to 200-year flood condition; 15 of 29 remain open in 100-year flood condition	Closing of 16 crossings: 13 of 29 in total future crossing stock remain open in 200-year and 100-year condition	Closing of 15 crossings: 14 of 29 in total future crossings stock remain open up to 200-year flood condition; 15 of 29 remain open in 100-year flood condition				

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
Flooding (Cont'd)								
- Regional Impacts (Cont'd)								
Incidence of transportation disruptions	Severe disruptions to transportation and affected services--probable limitation of the one remaining crossing to emergency use only. Separation of communities north and south of river for extended period. (If Mill Avenue and Southern Pacific Railroad Bridges were available for work-related crossings, of 125,000 commuters normally crossing per day, only 72,000 would be able to do so)	Elimination of major disruptions to transportation. (Bridges remaining open during 200-year flood are expected to carry 75 to 80 percent of all traffic crossing on a normal day.) Some slowing of traffic due to adjustments to new routes and added driving distance to open crossings						
Incidence of health and safety problems related to flooding	Severe health hazards due to potential for raw sewage in river. Extensive inundation potential in large sector of the community. Hazards from down power lines. Greatly over-burdened emergency and medical care facilities with some areas cut off from direct access to any emergency and medical services	Elimination of health and safety hazards due to damages to power lines and sewer lines. Substantial reduction in delays in delivery of emergency services	Substantial reduction in health and safety hazards due to damages to major power lines and breaks in sewer lines. Substantial reduction in delays in delivery of emergency services	Elimination of health and safety hazards due to damages to power lines and sewer lines. Substantial reduction in delays in delivery of emergency services				
Effect		BF	SB	BF	BF	BF	BF	BF

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
ECONOMIC @ 7 3/8%								
Cost ($)								
-Total Construction Cost (including IDC)	0 (2,500,000,000)	476,140,000	408,550,000	764,640,000	1,173,810,000	1,083,810,000	746,150,000	746,150,000
-Total Annual Cost	0 (185,000,000)	41,110,000	31,840,000	66,650,000	95,930,000	89,280,000	64,320,000	62,890,000
Benefits ($)								
-Regulatory Storage								
Energy management	0	0	0	17,170,000	16,160,000	16,160,000	16,160,000	16,160,000
Hydropower	0	700,000	0	3,600,000	2,900,000	2,900,000	940,000	940,000
Water Supply Benefits		8,660,000	1,200,000	13,920,000	11,700,000	11,700,000	11,880,000	6,200,000
Total Regulatory Storage Benefits		9,360,000	1,200,000	34,690,000	30,760,000	30,760,000	28,980,000	23,300,000
-Flood Control								
Inundation Reduction		10,580,000	5,373,000	10,580,000	9,560,000	9,560,000	10,580,000	10,580,000
Location and Intensification		16,460,000	4,873,000	16,460,000	17,400,000	17,400,000	16,460,000	16,460,000
Total Flood Control Benefits		27,040,000	10,246,000	27,040,000	26,960,000	26,960,000	27,040,000	27,040,000
-Safety of Dams		29,530,000	29,530,000	29,530,000	14,500,000	14,500,000	29,530,000	29,530,000
-Recreation		Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
-Fish and Wildlife		Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Total Annual Benefit[a]		65,930,000	40,970,000	91,260,000	72,220,000	72,220,000	85,550,000	79,870,000
-Net Economic Benefit		24,830,000	9,136,000	24,610,000	-23,710,000	-17,060,000	21,230,000	16,980,000
-Benefit/Cost Ratio		1.60	1.29	1.37	0.75	0.81	1.33	1.27

[a]See following page for a descriptive note on the computational procedure used for benefits.

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
ECONOMIC @ 7 3/8%								
	Note: During initial plan formulation, it was assumed that the plans would be operated so as to deliver as much water from the Colorado River as possible subject to such constraints as aqueduct capacity, demand, and ability to exchange water. Analyzing the regulatory storage benefits obtained using this operation indicated that by operating the plans differently the potential to significantly increase the regulatory storage benefits existed. To verify this, the benefits for the plans were quickly reevaluated using different operating criteria. With these criteria the plans would be operated to develop additional water only from within Arizona and energy management potential would be maximized. If this second assumption is used, the net benefits for all plans with direct-connected regulatory storage will increase. The following table shows the benefits and yield for the plans under this assumption. Discussions will continue in an effort to define what the operating goals of regulatory storage will be. Based on the results of these discussions, some plan or plans will be re-fined and perhaps re-sized.							
Cost ($)								
-Total Construction Cost		476,140,000	408,550,000	764,640,000	1,173,810,000	1,083,810,000	746,150,000	746,150,000
-Total Annual Cost		41,060,000	31,840,000	64,990,000	95,298,000	88,646,000	61,940,000	60,440,000
Benefits ($)								
-Total Annual Benefits		65,815,000	40,976,000	102,183,000	84,976,000	84,967,000	94,652,000	86,645,000
Net Benefits		24,755,000	9,136,000	37,193,000	-10,322,000	-3,670,000	32,712,000	26,205,000
Benefit/Cost Ratio		1.60	1.29	1.57	.89	.96	1.53	1.43
-Yield (acre-feet)		100,000	16,000	130,000	130,000	130,000	95,000	65,000

Table 12 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future-Without Project)	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
FINANCIAL*($) @ 3⅛%								
Non-Reimbursable								
SOD	0 (0)	201,360,000	**	225,600,000	370,770,000	370,770,000	210,950,000	***
CAWCS	0 (67,948,000)	189,328,000	**	270,696,000	328,502,000	282,051,000	205,100,000	***
CAWCD Net Repayment Obligation	0 (833,829,000)	37,021,000	**	-427,002,000	-260,319,000	-322,908,000	-365,522,000	***

* The financial analysis is based on preliminary data. It is applicable only for planning purposes, and is subject to policy and legal review.

