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Central Arizona Water Control Study



SAFETY of DAMS

SALT RIVER PROJECT EVALUATION OF CAWCS/SOD CANDIDATE PLANS

September 1981

A902.908



Salt River Project

WATER ◆ POWER

P. O. BOX 1980
PHOENIX, ARIZONA 85001
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September 24, 1981

KARL F. ABEL, PRESIDENT
JOHN R. LASSEN, VICE PRESIDENT
A. J. PFISTER, GENERAL MANAGER

Dr. Lee Thompson, Chairman
Governor's Advisory Committee
1428 South College Avenue
Tempe, Arizona 85281

Dear Dr. Thompson:

To aid in the deliberations of the Governor's Advisory Committee, we are enclosing Salt River Project's evaluation of CAWCS/SOD Candidate Plans. We have concluded that Plans 1, 3, 6 and 7 would all be acceptable to Salt River Project, and that Plans 2, 4, 5 and 8 are unacceptable. Of the four acceptable plans, we have rated Plan 3 as the best overall technical plan and Plans 6 and 7 as second best. Plan 1, while acceptable, was rated as the lowest acceptable plan because of the absence of adequate regulatory control for CAP.

We recognize that the plans raise significant environmental and social issues. However, because of the subjective judgments required, we have not attempted to rank the plans from an environmental and/or social viewpoint as we feel that such a ranking can best be done by the Governor's Advisory Committee.

We have also enclosed a copy of the press release that we have issued concerning the results of our evaluation.

Representatives of Salt River Project will be in attendance at your meetings on October 2 and 3 to answer any questions the Committee may have concerning our evaluation.

Very truly yours,



A. J. Pfister

kmf
enc.

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Carol Jennings 273-5708

FOR IMMEDIATE RELEASE

September 24, 1981

Four of the eight plans proposed to help solve central Arizona's water control problems will do the job, a Salt River Project task force has concluded.

The four remaining plans, despite their other benefits, would expose the Valley to unacceptable flood risks and provide inadequate regulatory storage for the Central Arizona Project (CAP), the task force says.

The eight plans grew out of the Central Arizona Water Control Study (CAWCS), an effort by the U.S. Bureau of Reclamation (USBR) and the U.S. Army Corps of Engineers to provide flood control, dam safety and storage for regulating the water to be delivered by the CAP.

SRP formed the task force this summer after it became apparent that all eight of the CAWCS alternatives would directly affect SRP's facilities and operations, and that there was no obvious best solution as all eight offered drawbacks and benefits both to the community and to SRP.

The SRP task force focused mainly on a technical evaluation of the plans.

"Although we felt qualified to look at the technical aspects of the plans, we recognized that the significant social and environmental issues they raise must be fully evaluated from a broader, community perspective, such as that of the Governor's Advisory Committee on CAWCS," said General Manager Jack Pfister.

All four of the plans preferred by SRP would control flooding by increasing the height of the existing Roosevelt Dam on the Salt River or building a new Roosevelt Dam, and by building a new dam halfway between Horseshoe and Bartlett dams on the Verde River. The new dam, called Cliff Dam, would be larger than the existing Horseshoe Dam.

New storage space would be provided in Roosevelt and Cliff dams to protect all of the Salt and Verde river dams from the worst floods that can occur.

SRP's task force found that the four plans would do an equally good job of providing dam safety and flood control for the Valley, and would minimize flood damages to SRP reservoirs by providing flood control at upstream reservoirs. However, some of the plans are better than others for providing regulatory storage for CAP water.

Regulatory storage will allow CAP to use more efficiently the supply of water and power available to it, which will help keep the cost of CAP water as low as possible.

After an evaluation of the technical aspects of all the plans, SRP's task force concluded that Plan 3 was its first choice. This plan includes a small dam for regulatory storage at the confluence of the Salt and Verde rivers. The plan was chosen because it provides more CAP water storage than the other three plans.

Plans 6 and 7 are SRP's second choice. These plans call for a new Waddell Dam on the Agua Fria River and provide the next most efficient regulatory storage for CAP.

Of the four preferred plans, Plan 1--the plan that provides regulatory storage by making SRP deliveries with CAP water--is the least favored by SRP.

Plan 1 provides the least amount of storage and, unlike Plans 3, 6 and 7, does not allow the CAP to reduce the cost of its water by using the power supply available to it as efficiently.

However, SRP is willing to cooperate with CAP to accomplish the water exchanges necessary to make this plan work, if this plan is selected for implementation. This plan may appear more attractive if funding is unavailable for construction of a new dam--a confluence dam or a new Waddell Dam--for CAP regulatory storage.

All four plans call for SRP's dams to be operated for flood control, using storage space added specifically for that purpose. Pfister says the task force's report reaffirms the Project's long-standing commitment to operate its facilities for flood control as well as water conservation, if given the tools to do the job properly.

Two of the plans unacceptable to SRP--Plans 4 and 5--assume that the USBR's work to make the SRP dams safer will be delayed. These plans include a high dam at the confluence to handle flood control, regulatory storage and potential dam failures upstream.

SRP believes the risk of dam failure from flooding is too great to endorse any plan that fails to fix the safety problems upstream from the confluence.

Recent floods and new hydrological information have illustrated that flows large enough to cause water to flow over the tops of the dams are more likely to occur than previously thought possible.

The two remaining plans--Plans 2 and 8--also are unacceptable to SRP. Plan 8 recommends that safety of dams studies continue, but also recommends that no action be taken to solve the problems of flood control and regulatory storage. These problems are too important to be ignored, the task force said.

Plan 2 suggests modifications to Roosevelt Dam or construction of a new Roosevelt dam and construction of Cliff Dam for dam safety, but provides no storage space for flood control. SRP's task force concluded that flood flows through the Valley would be unacceptably high under Plan 2.

SRP's recommendations will be submitted to the Governor's Advisory Committee on the CAWCS and to the USBR.

SRP EVALUATION OF CAWCS CANDIDATE PLANS

Introduction

The purpose of this paper is to present the results of Salt River Project's evaluation of the Central Arizona Water Control Study (CAWCS) candidate plans and SRP's recommendation of a preferred plan. The August 1981 "Special Edition" CAWCS newsletter is included as reference material regarding the CAWCS candidate plans.

CAWCS

In 1977, as a result of a presidential water project review, Orme Dam was deleted from the Central Arizona Project (CAP). Subsequently, during the summer of 1978, the United States Bureau of Reclamation (USBR) began to formulate a study plan with the Corps of Engineers (COE) to pursue the CAWCS. The primary purpose of CAWCS was to investigate alternatives to satisfy CAP regulatory storage requirements and provide flood control along the Salt and Gila rivers between Granite Reef and Painted Rock dams.

Dam Safety Also Studied

The USBR also is in charge of a separate study of the safety of the six dams on the Salt and Verde rivers. Studies performed under the safety of dams (SOD) program revealed the problem was more widespread than anticipated.

New technologies for evaluating the worst storms and earthquakes that could occur showed dozens of federal dams--including all the SRP dams--would be unsafe under these extreme conditions. Legislation now before Congress would raise the dam safety authorization from \$100 to \$450 million.

What SRP's Done

In June 1981, the USBR announced eight "candidate" plans, which are described in the August 1981 "Special Edition" CAWCS newsletter included in this report. These plans consider both CAWCS and SOD purposes and are offered by the USBR as the best solution to both problems.

SRP began studying the proposed plans as soon as they were announced. A task force was formed to evaluate the impact of the various plans on SRP and on the community.

One of the key elements of the SRP task force was its diversity: financial experts and environmental specialists joined engineers and technical groups of power and water experts. The goal was to evaluate the plans from a wide range of viewpoints. Both objective and subjective evaluations followed lengthy briefings on the features of the plans.

SRP's task force considered whether each plan would solve safety and flooding problems, how much additional water its regulatory function would provide, the impact it would have on water quality and hydroelectric generation, and the potential political, legal and environmental problems that might have to be overcome before the plan could be implemented. In SRP's evaluation, dam safety and flood control were considered to be the most pressing problems. CAP regulatory storage also was considered to be of great importance because of the benefits it would provide for the state.

Results of SRP's Evaluation

After continued involvement in the studies and participation in the public process, SRP believes that the studies were completed in a very professional and objective manner. The process also has permitted adequate opportunities for the public to provide input for incorporation into the studies. SRP commends the members of the study team for an outstanding effort.

These studies are the most complex and difficult technical and environmental studies with which SRP ever has been involved. There is no single or obvious preferred solution. Each plan has virtues and serious drawbacks. The evaluation team established by SRP was not unanimous in its conclusions. SRP's process did produce a strong consensus; however, there were strong and articulate dissents.

SRP fully supports those candidate plans which provide flood control, dam safety and CAP regulatory storage. Four of the eight candidate plans fulfill these objectives in varying degrees. SRP recommends that:

- Plan 3 be selected as the plan which best fulfills CAWCS/SOD objectives;
- Plan 6 and 7 be considered second best; and
- Plan 1 be deemed acceptable as a third choice.

SRP believes that the four remaining plans expose the community to unacceptable risks by providing inadequate flood control and/or delaying a dam safety solution and, therefore, does not support Plans 2, 4, 5 and 8.

The Best Plan: Number 3

A low confluence dam plus new or modified dams upstream would provide adequate flood control, meet SOD requirements and supply regulatory storage for CAP. Plan 3 also provides a unique opportunity to increase hydroelectric generation on the Salt and Verde rivers and may make a solution to Stewart Mountain Dam's safety problem less expensive.

The Bureau estimates CAP's annual water yield would increase by 163,000 acre-feet per year with regulatory storage at the confluence site. With regulatory storage, CAP also would be able to optimize the power available to it by matching its pumping schedule to power supplies. The Bureau's studies also show that regulatory storage at the confluence site is more effective than storage at alternate locations such as a new Waddell Dam.

The Next Best: Plans 6 & 7

Because of the importance of regulatory storage, Plans 6 and 7 come in second best in SRP's estimation. Both include an enlarged Waddell Dam that would increase CAP's average annual yield by 143,000 acre-feet. The Cliff and Roosevelt dams envisioned by Plans 6 and 7 are the same as for Plan 3 and would provide enough storage on the Salt and Verde rivers for both flood control and dam safety.

Plan 7, with its additional environmental emphasis, may be more beneficial to the community than Plan 6, assuming enough CAP water is available to maintain the minimum pools and instream flows the plan suggests.

Plan 1 Would Work Too

If the funding is unavailable for an additional dam for regulatory storage--it would cost at least \$245 million--Plan 1 will utilize Cliff and Roosevelt to do the job of flood control and ensure dam safety in the same manner as Plans 3, 6 and 7. Regulatory storage benefits would be somewhat less than the plans previously mentioned: 107,000 extra acre-feet per year. SRP would cooperate and provide the regulatory storage through water exchange by storing CAP water in the SRP dams in the winter, and releasing it for CAP use in the summer. Although this plan, like Plan 3, would affect the quality of the water SRP delivers, seasonal exchange is from SRP's viewpoint a less effective but a feasible means of providing regulatory storage.