**Not completed since incidental flood control benefits attributed to constructing Roosevelt and Cliff Dams were not available for Plan 2.

***Not completed since water allocations for Plan 7 were not available.

2. Energy management

3. Flood control

4. Safety of dams

5. Stream-oriented recreation

6. Reservoir-oriented recreation

7. Threatened and endangered species

8. Riparian/wetland habitat

9. Perennial stream/riverine aquatic community

10. Eutrophication potential

11. Prehistoric cultural resources

12. Historic cultural resources

13. Non-Indian relocation

14. Indian relocation

15. Public views of candidate plans

16. Construction cost

17. Total annual costs

18. Total benefits

19. Net economic benefits

20. Total nonreimbursable cost

21. Central Arizona Water Conservation District's net repayment obligation

Once the data for the 21 evaluation criteria were displayed and analyzed, it was determined that although all criteria were critical to the plan evaluation process, only certain factors were significant in the discrimination of plans.

These criteria were as follows: yield, energy management, flood control, total construction cost, B/C ratio, threatened and endangered species, riparian habitat, cultural resources, and Indian relocations. For ease of analysis, these nine criteria were aggregated into the following categories: performance (ability to meet CAWCS objectives), economics, environmental impacts, social impacts, and public acceptability.

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 the aggregated categories. As a result of these analyses, the Arizona Projects Office of the Bureau of Reclamation recommended plans 4 and 5 be eliminated from further consideration and that Plans 1, 3, and 6 were appropriate for consideration as the proposed action. Plan 2 was not recommended because it does not provide any regulatory storage capability and offers less flood protection than other action plans. Plan 7 is an environmentally-oriented variation of Plan 6, and many of the benefits of Plan 7 could be obtained with mitigation measures included as part of Plan 6. Therefore, although Plan 7 was not recommended for further consideration, features of this plan could still be obtained. Plan 8 was not recommended because the plan does not meet project objectives of flood control and regulatory storage. Plans 1, 2, 3, 6, 7, and 8 would be displayed in the draft EIS. The reasons for these recommendations were as follows:

Plan 4 (Confluence with a large spillway + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain) and Plan 5 (Confluence with a small service spillway and auxilary spillway + Cliff + New/Enlarged Roosevelt + Reconstructed Stewart Mountain) were eliminated from further consideration. They were not considered for recommendation as the proposed action, nor are they presented in the Regulatory Storage Division Environmental Impact Statement. Although these two plans would eventually meet the primary objectives of flood control, regulatory storage, and safety of dams, they would not do so efficiently. Both of these plans had excessive costs and negative net economic benefits. They would require additional non-Indian relocations (Fountain Hills) and they would take the longest to implement because of the delay in implementing the safety of dams solutions.

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

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 and 7; 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, steam recreation, water quality, and cultural (prehistoric and historic) resources. Environmental impacts of Plan 6 include losses of riparian habitat and cultural resources; these same impacts would occur with Plans 1 and 7, which would also adversely affect endangered species. Plan 2 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.

Other items that were considered in evaluating the plans were the Solicitor's opinion regarding project authorization, CAP cost ceiling, SOD cost ceiling, availability of funding, mitigation authority, and institutional issues.

Table 13 provides a comparative display of the advantages and disadvantages of Plans 1, 2, 3, 6, and 7 relative to the significant evaluation criteria.

After reviewing the three recommended plans (Plans 1, 3, and 6), the Secretary of the Interior selected Plan 6 as the agency proposed action in November 1981.

Plan 6 was 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, and 7 also avoid impacts to the Fort McDowell Community, they do not perform as well as does Plan 6.

Table 13

COMPARATIVE EVALUATION OF CANDIDATE 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 resouces 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 endanagered 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

Table 13 (Continued)

	Advantages	Disadvantages
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 Insignificant impacts to endangered species Strong broad-based public support	High cost Adverse impacts to riparian 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

SUMMARY OF PROCESS

USED TO PREPARE

REGULATORY STORAGE

DRAFT EIS

planning down the road after Plan II has been accepted.

IV. CURRENT PLANNING

Section III presented the information used by the Secretary in selecting Plan 6 as the agency proposed action. The information for all the plans was at a comparable level of detail. At the time of the decision, the agency recognized that more planning and study needed to be done before any plan could be carried forward to implementation. The agency also recognized that this additional planning and study could not be done for all the candidate plans. Therefore, this additional planning is being done for Plan 6, the agency proposed action. However, any changes that were made in the plan were examined to determine their affect on the decision to select Plan 6 as the agency proposed action. It was determined that the changes did not affect the decision.

A. New Waddell Sizing Study

At the time of the selection of the proposed action, the agency recognized that more study was required to ensure that the optimum power marketing plan was formulated. Of the three plans that the CAWCS planning team identified for consideration as the agency proposed action, Plan 6 was the only one that could be optimized. Since there is no direct connection between the aqueduct system and the reservoir system in Plan 1, there is no potential for enhanced power marketing. In Plan 3, there would be severe impacts to the environment, the Fort McDowell Indian Community, and to Stewart Mountain Dam if Confluence Dam was optimized for power marketing because this optimization requires more regulatory storage capacity. New Waddell Dam, the regulatory storage feature in Plan 6, is located at a site with sufficient reservoir capacity to allow an optimization of reservoir size.

The New Waddell Sizing Study was initiated in November 1981 by a request from the Arizona Projects Office (APO) to the Lower Colorado Region to organize a task force to refine the proposed Navajo marketing plan used in the CAWCS study and explore alternatives before selecting the final size for CAP regulatory storage. Its primary purpose was to present a comparison of alternative sizes for New Waddell Reservoir from the standpoint of cost effectiveness, environmental and social impacts.

The task force developed and evaluated options in order to determine which New Waddell Dam size would be appropriate for feasibility design. A range of sizes with an appropriate operating mode for each size was evaluated. The alternative of "no structure" was not evaluated because the earlier Stage III decisions identified a need for a regulatory structure of some size at the New Waddell site. It presented only an incremental analysis of sizes greater than the baseline. Environmental and social impacts were also addressed for each of the sizes selected. The options had to meet the primary objectives of regulatory storage, which include water supply and power management for CAP and be evaluated for efficiency, completeness, effectiveness, and acceptability.

The sizing task force defined and evaluated three different sizes of the regulatory storage portion of New Waddell Reservoir, each representative of a unique CAP limitation, water operation concept, and/or power marketing objective.

Three options were developed for the New Waddell Reservoir regulatory storage capacity. Option 1 requiring 325,000 acre-feet of storage, Option 2 requiring 660,000 acre-feet of storage, and Option 3 requiring 485,000 acre-feet. The options had to meet the primary objectives of regulatory storage which included water supply and power management for CAP. Each option was evaluated for performance, economics, environmental, and social impacts. Table 14 provides a comparative display of these four categories. Refer to the New Waddell Sizing Study (May 1982) and the New Waddell Sizing Study Summary (July 1982) for more detail.

Option 2 is the most beneficial option for CAP regulatory storage purposes and it is recommended that it be pursued in field data collection and feasibility design. It is also concluded that designs should proceed so as not to preclude later addition of flood control (if warranted) or pumped storage facilities.

B. Agua Fria River Flood Control Study

In conjunction with the regulatory storage sizing analysis at New Waddell, the potential for flood control on the Agua Fria River was also re-analyzed. During Stage II of the CAWCS study, it was tentatively concluded that there was no justification for including flood control in New Waddell Dam. This conclusion was based on previous assumptions about the ability of the existing dam to control floods. The floods of 1978 and 1980 challenged these assumptions, and recently completed reanalysis of hydrologic data by the COE suggested that the flood control needs on the Agua Fria should be reassessed. Because of this, New Waddell was reanalyzed to estimate its flood control potential under the proposed design and operation, or through modification of the operation criteria or the structure.

The analysis rested on several assumptions. It was assumed that, as recommended in the New Waddell Sizing Study, the dam would have a regulatory storage pool of 660,000 acre-feet, with a spillway crest located at about elevation 1702. The regulatory storage pool operation would conform to the sizing study's Option 2 operating criteria. It was further assumed that a 15,500 cfs outlet as well as the 3,000 cfs CAP outlet would be available to make flood releases. A flood release of 25,000 cfs was assumed to be non-damaging flow. The standard project flood (SPF) was selected as the level of flood control which the design would control. More information on the basis of these assumptions is contained in the flood control analysis portion of the New Waddell Sizing Study.

Four alternatives for providing flood control were investigated: (1) the currently proposed operation, (2) modifying the operation to keep the reservoir below the critical elevation in all months except April through June, (3) modifying the operation to keep the reservoir lowered to the critical elevation throughout the year, and, (4) modifying the structure to provide additional permanent flood control storage space.

The analysis revealed that the first alternative, the currently proposed operation of New Waddell Dam, would provide an unusually high degree of incidental flood control. The probability of having damaging releases as a result of the SPF dropped from a 0.5 percent chance to 0.1 percent chance.

Table 14

Summary of Significant Evaluation Criteria,
New Waddell Dam Regulatory Storage Optimization

Performance	Option 1	Option 3[1/]	Option 2[1/]
Increased Yield (ac-ft)	Baseline	8,500	15,400
Power Management ($/yr)	Baseline	23,700,000	49,700,000
Economics			
Total Construction Cost ($)	Baseline	- 2,800,000	- 2,300,000
Total Annual Cost ($)	Baseline	6,200,000	15,700,000
Total Annual Benefits ($)	Baseline	23,500,000	49,300,000
Net Benefits ($)	Baseline	17,300,000	33,600,000
Environmental			
Threatended/Endangered Species	Baseline	If Bald Eagle Presence is Confirmed, Probable Loss of Nest Site	If Bald Eagle Presence is Confirmed, Probable Loss of Nest Site
Social			
Relocations	Baseline	0	0

1/ Options 3 and 2 show increases over Option 1 the baseline

The second alternative, modifying the operation of the dam to keep the reservoir below elevation 1694 in flood-prone months, further reduced the probability of a damaging release from the SPF to 0.01 percent chance. The reduction was accomplished without a significant reduction in CAP water supply or power marketing benefits.

Alternative 3, operating the reservoir so that a water surface elevation of 1694 was never exceeded, virtually eliminated the probability of a damaging release from the SPF, and will not significantly affect the CAP water supply and power marketing benefits during the early years of the project.

The probability of a damaging release due to the SPF could also be virtually eliminated by Alternative 4, adding additional permanent flood storage space to the reservoir. A cost comparison showed that the optimal combination of additional embankment and outlet capacity favored minimum outlet sizes. With a flood outlet of 5,000 cfs an additional 18 feet of embankment would be required. A complete analysis of all the alternatives is contained in the flood control analysis portion of the New Waddell Sizing Study.

Based on the results of the analysis, it was recommended that Alternative 2, modifying the operation during the flood prone season, be included as the operating criteria for the feasibility design of New Waddell Dam. It provided a high degree of flood control, with no loss in benefits and at no additional cost.

It was also recommended that the Corps of Engineers be requested to perform a detailed economic analysis to determine the flood control benefits attributable to this operation, for cost allocation purposes.

C. Pumped Storage at New Waddell

As part of reanalysis of the New Waddell sizing, a conceptual evaluation of the site for the potential development of independent pumped storage, hydroelectric power was undertaken. The task force concluded that such pumped storage hydroelectric development appears viable technically and would be competitive with other such operations. It also determined that more information would be required before the justification of such a facility could be determined. The studies required would be beyond the scope of the CAWCS. In January 1983, a local utility (Arizona Public Service) received a permit from the Federal Energy Regulatory Commission to perform such a study. Feasibility design data have been submitted which will not preclude later addition of pump storage to New Waddell.