Plan	Regulatory Storage (Acre-Feet)	Sediment	Increase in CAP Water Supply (Acre-feet)	Remarks
1	200,000	246,000	107,000	CAP/SRP Seasonal Exchange
2	0	246,000	16,000	Use of New Sedimentary Storage
3	500,000	296,000	163,000	Low Confluence Dam
6,7	450,000	308,000	143,000	Waddell Dam

Plan 2, Flood Control Not Effective

Plan 2, although it does address the safety issues by adding some storage at Roosevelt Dam, constructing a lower Cliff Dam and modifying Stewart Mountain Dam, fails to adequately address the two remaining issues of flood control and regulatory storage.

Plan 2 increases the CAP water supply by only 16,000 acre-feet. That would prevent Arizona from using its full share of the Colorado River.

In addition, Plan 2--which includes the basic SOD remedy of a new or modified Roosevelt Dam and a new Cliff Dam--will not reduce flows at the airport to the levels of other plans. Even with additional dam safety storage space on the Salt and Verde rivers being used for flood control, the releases through the Valley would be unacceptably high--at least 150,000 cubic feet per second. SRP would agree to operate its system for flood control as well as water conservation as proposed in Plan 2. However, SRP would be unable to meet acceptable flood control objectives without additional storage space for flood control.

Plans 4 & 5, SOD Delay Not Acceptable

USBR studies show that the safety of SRP's dams is an issue for immediate concern and action. Plans 4 and 5 assume that the SOD remedies at SRP dams will be delayed and that a high dam will be built at the confluence site.

It is SRP's belief that the dam safety risk of such a plan is unacceptable to the community. Without a simultaneous CAWCS/SOD solution at SRP's dams, the SOD risk could continue for an extended period of time.

In addition, the risk of having a high earthen dam at the confluence site without upstream SOD action may be unacceptable to downstream residents.

Another principal concern is the possibility that the Phoenix metropolitan area could be exposed to devastating flows in excess of 1,000,000 cfs and to the loss of some of its water supply if the dams should fail. The Valley would be without at least a portion of its water supply during the time it would take to rebuild or repair the SRP dam.

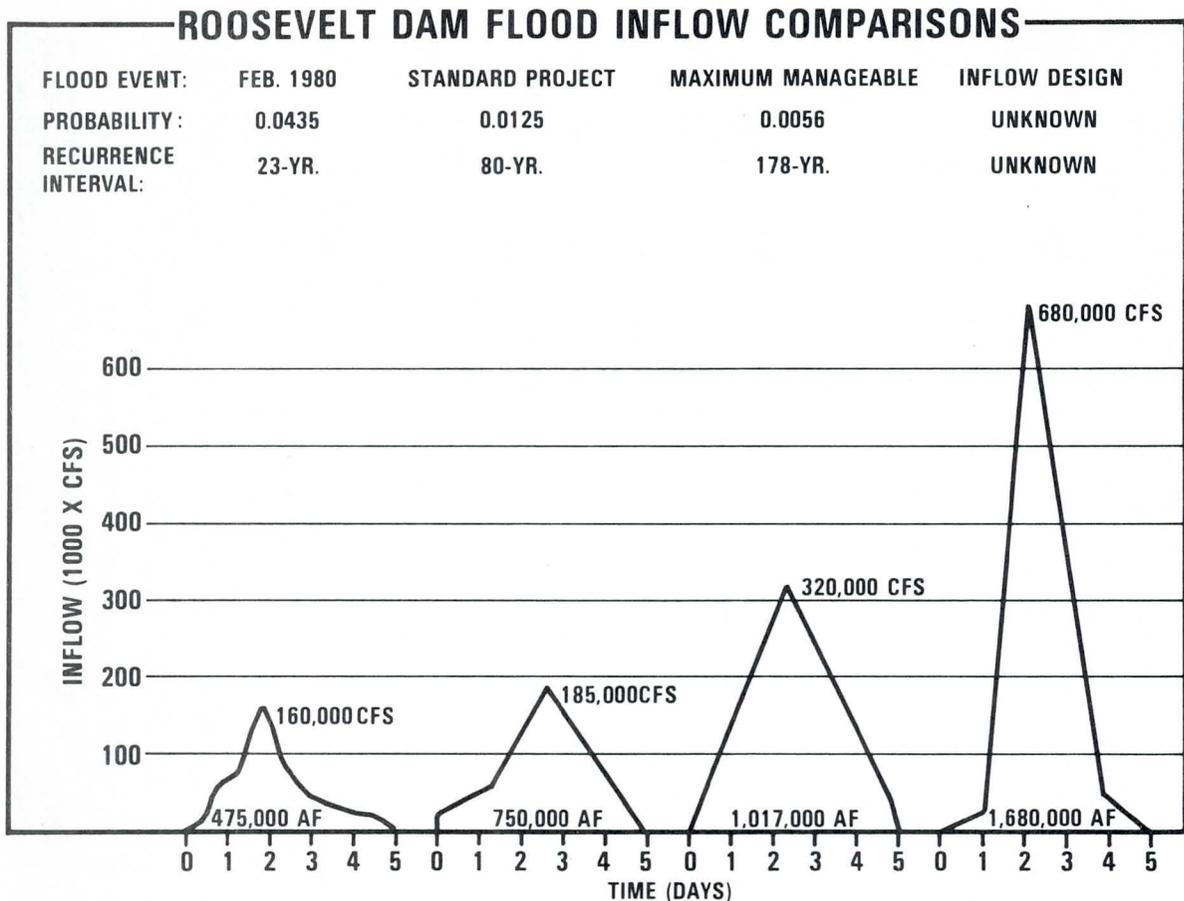
The City of Phoenix is the most vulnerable because an important portion of its water supply is stored in Horseshoe Dam, an earthen dam on the Verde River which will fail if water flows over its top.

Actually, safety problems have always existed at the SRP dams. But the technology that has identified the problems has developed since the dams were built. The dams are not "worn out" or in poor condition. In fact, SRP's dams have been well maintained and for the most part are in as good a structural condition as when they were built. SOD problems have come about as a result of updated inflow design flood (IDF) and maximum credible earthquake (MCE) data developed using techniques and studies that both the Corps and the Bureau rely on in designing modern dams. These techniques are used to evaluate the ability of the dams to withstand hydrologic and seismic events that are rare but rational, believable and possible occurrences. The updated IDF and MCE show that the failures of both Salt and Verde river dams is a distinct possibility.

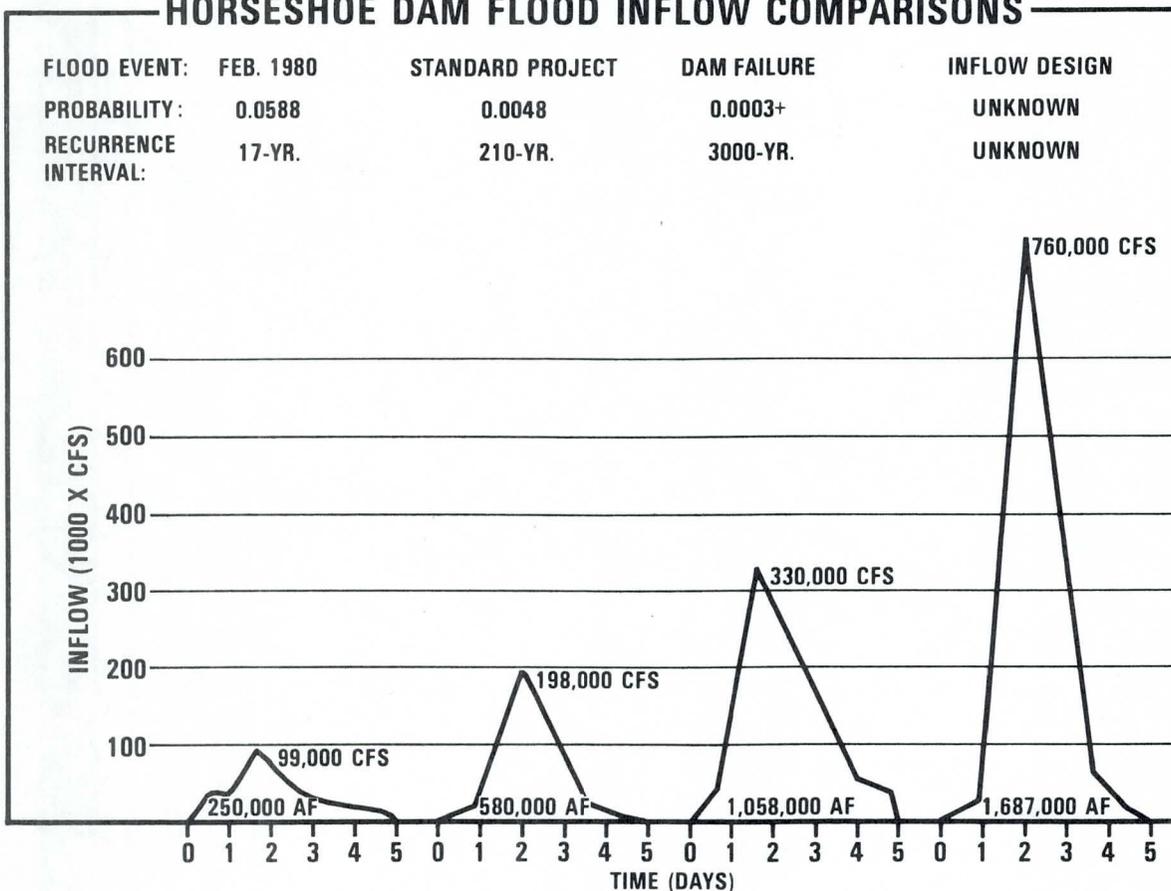
While measures must be taken to protect the dams from the updated MCE, the risk of dam failure from flooding is much more believable, particularly in view of winter storms experienced during 1978, 1979 and 1980.

And while the IDF may never occur, recent floods indicate that flows into the dams can be substantially greater than thought of at the time the dams were designed. For example, during the February 1980 storm, the peak inflows into Roosevelt were 160,000 cfs and were forecast to exceed the previous IDF of 214,000 cfs.

SRP studies indicate that the maximum floods which can be experienced without overtopping Roosevelt and Horseshoe are much smaller than the updated IDF and, therefore, they are potentially more frequent events. This demonstrates the need for early SOD action to reduce the risk to the downstream community.



HORSESHOE DAM FLOOD INFLOW COMPARISONS



Plans 4 and 5 cost more than any of the others due to the high cost of building a dam at the confluence large enough to withstand the possible failure or overtopping of the upstream dams.