D. New Waddell CAP Pumping and Generation

New Waddell Dam and Reservoir would be connected to the CAP Granite Reef Aqueduct by Waddell Canal. Water would be pumped from the canal into the reservoir and then would flow by gravity from the reservoir into the reversible canal through a pump-generator facility.

In determining the size of this pumping and generating facility, costs, benefits, and net economic benefits were calculated for several different sizes of plant facilities. These are displayed on figure 5 in graphical form.

NEW WADDELL GENERATOR SIZING

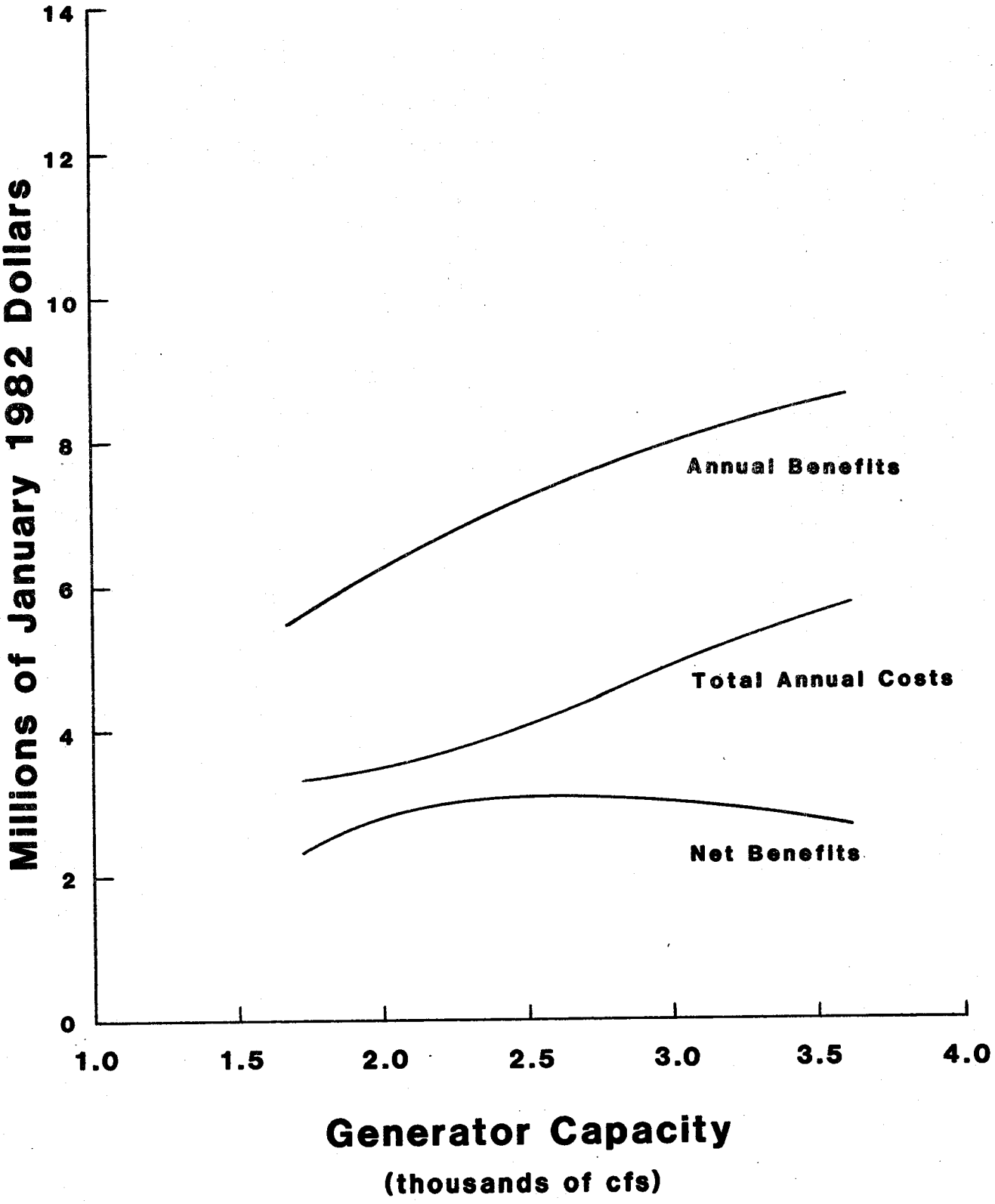


Figure 5

This analysis indicated that the greatest net economic benefits occurred for a generation facility with a 2,700 cfs capacity. However, considering the level of detail of the analysis, the difference between the net benefits for a 2,700 cfs facility and a 3,000 cfs facility were negligible. Therefore, in order to have flexibility in the system, it was felt that the feasibility design of New Waddell Dam should include a pumping and generating facility with a 3,000 cfs capacity.

E. Roosevelt Analysis

Because it was not known whether the existing Roosevelt Dam could be modified to accommodate both dam safety and flood control, a decision was made early in Stage III to use New Roosevelt Dam in the comparison of candidate plans. This strategy was developed to aid in the comparison of plans only, and no decision has yet been made as to which Roosevelt option would be selected. Both options at the Roosevelt site are displayed in the draft EIS, with the understanding that the selection of the option to be implemented will be made prior to the filing of the final EIS. This strategy allows the draft statement to be filed, while still ensuring that impacts and effects of both options are displayed.

Both the new and the modified dam would provide the same amount of flood control and water conservation and both would solve the SOD problem to the same extent. There are no significant differences between the two options as far as social, environmental, and cultural impacts are concerned. The mitigation plan for the cultural resources could vary depending on which option was implemented. The acceptability and implementability of the two options are similar with an adequate mitigation plan. The factor that will discriminate between the two options, if both are found to be technically feasible, will be the cost. A feasibility grade cost estimate is completed for New Roosevelt Dam and the estimate for the modified dam is ongoing. After completion of feasibility design and cost estimates, a decision will be made prior to the filing of the final EIS. Criteria for the decision will primarily be total project cost, however, other factors such as authorization, cost ceiling, and funding will be evaluated.

F. Stewart Mountain Dam Analysis

In a manner similar to that previously described for Roosevelt Dam, it has not yet been determined if a new or modified Stewart Mountain Dam should be constructed. The decision is dependent on the outcome of the technical analysis of the stability of the dam. The draft EIS displays both options with their impacts and effects. However, a decision on the appropriate option will be made prior to the filing of the final EIS.

Current studies on Stewart Mountain Dam include material testing to determine the existing condition of the structure and a model analysis to determine the stability of the structure.

G. Recreation Plans

The Recreational Planning processes involved in the CAWCS resulted in the development of the Stage III Conceptual Recreation Plans.

During Stages I and II a data base was generated and utilized as the background support material for the Stage III effort.

The recreation planning aspects of the study involved close coordination among the interested agencies and public. A Recreation Technical Subcommittee to the TAG was established to provide input into the recreation plans. Numerous meetings were held with all concerned agencies and individuals. The plans that were developed were based on this input. After the development of the Stage III Conceptual Recreation Plans the processes of review and refinement of the basic plans continued. As a result of these reviews certain changes were necessitated in the conceptual plans. These changes were primarily geared toward reducing the impacts at the proposed Cliff and Roosevelt sites. The enlargement of the proposed New Waddell site necessitated a complete revision of those plans.

The specific details of the conceptual recreation plans and planning efforts are currently contained in the recreation support material. This primary material consists of:

- Impacts and Effects Working Papers
- Recreation Planning Report - Stage III - CAWCS (December 1981)
- Detailed Specific Site and Element Visitation, Cost, and Facility Information - (December 1981)
- Final Recreation Planning Report - Stage III - Summary (September 1982)

H. Mitigation

Mitigation initiatives are mitigation measures that would achieve the goal of minimizing or eliminating impacts caused by the construction and operation of the proposed action, and are provided in this form to give a more concrete idea of the actual mitigation plan for the proposed action. Specific mitigation measures have not been determined at this time. A final determination will be made when more detailed information is available on the proposed action and evaluations of the mitigation measures have been completed.

Although the actual quantity and quality of the mitigation measures are not identified, the Bureau is committed to use the initiatives to provide mitigation at a sufficient level to either minimize or eliminate the impacts caused by the proposed action. Prior to the filing of the final EIS a specific mitigation plan will be proposed by the agency and distributed to appropriate parties.

Mitigation initiatives for Plan 6 are described in detail in the draft EIS. For each major resource category, goals for mitigation are established, various means for accomplishing the goals are described, issues relating to the measures are discussed, and the future direction that will be taken to finalize a mitigation plan is defined.

The Bureau is committed to the mitigation goals stated in the EIS and the development of a mitigation program for each of the following resource categories:

1. Biological Resources

    a. Riparian/Wetland Communities

    b. Other Terrestrial Communities

    c. Perennial Streams

    d. Reservoir Aquatic Communities

    e. Threatened and Endangered Species

    f. Special Use Areas

2. Cultural Resources

3. Social Resources

4. Construction-Related Impacts

    a. Public Safety

    b. Blasting Control

    c. Dust Control and Air Pollution

    d. Noise Abatement

    e. Water Pollution Abatement and Waste Material Disposal

    f. Erosion Control

    g. Prehistoric and Historic Cultural Resources

    h. Vegetation

    i. Wildlife

I. Hydropower

Preliminary studies early in Stage III identified new hydroelectric facilities for Cliff, Confluence, and New Waddell Dams. These facilities were included in the candidate plans. However, since the selection of Plan 6 as the agency proposed action, it was determined that the hydroelectric facilities at Cliff Dam should not be pursued by the Bureau at this time due to the high cost of providing a transmission system from the site.

J. Summary of Information Displayed in Draft EIS

Since November 1981, when the Secretary of the Interior identified Plan 6 as the proposed action for further study, more analysis has been performed. The following comparative table (table 15) summarizes the results of these studies for Plans 1, 2, 3, 6, 7, and 8. The plans remain basically unchanged from those presented in Section III except for Plans 6 and 7 where the size and operation of New Waddell Dam has been changed.

Table 15 SUMMARY OF 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
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
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	0	1
Conceptual Mitigation		Establish 230 acres preferred habitat	None proposed	Establish 370 acres preferred habitat	None proposed	Establish 280 acres preferred habitat
Typical Year Unmitigated/ Mitigated Effect		SA/I	I	AF/AF	I	SA/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
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
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
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 640 acres of high quality habitat
Typical Year Unmitigated/ Mitigated Effect (on high quality habitat)		SA/SA	SA/SA	AF/AF	SA/I	SA/SA

Table 15 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
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
Change in flow characteristics of Salt and Verde Rivers	No change (on average, 106 days/ year $\leq$ 50 cfs in Salt, 61 days/year $\leq$ 50 cfs in Verde)	No change	No change	No change	No change	Guaranteed minimum flows of 200 cfs in Salt and Verde
Conceptual Mitigation		None proposed	None proposed	Stream losses not mitigatable	None proposed	None proposed
Typical Year Unmitigated/ Mitigated Effect		I	I	AF/AF	I	SB
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
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
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)
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