Plans 4 and 5 also have the greatest impact on the Fort McDowell Reservation, and to a lesser degree, on the Fountain Hills community. Because of the cost and adverse SOD impacts, SRP does not support Plans 4 and 5.

Plan 8 Not Acceptable

SRP cannot endorse a plan which does not meet the basic objectives of providing flood control, dam safety and regulatory storage. Therefore, Plan 8, a "no action" plan, is unacceptable.

Environmental & Social Evaluation

While it is relatively easy to compare the plans on the basis of how well they satisfy the technical objectives of the study, it is extraordinarily difficult to compare the plans from an environmental and social standpoint because of the subjective judgments that must be made about the relative value of the environmental and social issues. SRP's Environmental Services Department, focusing on only environmental and social issues, developed the following ranking:

<u>Rank</u>		<u>Weight</u>
1.	Relocation (Ft. McDowell, Roosevelt, Fountain Hills residents)	28%
2.	Water Quality	20%
3.	Wildlife (Biota)	18%
4.	Public View	13%
5.	Recreation	11%
6.	Cultural Resources (historic and archaeological sites)	<u>10%</u>
		100%

The next problem is how to weigh the technical considerations against the environmental and social considerations. The relative weights of the two areas could change the results of the evaluation.

While Plan 3 clearly is technically superior, the technical difference between Plan 3 and Plans 6 and 7 is small and the costs are nearly the same. Using the rankings of the environmental and social issues developed by SRP's Environmental Department, Plans 6 and 7 would receive higher environmental and social rankings than Plan 3.

SRP feels fully qualified to rank the plans on a technical basis. However, relative ranking of significant environmental and social issues raised in the CAWCS/SOD study should reflect a broader viewpoint, such as that represented on the Governor's Advisory Committee. SRP therefore has not developed its own ranking of the environmental and social issues.

SRP does feel, however, that the public debate on the environmental and social issues has been too narrow and that the issue of water quality, in particular, has not received the attention it deserves.

Water Quality

SRP studied the effect of the candidate plans on the quality of SRP's surface water, and identified a number of problems that will result from mixing Colorado River water with SRP Salt and Verde waters.

These include increased mineral content and hardness, increased potential for formation of chloroform and similar chemicals during municipal water treatment, probable growth of undesirable algae-type water plants, particularly with a confluence reservoir, and stimulation of growth of aquatic weeds in SRP's canals and irrigation system.

The mineralization and chloroform problems would affect municipal water users with little or no impact on other users. Algae growth in reservoirs would primarily affect domestic water users--taste and odor problems--though use of the reservoir for recreation also could be affected. Increased growth of aquatic weeds in SRP's canals and irrigation system would affect all water users through the increased cost of maintaining the delivery system. The candidate plans with regulatory storage on the Salt River would have the greatest effect on water quality; these are Plans 3, 4 and 5. The plans having the least effect in order of preference are: 6, 7, 8, 2 and 1.

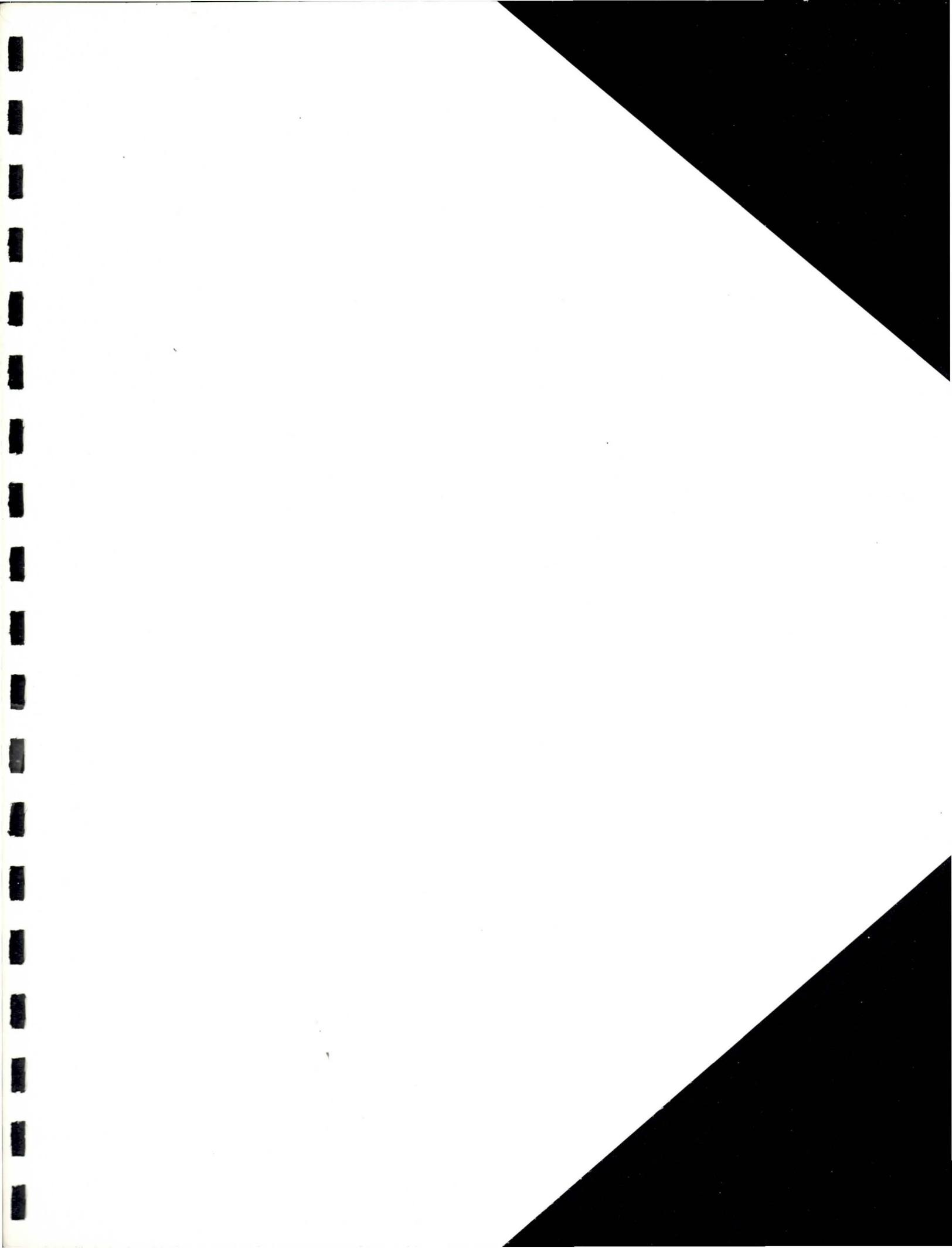
Inadequate information is available to fully evaluate the water quality issues and once a preferred plan is identified, more study will be required to develop mitigation measures.

Conclusions and Recommendations

1. SRP recommends Plan 3 as the preferred plan from a technical viewpoint if adequate funding is available to fully accomplish all of the CAWCS/SOD objectives.
2. SRP recommends Plans 6 and 7 as the second best choice.
3. SRP recommends Plan 1 as the preferred plan if a lesser appropriation is available.

Plans 1, 3, 6 and 7 all are acceptable to SRP, and all would receive SRP's unqualified support. Plans 2, 4 and 5 have serious impacts and deficiencies or excessive costs which SRP believes render them unacceptable. And a conclusion to do nothing--Plan 8--is unthinkable.

We believe that once a preferred plan is identified there are opportunities to optimize the benefits, reduce the costs and develop mitigation measures which will enhance the benefits and reduce the environmental and social impacts. SRP will continue to cooperate with the Bureau and Corps to achieve these objectives.



CAWCS "SPECIAL EDITION"

AUGUST 1981 NEWSLETTER

The CAWCS planning process has been very dynamic. Data and study assumptions and parameters have been undergoing constant scrutiny and refinement. Changes continued to occur in the USBR data after the printing of the CAWCS "Special Edition" August 1981 newsletter describing the eight "candidate plans" (*see next page*). The SRP's evaluation of the candidate plans has been based on the plans set forth in the newsletter, taking into account the following refinement:

SRP Re-regulation Deleted

Plan 2, described on page 4 of the newsletter, no longer includes SRP re-regulation as a means of providing flood control. The USBR and COE have concluded that the use of existing SRP dams for flood control is not feasible without very expensive, major modifications to the outlet works at the dams.

Data Has Been Updated

Various data was updated by CAWCS Factbook released September 23, 1981.

CAWCS FINAL PLANS

The Central Arizona Water Control Study (CAWCS) is now in the last of three stages. The efforts of the past three years have led to the development of eight "candidate" plans, including a "No Action" alternative. It is from among these that a proposed action will be selected.

The purposes of this brochure are:

- To present the candidate plans
- To identify the significant issues to be addressed in the Environmental Impact Statement.
- To present the evaluation factors critical to selection of a proposed action

A mail-in response form is included in this brochure through which you can provide input on the significant

environmental issues and comment on the plans and factors to be used in evaluating them.

PLAN DEVELOPMENT

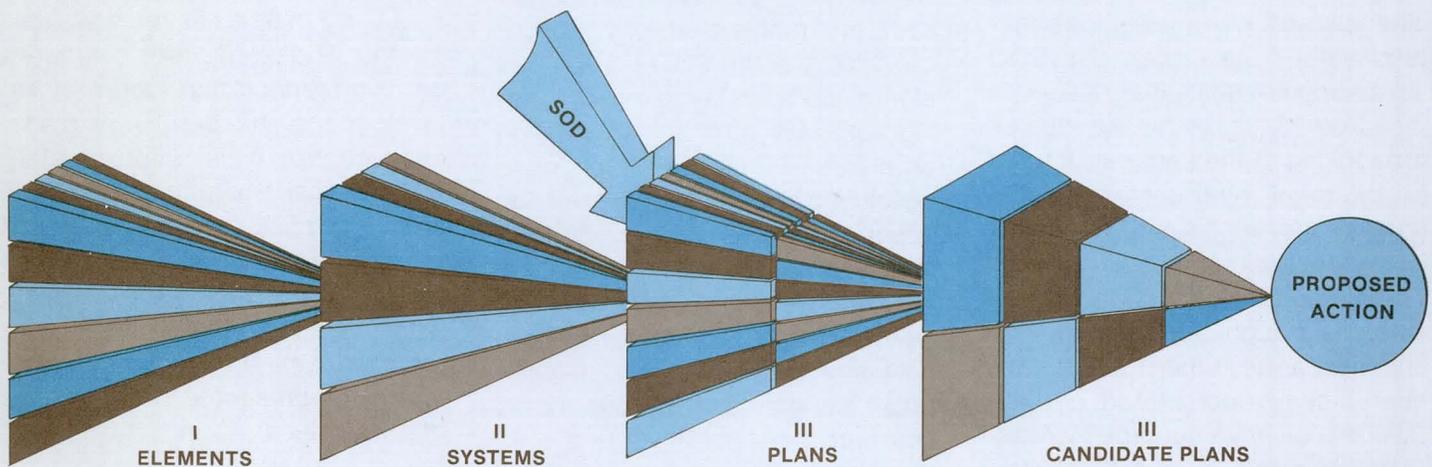
In each of the preceding stages of the CAWCS, alternatives have been continually evaluated, refined, and the number of potential solutions reduced. In Stage I, a large number of alternatives (elements) were evaluated at a preliminary level to eliminate clearly unsuitable ones. Stage I recommendations were based largely on geology, location, and economics. The major effort in Stage II was to combine the remaining elements into systems and analyze and evaluate them in greater detail. Stage II culminated in a number of recommendations for

Stage III analysis at the most detailed level. Plan development to date is documented in a Plan of Study prepared at the end of Stage I, and in a Stage II report, both of which are available for review.