Table 15 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
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.	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%)	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-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.		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.	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 15 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
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 15 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
CULTURAL RESOURCES						
Prehistoric Cultural Resources						
Number of sites destroyed by construction activities/total number of sites potentially affected in dam site areas[c]	0 (3,328 sites in site areas)	132/2,942	72/2,942	156/3,208		158/3,062
Acres of archaeological deposits affected	0 (12,117 acres of deposits in site areas)	4,272	4,272	12,015		4,374
Effects Factor (for total sites affected)[d]		-5,760	-4,747	-14,665		-5,887
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
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
Effects Factor (Range)[d]		-73 to -320	-173 to -370	-438 to -798		-225 to -422
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 not mitigatable		Fort McDowell, Roosevelt Dam, and Verde River Sheep Bridge impacts not mitigatable		Roosevelt Dam and Verde River sheep Bridge impacts not mitigatable
Unmitigated/ Mitigated Effect		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 15 (continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
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
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
Conceptual Mitigation		None proposed	None proposed	Loss of stream miles not mitigatable	None proposed	None proposed
Typical Year Unmitigated/ Mitigated Effect		I	I	AF/AF	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
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
Conceptual Mitigation		None proposed for this factor				
Typical Year Unmitigated Effect		SB	I	SB	SB	BF

Table 15 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Social 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 15 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Social (continued) 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 15 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Social (continued) 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 15 (continued)

	Relocation of Indian People	Relocation of Non-Indian People	Flood Damage Reduction
Social (continued) 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.

Other changes from information displayed in Section III have occurred that are displayed on the Comparative Evaluation Table. The reasons for these changes are listed below:

- Threatened/Endangered Plant and Wildlife. Typical year pool of Cliff revised.
- Riparian/Wetland Biotic Communities. A larger recovery area in old Horseshoe Reservoir has been identified.
- Perennial Stream/Riverine Communities. The typical-year pool at Cliff Dam was revised and does not inundate the old Horseshoe Reservoir.
- Reservoir Aquatic Communities. The typical-year pool at New Waddell Dam is larger.
- Water Quality. New data have been analyzed.
- Prehistoric Cultural Resources. Acres of archaeological deposits were recalculated.
- Historical Cultural Resources. Typical-year pools and construction impacts at Stewart Mountain Dam have changed.
- Stream-Oriented Recreation. Typical-year pools have changed.
- Reservoir-Oriented Recreation. New Waddell Reservoir increased in size and recreation plans have changed.
- Social. Social tables have been reformated.
- Non-Indian Relocations. Existing information was reanalyzed and additional data have been obtained.

The economic costs and benefits of the plans are displayed in table 16. As discussed earlier in this chapter, studies are still ongoing to determine whether Roosevelt Dam would be modified or whether a new dam would be required and whether Stewart Mountain Dam would be modified or whether a new dam would be required. For each plan, there are four possible combinations of these options.

The CAWCS alternatives address problems related to SOD under the Reclamation Safety of Dams Act as well as functions such as water supply, flood control, power, recreation, and fish and wildlife enhancement authorized as part of the CAP. Therefore a two-stage cost allocation process was adopted to (1) separate from the CAWCS plans the

Table 16 ECONOMIC COSTS AND BENEFITS OF PLANS

Plan Options	Total Construction Cost[a,b] ($)	Total Annual Cost[a,c] ($)	Total Annual Benefits[a] ($)	Net Economic Benefits[a] ($)
Plan 1				
Cliff + Modified Roosevelt + Modified Stewart Mountain	694,940,000	58,060,000	89,040,000	30,980,000
Cliff + New Roosevelt + New Stewart Mountain	874,230,000	71,300,000	89,040,000	17,740,000
Cliff + New Roosevelt + Modified Stewart Mountain	788,340,000	64,960,000	89,040,000	24,080,000
Cliff + Modified Roosevelt + New Stewart Mountain	780,830,000	64,400,000	89,040,000	24,640,000
Plan 2[d]				
Cliff + Modified Roosevelt + Modified Stewart Mountain	541,570,000	41,870,000	53,310,000	11,440,000
Cliff + Modified Roosevelt + New Stewart Mountain	627,460,000	48,210,000	53,310,000	5,100,000
Plan 3				
Confluence + Cliff + Modified Roosevelt + Modified Stewart Mountain	1,116,250,000	93,970,000	125,970,000	32,000,000
Confluence + Cliff + New Roosevelt + New Stewart Mountain	1,295,540,000	107,200,000	125,970,000	18,770,000
Confluence + Cliff + New Roosevelt + Modified Stewart Mountain	1,209,650,000	100,860,000	125,970,000	25,110,000
Confluence + Cliff + Modified Roosevelt + New Stewart Mountain	1,202,140,000	100,310,000	125,970,000	25,660,000
Plan 6				
New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain	978,430,000	82,710,000	174,290,000	91,580,000
New Waddell + Cliff + New Roosevelt + New Stewart Mountain	1,157,720,000	95,940,000	174,290,000	78,350,000
New Waddell + Cliff + New Roosevelt + Modified Stewart Mountain	1,071,830,000	89,600,000	174,290,000	84,690,000
New Waddell + Cliff + Modified Roosevelt + New Stewart Mountain	1,064,320,000	89,050,000	174,290,000	85,240,000
Plan 7				
New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain	978,430,000	82,710,000	168,160,000	85,450,000
New Waddell + Cliff + New Roosevelt + New Stewart Mountain	1,157,720,000	95,940,000	168,160,000	72,220,000
New Waddell + Cliff + New Roosevelt + Modified Stewart Mountain	1,071,830,000	89,600,000	168,160,000	78,560,000
New Waddell + Cliff + Modified Roosevelt + New Stewart Mountain	1,064,320,000	89,050,000	168,160,000	79,110,000

[a]Costs and benefits are shown in January 1982 dollars. Annual equivalents are calculated at 7 3/8%. Cost of plans would be allocated among several funding sources; for this analysis two sources were assumed: Reclamation Safety of Dams Act and Colorado River Basin Project Act.
[b]Includes interest during construction (IDC).
[c]Includes operation, maintenance, and replacements costs (OM&R).
[d]Plan 2 (limited construction) includes only modifications to Roosevelt Dam which may be required for dam safety.
Source: Economics Supporting Document, USBR, 1982.

The allocation of costs between CAWCS and SOD cannot be finalized prior to completion of final design. At present it is not known whether either Roosevelt or Stewart Mountain Dam can be modified or if they must be reconstructed. An approximate breakdown of the costs, in percent, between CAP and SOD based on the separable cost/remaining benefit method, assuming both dams can be modified for the features of Plan 6 are 69 percent to CAP and 31 percent to SOD.

Under the terms of the repayment contract, implementation of Plan 6 would decrease the property tax burden on the residents of the CAWCD service area. The combination of increased power revenue and increased Federal participation because of the provision of flood control more than offset the increase in the districts repayment obligations.

Recently there have been discussions of local funding spurred by a decline in the purchasing power of annual appropriations for CAP construction. Proposals for local funding are not yet concrete enough to estimate their impact on local taxes or water charges. It is likely that some of the increased power revenues resulting from implementation of a CAWCS alternate could be committed to CAP construction.

Table 17 summarizes the physical features of Plan 6 and the cost of those features.

Table 17
DESIGN DETAILS - PLAN 6

NEW WADDELL DAM

DAM STRUCTURE:

Height	306 feet
Crest Length	5,000 feet
Embankment Volume	24,000,000 cubic yards

SPILLWAY:

Crest Length	500 feet
Head	26 feet
Capacity	250,000 cfs

APPURTENANT WORKS:

Pump Generator	3,000 cfs
Hydroelectric Power Plant	--
Service Outlet	600 cfs
Flood Outlet:	
Capacity in Flood Pool	--
Capacity at MWS	--
Reversible Canal:	
Capacity	3,000 cfs
Length	5 miles

STORAGE ALLOCATION:

	Allocated Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Steambed	0	0	0	1,430
Inactive	5,000	5,000	---	---
Sediment	68,800	73,900	---	---
Replacement	157,600	231,400	---	---
Regulatory Storage	660,000	891,400	10,238	1,702
Flood Control	---	---	---	---
Surcharge	297,200	1,188,600	12,680	1,728
Dam Crest	---	---	---	1,736

Estimated Cost (January 1982$):

DAM STRUCTURE	$ 66,900,000
SPILLWAY	$ 17,100,000
OUTLETS	$ 23,300,000
RECREATION	$ 14,200,000
MISCELLANEOUS	$ 171,300,000
CONSTRUCTION COST	$ 292,800,000
INTEREST DURING CONSTRUCTION (@ 7-3/8%)	$ 43,190,000
TOTAL CONSTRUCTION COST	$ 335,990,000
ANNUAL OM&R	$ 4,050,000
TOTAL ANNUAL COST	$ 28,850,000

Table 17 (Cont.)
DESIGN DETAILS - PLAN 6

CLIFF DAM

DAM STRUCTURE:	
Height	338 feet
Crest Length	2,900 feet
Embankment Volume	15,000,000 cubic yards
SPILLWAY:	(perched and ungated)
Crest Length	125 feet
Head	47 feet
Capacity	150,000 cfs
APPURTENANT WORKS:	
Hydroelectric Power Plant	--
Pumping Plant Combined for Cliff and Roosevelt	1,600 cfs
Service Outlet	4,000 cfs
Flood Outlet:	
Capacity in Flood Pool	25,000 cfs
Capacity at MWS	36,000 cfs
Reversible Canal:	
Capacity	--
Length	--

STORAGE ALLOCATION:

	Allocated Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Steambed	0	0	0	1,810
Inactive	---	---	---	---
Sediment	41,300	41,300	---	---
Replacement	131,400	172,700	---	---
New Conservation	170,000	342,700	5,328	2,001
Flood Control	445,000	787,700	8,713	2,066
Surcharge	861,000	1,648,700	14,246	2,143
Dam Crest	---	---	---	2,148

Estimated Cost (January 1982$):

DAM STRUCTURE	$ 127,100,000
SPILLWAY	$ 6,800,000
OUTLETS	$ 66,800,000
RECREATION	$ 15,700,000
MISCELLANEOUS	$ 94,700,000
CONSTRUCTION COST	$ 311,100,000
INTEREST DURING CONSTRUCTION (@ 7-3/8%)	$ 45,890,000
TOTAL CONSTRUCTION COST	$ 356,990,000
ANNUAL OM&R	$ 3,240,000
TOTAL ANNUAL COST	$ 29,590,000

Table 17 (Cont.)
DESIGN DETAILS - PLAN 6

STEWART MOUNTAIN DAM

	New	Modified (same as existing)
DAM STRUCTURE:		
Height	118 feet	116 feet
Crest Length	1,300 feet	1,260 feet
Concrete Dam Volume	130,000 cubic yards	130,000 cubic yards

SPILLWAY:	Existing	Auxiliary	Existing	Auxiliary
Crest Length	270 feet	150 feet	270 feet	150 feet
Head	27 feet	37 feet	27 feet	37 feet
Capacity	123,000 cfs	87,000 cfs	123,000 cfs	87,000 cfs

APPURTENANT WORKS:		
Hydroelectric Power Plant	Replace existing	Existing plant remains
Pumping Plant	---	---
Service Outlet	1,800 cfs (existing)	1,800 cfs (existing)
Flood Outlet:		
Capacity in Flood Pool	---	---
Capacity at MWS	---	---
Reversible Canal:		
Capacity	---	---
Length	---	---

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Steambed	0	0	0	1,417
Inactive	---	---	---	---
Sediment	---	---	---	---
Replacement	69,800	69,800	1,254	1,529
New Conservation	---	---	---	---
Flood Control	---	---	---	---
Surcharge	---	---	---	1,533
Dam Crest	---	---	---	1,535