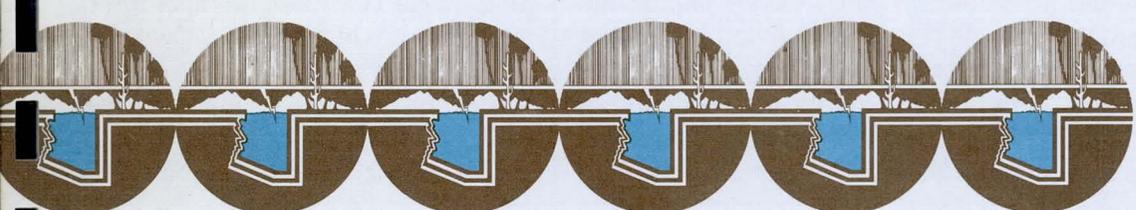
Throughout the CAWCS planning process, new and better data continually has become available, and certain issues gain or lose importance in light of new findings. At the end of Stage II, Safety of Dams considerations began to affect the development of CAWCS plans for Stage III analysis.

SPECIAL EDITION
AUGUST 1981

CAWCS PLANNING PROCESS



CENTRAL ARIZONA WATER CONTROL STUDY



Special Edition 2

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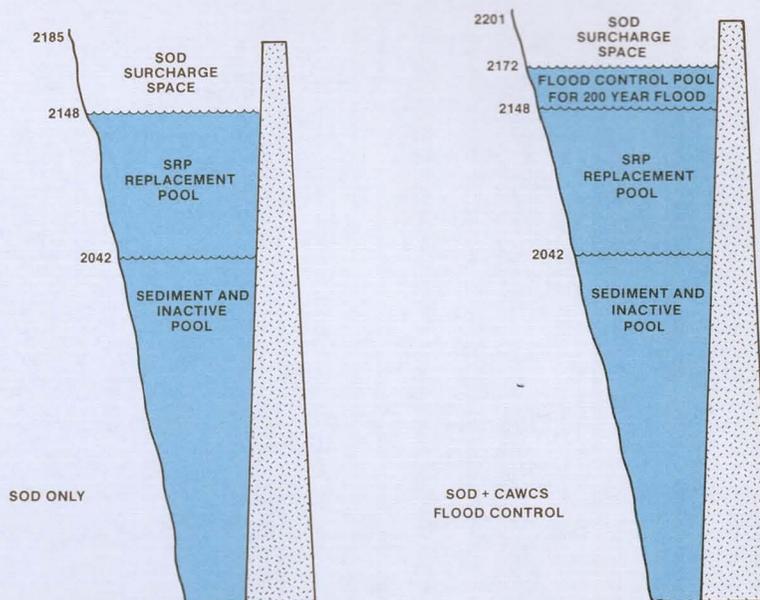
Safety of Dams Included In All Plans

Through the middle of Stage III, the development of alternatives had been aimed at meeting the major planning objectives of flood control and CAP regulatory storage, together with other study purposes such as water conservation, recreation, fish and wildlife enhancement, preservation or enhancement of social conditions, and energy management opportunities. At the same time, but under different Congressional authorization, the Bureau had been conducting a Safety of Dams (SOD) study of existing dams on the Salt and Verde Rivers.

Hydrologic analyses performed as part of the SOD study indicated that six dams on the Salt and Verde Rivers were inadequate to withstand the Inflow Design Flood without overtopping. Consequently, the Bureau has been developing and evaluating alternative ways to insure their structural safety. Obviously, any SOD solution could substantially influence the CAWCS, since the two studies are looking at the same structures on the same river systems. Additionally, the opportunity arises for joint solutions and cost-sharing. Therefore, the CAWCS and SOD study, although separate studies under separate authorizations, have been closely coordinated, and the SOD issues have become increasingly important in CAWCS plan development.

As the CAWCS schedule tightened and the need to come up with timely decisions increased, it became apparent that it was no longer feasible to wait for separate SOD and CAWCS solutions. Therefore, the Bureau widened the focus of the CAWCS to include SOD as a major objective, and all plans developed for Stage III analysis

TYPICAL DAM CROSS-SECTION



Cliff and Roosevelt are included in all plans for SOD, and in some cases for SOD plus flood control. The dam would be higher, as shown above for Roosevelt, if the reservoir included CAWCS flood control.

now consider CAWCS and SOD purposes for the best solution to both problems.

SOD Delays Considered

As CAWCS and SOD are under separate authorization, it is conceivable that the SOD portion of a plan could be delayed due to funding, authorization or implementation problems. Plans therefore were developed in which 1) a joint solution could be implemented, 2) a CAWCS solution could be implemented first with SOD delayed, or 3) CAWCS no action and SOD continues. More details on this issue are discussed under the plan descriptions in this brochure.

Ranking Identifies Candidate Plans

At the start of Stage III, only those elements considered the best to be carried forward for combination into plans remained. While the number of alternatives was greatly reduced by this time, with the inclusion of SOD it was still possible to combine them into over 100 possible plans. It would have been impractical to

evaluate such a large number in detail, so the first task in Stage III was to reduce the number of alternative plans to the most reasonable or "candidate" plans.

A ranking of alternatives was conducted. The plans were compared on seven aspects considered critical in selecting the candidate plans: flood control, water supply, safety of dams, cost, environmental impact, social impact, hydropower, and energy management. Based on the results of the ranking, the "best" were identified. These plans were then reexamined closely to insure that they represented the best range of possibilities.

Two important decisions resulted during the ranking process. Among the options under consideration in the SOD study were larger spillways, raised existing dams, new dams, and revised dam operating criteria. The analysis indicated that, when a SOD solution and CAWCS solution were combined, Cliff Dam on the Verde and New/Enlarged Roosevelt on the Salt River should be used to solve the SOD problems, as only

new dams provided the opportunity to add flood control or regulatory storage space together with a safety solution. Cliff Dam and New/Enlarged Roosevelt Dam are therefore included in all candidate plans for safety of dams purposes.

Also, at the end of Stage II, construction of a New Stewart Mountain Dam

was still under consideration for CAWCS purposes. However, further analysis showed that while it had the advantage of low environmental and social impact, when combined with other elements, it was too expensive to be considered further as a viable option. Therefore, New Stewart Mountain Dam is not included in any of the plans as a

CAWCS option. Reconstruction (constructing a new face, foundation work, and spillway) of the existing Stewart Mountain Dam for safety reasons, however, was determined to be a reasonable safety of dams solution and is included in all candidate plans, along with Cliff and New/Enlarged Roosevelt Dams, for SOD purposes.

THE PLANS

Based on the development and ranking of plans, eight candidate plans, including a CAWCS "No Action" alternative, have been identified. Some important things to note about the plans are:

- Through Stage II, a range of structure sizes was used in evaluating alternatives. For Stage III analysis, a specific size has been determined for each structure. Regulatory storage and/or flood control capacity were added in increments as long as the additional benefits justified the increased costs. Structures therefore include the economic optimum amount of storage for each plan.
- To evaluate the flood control performance of a plan, it is necessary to characterize the water discharge at some geographical location—either at the confluence of the Salt and Verde Rivers or at some point along the Salt River before it meets the Gila River. To date, flood control performance has been characterized as the reduction in the Standard Project Flood (SPF) to some target discharge at the Salt/Verde confluence. However, flows at the confluence would be affected as they travel downstream because of such factors as infiltration, evaporation, and inflows from Indian Bend Wash,

which is the last major drainage upstream of metropolitan Phoenix. Therefore, for Stage III analysis, the flood control performance will be characterized as the reduction in the 200-year flood event (290,000 cfs at the Salt-Verde confluence) to a flow at the airport, which is one of the first areas of high potential damage below Indian Bend Wash. The reduction in the 100-year event at the airport is also identified, as the 100-year floodplain is the basis for land use regulations and is important in determining intensification and location benefits of flood control.

Note in the table on page 7 that discharges are higher than have been shown in previous stages. Hydrologic analyses have been completed and the discharges shown now take into account flows from intermediate drainages (below Cliff and Roosevelt Dams and from Indian Bend Wash).

- In addition to SOD purposes, some of the plans include new water conservation space in Cliff and Roosevelt Dams to increase the CAP water supply. In the winter, some of the waters that would normally have been spilled would be stored in the new conservation space and in the summer would be delivered, when needed,

to the Salt-Gila Aqueduct. In plans that do not have a regulatory storage reservoir with direct connection to the CAP aqueduct, CAP aqueduct water would also be exchanged with SRP on a seasonal basis. CAP would deliver aqueduct water to SRP users in the winter, and SRP would store water in the winter to be supplied to CAP users in the summer.

- While the majority of the information on plans in this brochure is technical in nature, the selection of a proposed action will be based on numerous other important factors. All of the plans have environmental and social consequences associated with them which will be evaluated and included in the selection of the proposed action.

Although not described in this brochure, each plan presented will also include a recreation plan. Conceptual recreation plans are being developed at this time. All plans will feature an increased level of recreation development based on the high demand for water-related recreation in the area.

Detailed information on these and other factors considered in plan selection will be presented when analysis is complete.

For ease of understanding and presentation, the plans have been grouped under three concepts:

- Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain
- Confluence + Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain
- New Waddell + Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain

Comparative data on the plans is summarized in the table on page 7.

Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain

Plans under this concept rely on three structures: two for flood control,

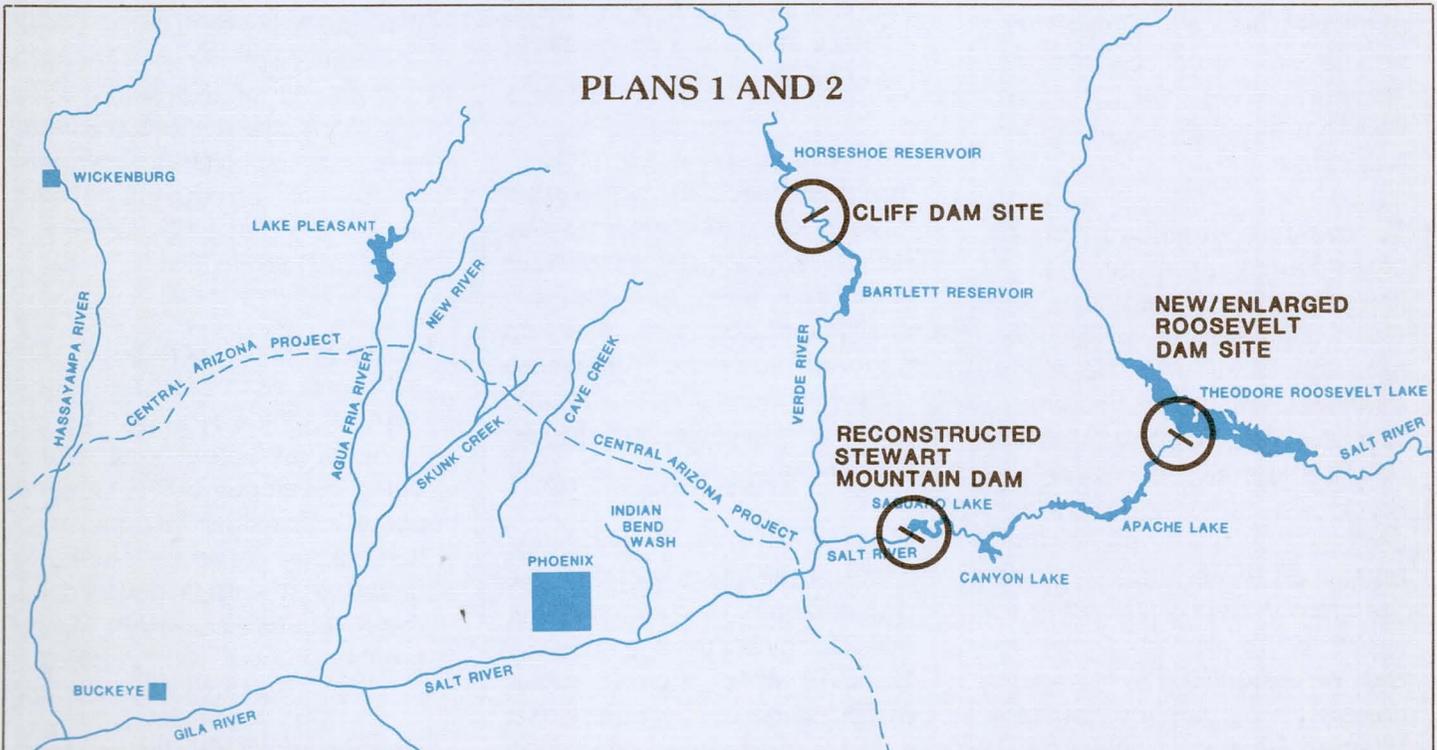
new conservation space for CAP water, and safety of dams, and one, Stewart Mountain Dam, is reconstructed for SOD purposes only.

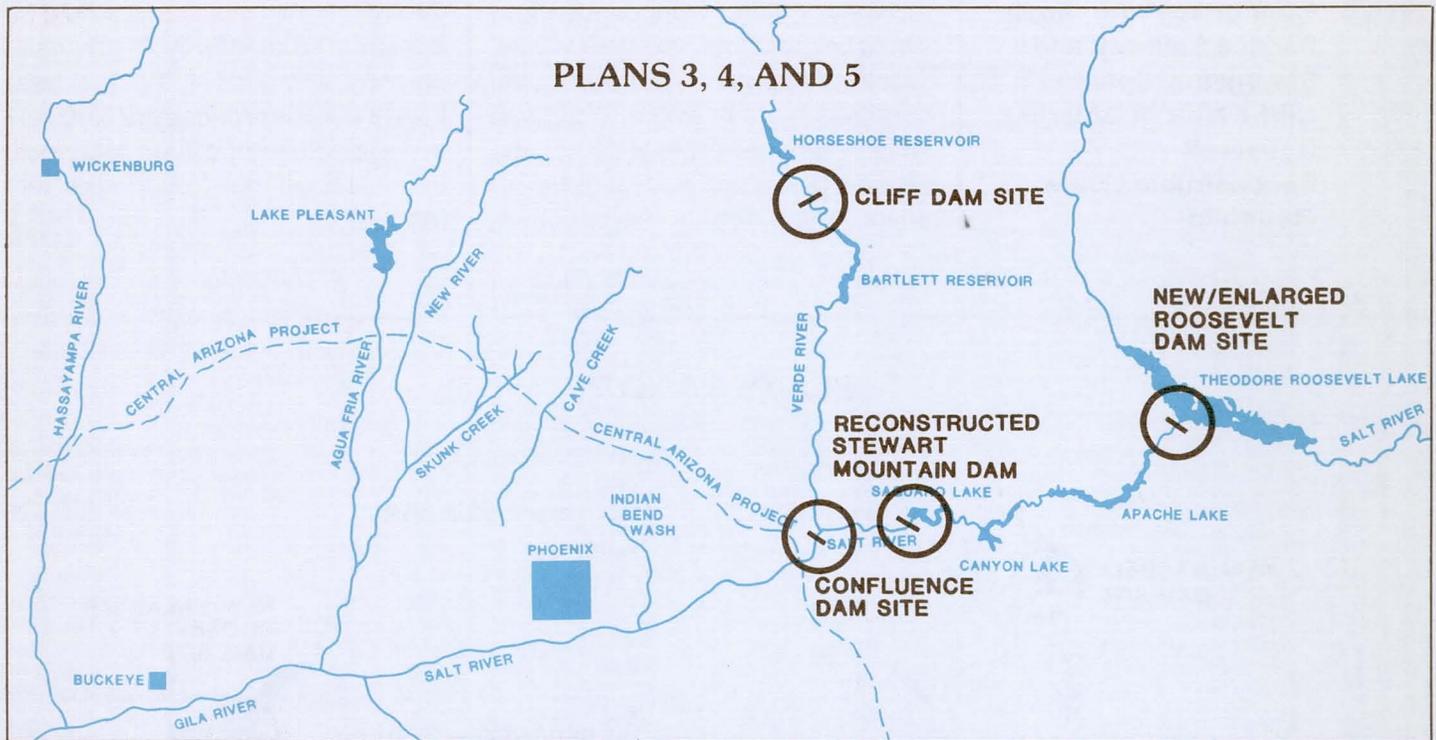
Plan 1: Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain

Under this plan, Roosevelt and Cliff would provide flood control on the Salt and Verde Rivers, respectively, and include new conservation space for CAP water, in addition to SOD. This plan would control the 200-year flood event (290,000 cfs) down to 92,000 cfs at the airport and the new CAP conservation space would increase the CAP water supply by 97,000 acre-feet per year with exchange.

Plan 2: Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain + SRP Re-regulation + Nonstructural

Under this plan, flood control would be provided by SRP re-regulation in combination with nonstructural flood damage reduction measures downstream (floodplain regulation, preparedness planning, and flood-proofing). As some water losses could result with re-regulation, groundwater recharge may be included in the plan as a possible means to mitigate these losses. Cliff and Roosevelt would be constructed for SOD purposes. No new conservation space for CAP water would be provided. With re-regulation for flood control, the 200-year flood would be reduced to a lesser extent than in Plan 1. CAP water supply could be increased by 16,000 acre-feet per year by the dual use of the new sediment pool at Roosevelt.





Confluence + Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain

All plans under this concept include a Confluence Dam. As discussed previously, delays could affect any of the plans developed; but, only in the case of a Confluence Dam would it affect the design of the structure. If a plan includes both a CAWCS and a SOD solution in the same structure (e.g., Cliff), implementation of the entire plan would be delayed if the SOD were delayed as it would not be feasible to build a structure for one purpose and then add on to it later for another purpose. However, for plans which include a Confluence Dam with SOD in a separate structure upstream, the design of the dam would differ, depending on whether SOD and CAWCS were implemented at the same time or SOD is delayed. For this reason, several confluence options had to be developed.

If SOD and CAWCS were implemented at the same time, analysis indicated that it is less expensive to put flood control in upstream structures, i.e., Cliff and Roosevelt. The confluence dam would be construc-

ted for regulatory storage. Plan 3 was developed on this premise.

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

Under this plan, Cliff, Roosevelt and a low Confluence would be constructed concurrently. Cliff and Roosevelt would provide flood control on the Salt and Verde, new conservation space, and SOD. A low Confluence Dam could be constructed for regulatory storage purposes. Routing floodwaters through this reservoir may provide some incidental flood control for the intermediate drainage below upstream dams. The 200-year flood could be controlled to between 70,000 and 92,000 cfs at the airport. Regulatory storage at the confluence and conservation space at Cliff and Roosevelt would increase the CAP water supply by 163,000 acre-feet per year.

If, however, SOD is delayed the Confluence Dam, as it is downstream of all other dams, would have to withstand the inflow design flood until the SOD solution was implemented upstream. Plans 4 and 5 have been developed for this situation.