Estimated Cost (January 1982$):	New	Modified
DAM STRUCTURE	$ 59,300,000	---
SPILLWAY	$ 16,100,000	$ 16,100,000
MISCELLANEOUS	$ 18,900,000	$ 4,000,000
CONSTRUCTION COST	$ 94,300,000	$ 20,100,000
INTEREST DURING CONSTRUCTION (@ 7-3/8%)	$ 13,910,000	$ 2,220,000
TOTAL CONSTRUCTION COST	$108,210,000	$ 22,320,000
ANNUAL OM&R	---	---
TOTAL ANNUAL COST	$ 7,990,000	$ 1,650,000

Table 17 (Cont.)
DESIGN DETAILS - PLAN 6

ROOSEVELT DAM

	New	Modified
DAM STRUCTURE:		
Height	299 feet	299 feet
Crest Length	1,250 feet	1,220 feet
Concrete Dam Volume	340,000 cubic yards	300,000 cubic yards
SPILLWAY:	(gated)	(gated)
Crest Length	200 feet	200 feet
Head	90 feet	90 feet
Capacity	150,000 cfs	150,000 cfs
APPURTENANT WORKS:		
Hydropower Plant	Replace existing	Existing plant remains
Pumping Plant	---	---
Service Outlet	11,000 cfs	11,000 cfs
Flood Outlet:		
Capacity in Flood Pool		
Capacity at MWS	Spillway to be used as flood outlet	
Reversible Canal:		
Capacity	---	---
Length	---	---

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Steambed	0	0	0	1,902
Inactive	---	---	---	---
Sediment	268,000	268,000	---	---
Replacement	1,344,000	1,612,000	20,933	2,147
New Conservation	---	---	---	---
Flood Control	565,000	2,177,000	25,256	2,172
Surcharge	774,000	2,951,000	30,004	2,201
Dam Crest	---	---	---	2,201

Estimated Cost (January 1982$):	New	Modified
DAM STRUCTURE	$ 90,700,000	$ 85,090,000
SPILLWAY	$ 48,500,000	$ 39,900,000
OUTLETS	$ 11,300,000	$ 10,700,000
RECREATION	$ 22,540,000	$ 22,540,000
MISCELLANEOUS	$137,660,000	$ 71,080,000
CONSTRUCTION COST	$310,700,000	$229,310,000
INTEREST DURING CONSTRUCTION (@ 7-3/8%)	$ 45,830,000	$ 33,820,000
TOTAL CONSTRUCTION COST	$356,530,000	$263,130,000
ANNUAL OM&R	$ 3,200,000	$ 3,200,000
TOTAL ANNUAL COST	$ 29,510,000	$ 22,620,000

APPENDIX A
TECHNICAL OR APPOINTED GROUP MEMBERSHIP

Governor's Advisory Committee

Dr. Lee Thompson, Chairman
Arizona State University

Herschel Andrews
Salt River Pima-Maricopa Indian Council

Ben Avery
Wildlife Groups

Tom Chauncey, Sr.
KOOL-TV

Joan Enos
Fort McDowell Tribal Council

Tom Fannin
Real Estate

Honorable Art Hamilton
State Representative, District 22, South Phoenix

Honorable Margaret Hance
Mayor of Phoenix

Honorable John B. Hawley
Mayor of Buckeye

Honorable Herbert R. Drinkwater
Mayor of Scottsdale

Thomas Jones
Fort McDowell Tribal Council

Sue Lofgren
League of Women Voters

Honorable Dessie M. Lorenz
Mayor of Avondale

Manuel G. Marin
South Phoenix

Chet McNabb
Superintendent, Buckeye School District

Honorable Harry Mitchell
Mayor of Tempe

John R. Norton, III
Agriculture

Ed Pastor
Maricopa County Board of Supervisors

Eva Patten
Governor's Commission on the Environment

Honorable Don Strauch
Mayor of Mesa

Hank Raymond
Central Arizona Project Association

Bill Schultz
Developer

Norris Soma
San Carlos Irrigation and Drainage District

Don Tostenrud
Arizona Bank

Keith Turley
Arizona Public Service Company

Mason Walsh
Publisher, Phoenix Newspapers

Howard Wuertz
President, Central Arizona Water Conservation District

Dr. Robert Witzeman
The Maricopa Audubon Society

Technical Agency Group

Federal Representatives

- Advisory Council on Historic Preservation
- Army Corps of Engineers
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Mines
- Soil Conservation Service
- Fish and Wildlife Service
- National Park Service
- Environmental Protection Agency
- Federal Highway Administration
- Interagency Archaeological Services
- Tonto National Forest
- Geological Survey
- Western Area Power Administration
- Department of Housing and Urban Development
- Department of the Interior

Indian Reservation Representatives

- Fort McDowell Mohave-Apache Tribal Council
- Gila River Indian Community
- Salt River Pima-Maricopa Indian Community

State Representatives

- Governor's Office
- Senate, Research Assistant to the President
- House, Minority - Staff
- Bureau of Mineral and Geology Technology
- Department of Game and Fish
- Department of Health Services
- Department of Transportation
- Outdoor Recreation Coordinating Commission
- State Land Department
- State Parks Board
- Department of Water Resources
- Division of Emergency Services

County Representatives

- Maricopa Association of Governments
- Maricopa County:
  - Health Services
  - Parks and Recreation
  - Planning
  - Highway

Special District Representatives

Central Arizona Water Conservation District
Flood Control District of Maricopa County
Maricopa County Municipal Water Conservation District No. 1
Rio Salado Development District

Local Representatives

City of Avondale
City of Glendale
City of Mesa
City of Peoria
City of Phoenix
City of Scottsdale
City of Tempe
City of Tolleson
City of Buckeye
City of El Mirage
Salt River Project

Other

Willdan Associates
Inter-Tribal Council of Arizona
Maricopa County Audubon Society