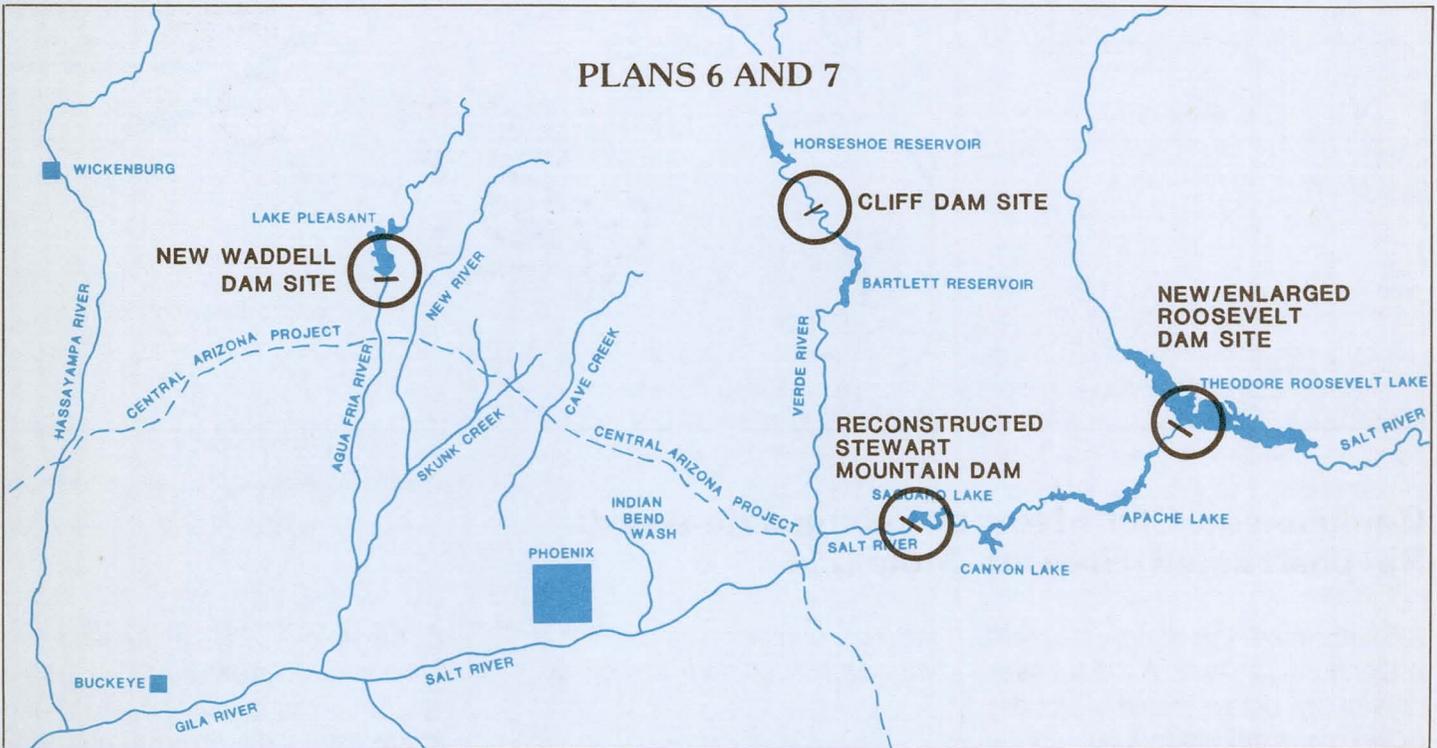
Plan 4: Confluence with a Large Spillway + Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain

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. Cliff and Roosevelt Dams would be constructed later for SOD purposes only. Under this plan, the 200-year flood would be reduced to 70,000 cfs at the airport and the CAP yield would be increased 141,000 acre-feet per year.

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

As in Plan 4, 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 emergency spillway (ungated) to ensure the safety of the structure.

Cliff and Roosevelt Dams would be constructed later for SOD purposes only. As with Plan 4, the 200-year flood would be reduced to 70,000 cfs at the airport and the CAP yield would be increased by 141,000 acre-feet per year.



New Waddell + Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain

Under these plans, regulatory storage is provided at New Waddell Dam on the Agua Fria River.

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

New Waddell would be constructed for regulatory storage only with flood control storage, new conservation space and SOD provided at Cliff and Roosevelt. This plan would control

the 200-year flood to 92,000 cfs at the airport. New conservation space at Cliff and Roosevelt and regulatory storage at New Waddell Dam would increase the CAP water supply by 143,000 acre-feet per year.

Plan 7: New Waddell + Cliff + New or Enlarged Roosevelt + Reconstructed Stewart Mountain

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 regulatory storage at New Waddell would be used for recreation and

fish and wildlife conservation. This plan would control the 200-year flood to 92,000 cfs at the airport. The increase in CAP water supply as a result of this plan is expected, due to system losses, to be less than 143,000 acre-feet per year.

Plan 8: CAWCS "No Action"

With this option, CAP would be constructed, but no CAWCS regulatory storage or flood control would be provided. SOD studies would continue to select a preferred SOD solution which may differ from the Cliff/Roosevelt combination. The "No Action" alternative provides the baseline against which all other plans are compared.

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SUMMARY OF PLANS*

PLANS	PURPOSE			PLAN PERFORMANCE			ESTIMATED CONSTRUCTION COST ³ (\$ millions—Jan. 1981)
	FLOOD CONTROL	REGULATORY ¹ STORAGE	SOD	FLOOD CONTROL (reduced flow @ airport—cfs)		REGULATORY STORAGE ² (increase in CAP water supply—af/year)	
				200-yr.	100-yr.		
CLIFF/NEW OR ENLARGED ROOSEVELT/STEWART MT.							
1. Cliff	x	x	x				250
New/Enlarged Roosevelt	x	x	x	92,000	55,000	97,000	130
Reconstructed Stewart Mt.			x				30
							<u>410</u>
2. Cliff			x				?
New/Enlarged Roosevelt		x	x	To be determined		16,000	?
Reconstructed Stewart Mt.			x				?
SRP Reregulation	x						?
Nonstructural	x						?
CONFLUENCE/CLIFF/NEW OR ENLARGED ROOSEVELT/STEWART MT.							
Concurrent							
3. Cliff	x	x	x	92,000 to	55,000 to		225
New/Enlarged Roosevelt	x	x	x	70,000 ⁴	50,000 ⁴	163,000	120
Reconstructed Stewart Mt.			x				30
Confluence	x	x					270
							<u>645</u>
SOD Delay							
4. Confluence w/large spillway	x	x					660
Cliff			x	70,000	50,000	141,000	210
New/Enlarged Roosevelt			x				110
Reconstructed Stewart Mt.			x				30
							<u>1010</u>
5. Confluence w/emergency spillway	x	x					590
Cliff			x	70,000	50,000	141,000	210
New/Enlarged Roosevelt			x				110
Reconstructed Stewart Mt.			x				30
							<u>940</u>
NEW WADDELL/CLIFF/NEW OR ENLARGED ROOSEVELT/STEWART MT.							
6. New Waddell		x					245
Cliff	x	x	x	92,000	55,000	143,000	240
New/Enlarged Roosevelt	x	x	x				130
Reconstructed Stewart Mt.			x				30
							<u>645</u>
7. Same as Plan 6 w/new water used for environmental enhancement	Same as 6	Same as 6	Same as 6	Same as 6	Same as 6	Expected to be less than 6	645
CAWCS No Action			x			—	—

¹Some plans include new water conservation space at Cliff and Roosevelt in addition to SOD to increase CAP water supply.
²Additional water made available by operation of the plan in conjunction with CAP. It is *not* total storage volume.
³Includes Safety of Dams costs.
⁴Incidental flow reduction by routing through confluence.
*Subject to change

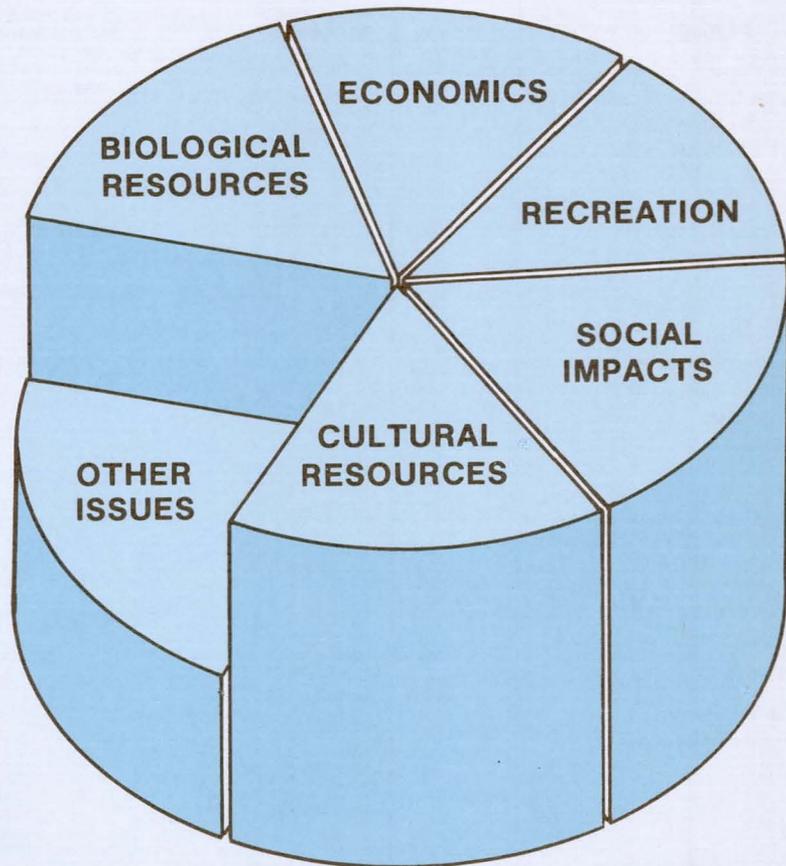
SCOPING THE ENVIRONMENTAL STATEMENT

The National Environmental Policy Act (NEPA) requires that an environmental impact statement (EIS) be prepared. The EIS displays the significant environmental and social impacts of all the candidate plans. One of the NEPA requirements is that a "scoping" process be held to determine the range of alternatives and the significant issues related to proposed actions to be addressed in the EIS. Since the CAWCS has been underway since 1978, considerable input has been received from interested and affected Federal, State, and local agencies, Indian Tribes, and other groups and individuals. Consequently, no formal public scoping meeting will be held, although interested parties will have the opportunity to participate in scoping the EIS.

The draft EIS will present the environmental consequences of the candidate plans in comparative form so the public and decision-makers can clearly see the differences among the plans. The proposed action will be identified in the EIS, but the impacts of this plan will not be described in any more detail than the impacts of the other alternative plans.

The EIS will be limited in length to 300 pages and will be scoped so that only significant environmental impacts will be described in detail. Insignificant impacts will be summarized or referenced.

Because of the limited length of the EIS, the descriptions of the candidate plans will be presented in sufficient detail to understand the impacts, but detailed descriptions of the physical features associated with the plans will not be provided. Detailed descriptions of the plans will be made available in other documents and clearly referenced in the EIS.



ISSUES TO BE ADDRESSED IN THE EIS

Lengthy descriptions of the affected environment will also not be included in the EIS. A brief profile of the regional environment will be provided, and descriptions of significant affected resources will be included. These descriptions will not be overly detailed, but they will provide enough information to understand the impacts. Inventories of the affected resources will be provided in supporting documents to the EIS.

The EIS will be limited to an assessment of the eight candidate plans, including a "No Action" alternative, and will not include a detailed assessment of alternatives screened out during the course of the planning study. The EIS will not address any impacts of the Central Arizona Project except those caused specifically by the plans being evaluated.

Significant Environmental Issues

Significant issues are matters of public, technical, and institutional concern related to the candidate plans. The significant issues shape the impact assessment and focus the comparison of alternatives for the decision-makers. The following environmental issues are currently identified as significant and will be addressed in detail in the EIS. Additional environmental issues may be identified as a result of public input in response to this brochure.

Biological Resources

Issues in biological resources relate to potential impacts to protected or high-quality resources, including endangered species such as the bald

eagle and Yuma clapper rail, riparian wetland communities, perennial stream communities, and lake communities. The EIS will assess beneficial and adverse impacts to these resources, as well as to desert communities and special use and management areas.

Exhaustive lists describing wildlife and vegetation in Central Arizona will not be included in the EIS, but the affected resources will be described in enough detail to understand the impacts. Inventories of affected biological resources will be included in an appendix to the EIS. Special biological studies will be conducted to meet the requirements of Section 7 of the Endangered Species Act and the Fish and Wildlife Coordination Act.

Cultural Resources

Issues related to cultural resources involve the potential loss, degradation, or enhancement of prehistoric and historic resources because of project actions. Prehistoric resources are sites and associated artifacts which date before the time of written records in the area and which represent Native American cultures and societies. Historic resources are sites and properties which were occupied after the time of available written records. The importance of these resources lies in their potential to yield valuable historical information as well as the pre-recorded history of the area. Data used in the impact assessment will be derived from surveys of the site areas. The assessment will be performed to meet the requirements of Section 106 of the National Historic Preservation Act, which requires that Federal agencies take into account the effects of their actions on properties included in or eligible for the National Register of Historic Places. The full Section 106

consultation process will be initiated on selection of the proposed action.

Recreation

Issues in recreation focus on the potential loss of stream-oriented recreation, such as tubing on the lower Salt River, and the potential gain of reservoir-oriented recreation. The impact assessment will be scoped to address the changes in the water-related resources, facilities, and activities that would be caused by project actions.

Social Impacts

Issues related to the social assessment involve impacts expected to occur both at the site of proposed structural alternatives and regionally throughout the study area. The site-specific impacts are those associated with relocation of resident populations within the site area. The impacts resulting from the stress of potential forced changes in lifestyle will be addressed both as they apply to individuals being relocated and to the relocated community itself. Emphasis will be placed on identifying the specific nature of the population groups affected and their ability to cope with changes in lifestyle and setting. Regional impacts are associated with reduction of floods in the Salt-Gila River drainage in central Arizona and changes in recreation use patterns. Impacts on transportation, health and safety, emotional and physical well-being, and inundation and evacuation will be addressed. For recreation, the induced social impacts of the changes in recreation opportunities from the potential reduction of flowing water recreation activities and increases in flat water recreation will be examined.

Economics

Candidate plans will be evaluated on the basis of their economic justifi-

cation, i.e., the extent to which positive net benefits exist. Benefits to be analyzed include flood control inundation reduction, location and intensification benefits, energy management and hydropower benefits, increased water supply, recreation, and fish and wildlife enhancement.

Other Issues

In addition to the significant issues described above, other environmental issues will be identified briefly in the EIS. But, they will not be addressed in detail because they are not considered to have a significant impact on the environment. They are:

- *Water Quality:* The focus of the water quality assessment will be mainly on probable changes in concentrations of water quality constituents caused by mixing CAP water with local surface water in a regulatory storage reservoir. In addition, the potential for eutrophication in reservoirs where mixing occurs will be evaluated.
- *Visual Quality:* The assessment will identify changes in visual resources (creation of new resources, loss of existing resources), considering flowing streams, flat water, lake fluctuation, changes in vegetation, and placement of structures.
- *Sound Quality:* Increases in noise that could affect people and wildlife are likely to occur because of blasting, construction, excavation, and pumping activities in the site areas. The impacts of changes in noise levels will be assessed on wildlife, residential areas, and recreational areas.
- *Land Quality:* The land quality assessment will focus on the compatibility of land uses associated

with the plans and the potential for conversion of land to more intensive uses, particularly in the floodplain.

- *Geological Resources:* Potential impacts to sand and gravel resources and prime agricultural farmland will be assessed. Detailed

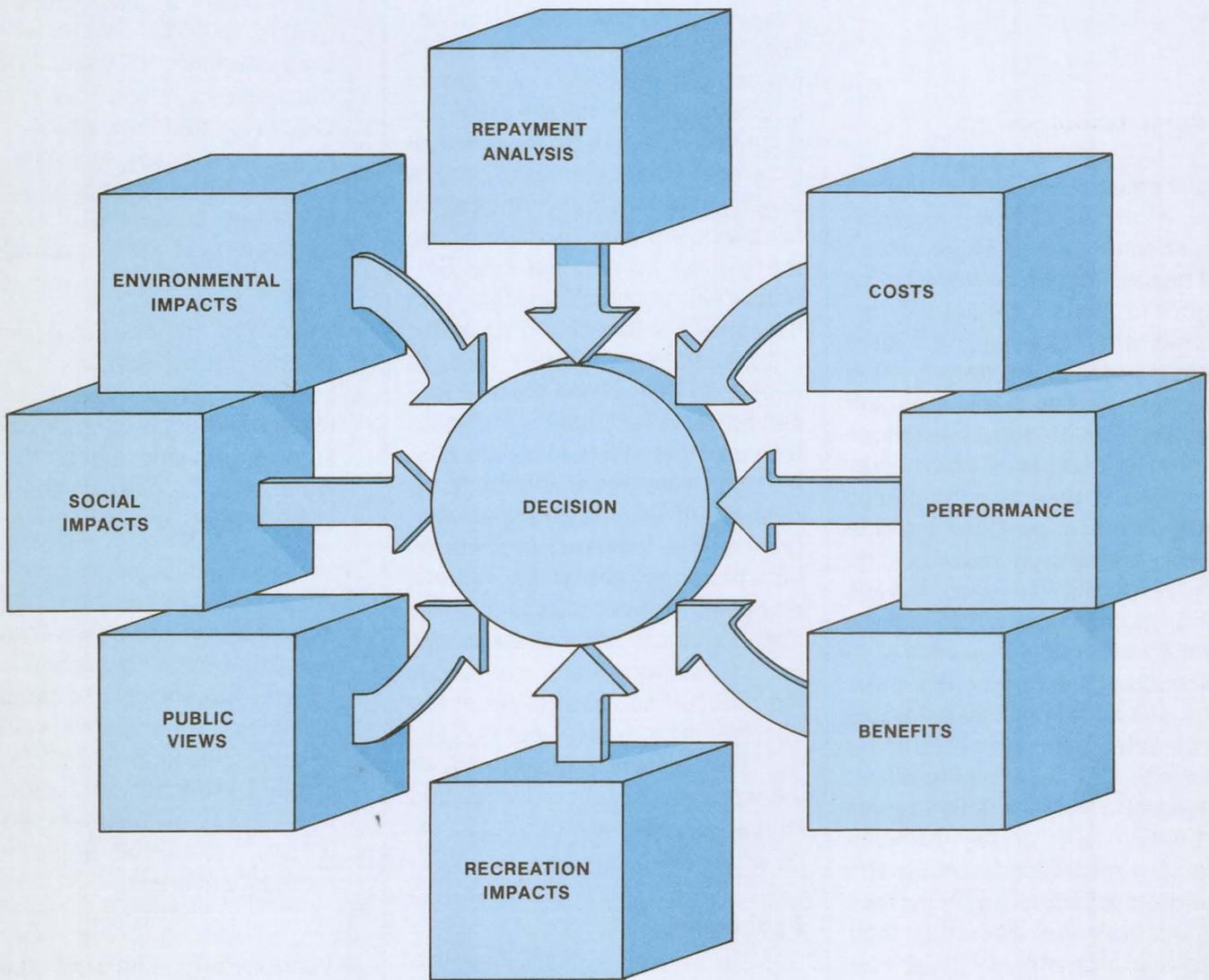
descriptions of geologic setting, seismicity, and other geological resources will not be included in the EIS.

PLAN EVALUATION AND SELECTION PROCESS

Through the end of August, plan impacts will be evaluated and design and cost estimates will be developed. Meetings with the public and the Governor's Advisory Committee will be held at the end of September to review and obtain public views on the plans. Then in early October, a ranking of plans will be conducted, the result of which will be a staff recommendation on a proposed action.

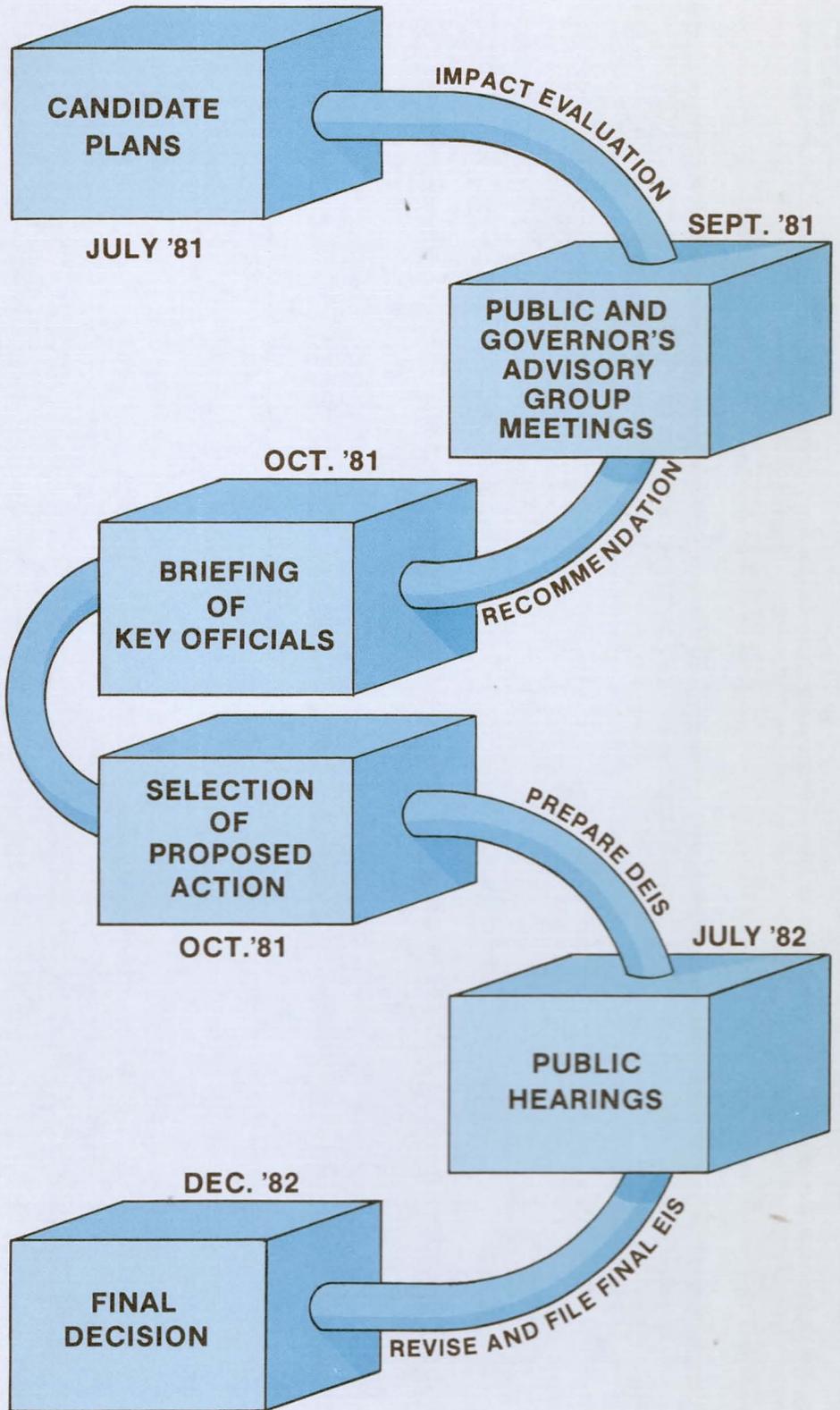
A list of evaluation factors has been identified by the Bureau. These evaluation factors are those considered to be critical in selecting a proposed action based on results of technical analyses and public involvement efforts to date. Comments on the factors can be made on the mail-in response form included in this brochure. The plan evaluation factors are:

- Yield (increase in CAP water supply and associated benefits)
- Energy management (providing regulatory storage to use energy in a more efficient way)
- Flood control (reduction in flood flows, associated benefits, and impacts on people)



PLAN EVALUATION FACTORS

- Safety of Dams (ability to meet dam safety requirements for existing structures)
- Recreation (reservoir and stream recreation use)
- Threatened and endangered species
- Riparian/wetland habitat
- Perennial stream habitat
- Lake habitat
- Prehistoric cultural resources
- Historic cultural resources
- Non-Indian relocations (due to land acquisition)
- Indian relocation (due to land acquisition)
- Public views of plans (based on results of an assessment of public values and other public involvement activities)
- Construction cost (cost of physical features)
- Total annual cost (construction cost plus interest during construction amortized over the life of the project, plus operation, maintenance, and replacement)
- Net economic benefits (difference between benefits and costs)
- Total nonreimbursable cost (federal government's obligation)
- Central Arizona Water Conservation District net repayment obligation (amount the District pays back to the federal government through property taxes and water charges)

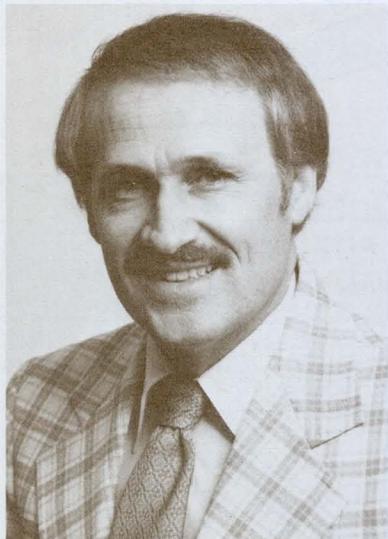


CAWCS SCHEDULE

Throughout October, briefings of key officials in the Department of Interior and the Congress will be held. At the end of October, the Regional Director of the Bureau's Lower Colorado Region will announce his selection of the proposed action.

A draft Environmental Impact Statement (EIS) will then be prepared describing the significant impacts of the candidate plans. The EIS process will take about a year. The final decision will be made in December 1982.

Hinds to Select Proposed Action



Eugene Hinds is Regional Director of the Bureau's Lower Colorado Region. As such, he is the person who, at the

end of October, will select the proposed action in the Central Arizona Water Control Study. The selection will take into consideration the staff recommendation, comments from the public meetings and the Governor's Advisory Committee and will further be based on consultations with Bureau and Corps officials, Department of Interior officials, the Congressional Delegation and the Governor.

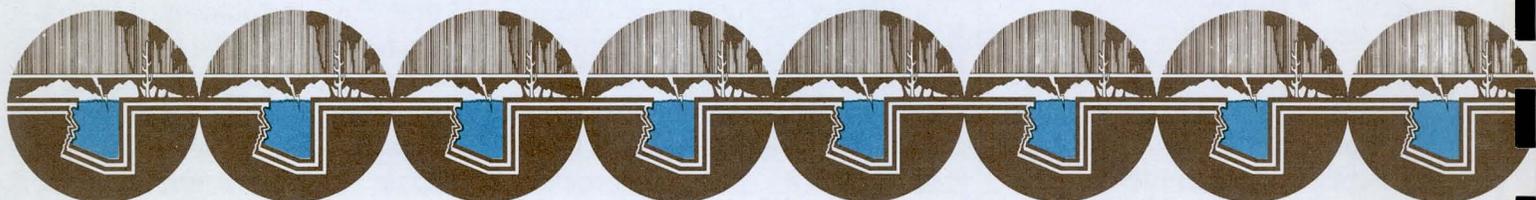
Hinds directs the Region's large planning, construction, operation and maintenance activities throughout the Pacific Southwest. He began his over 23 years of Federal service in 1956 with the Bureau of Indian Affairs in Tuba City, Arizona, and joined the Bureau of Reclamation five years later in Phoenix.

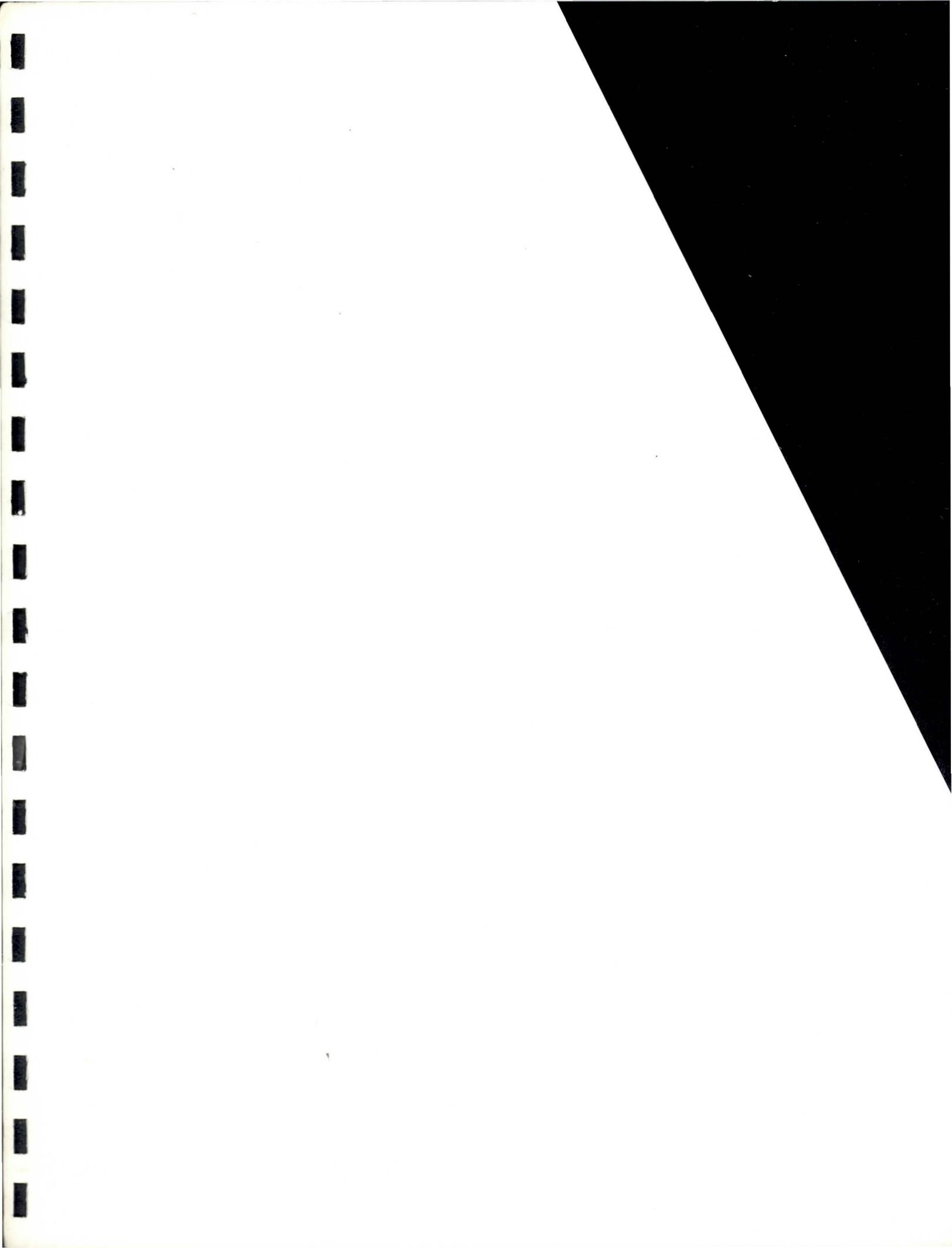
In 1964 Hinds moved to the Southern California Development Office in San Bernardino as Chief, Division of Economics and Land Resources. Two years later he transferred to Lower Colorado Regional headquarters in Boulder City to become Chief, Economics and Repayment Branch, Division of Water and Land. He was called to Washington, D.C. in 1975 to serve as Assistant Chief, Division of Water and Land of the Commissioner's staff and was later selected to head the Commissioner's Operation and Maintenance Policy Staff. In 1978 he transferred to the Lower Missouri Region headquartered in Denver as Assistant Regional Director, and a year later he returned once again to Boulder City to assume the position of Regional Director of the Lower Colorado Region.

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GLOSSARY

ADWR	Arizona Department of Water Resources
AWC	Arizona Water Commission (now ADWR)
CANDIDATE PLAN	A combination of structures and other features being considered as an alternate to Orme Dam.
CAWCS	Central Arizona Water Control Study
CFS	Cubic feet per second
COE	U. S. Army Corps of Engineers
COMINGLE	To mix or mingle water of different origins
CONFLUENCE STRUCTURE	A structure below the junction of the Salt and Verde rivers (Orme site)
CONSERVATION STORAGE	Long-term storage to impound water for beneficial uses
DAM HEIGHT (Hydraulic)	Difference in elevation from the bottom of reservoir to the dam crest
DAM CREST ELEVATION	Top of dam (elevation above sea level)
EIS	Environmental Impact Statement
IDF	Inflow design flood. The maximum runoff, in peak flow, that could ever occur in a watershed under extreme climatological and meteorological conditions. Previous IDF for: New IDF for: Salt 214,000 cfs Salt 680,000 cfs Verde 237,000 cfs Verde 760,000 cfs
MCE	Maximum credible earthquake. The largest earth movement which can be reasonably expected to occur at a given location.
NON-STRUCTURAL ELEMENT	One which does not require construction or modification of a dam
PARAPET	A wall built on a dam crest (usually the maximum dam height)
REGULATORY STORAGE	Reservoir storage provided for the temporary storage of CAP water in excess of current demands. (Extra Colorado River water can be pumped during winter months for utilization during summer months when demand will exceed aqueduct capacity.)

