IV. ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

IV. ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

This chapter includes a description of the environmental consequences of the alternative plans, focusing on the significant resource categories identified during scoping. This description summarizes the analysis in a large number of CAWCS supporting documents, including Stage III Methodology for Environmental Quality Assessment, Environmental Impacts and Effects of Plans (7 vols.), Social Impacts and Effects of CAWCS Plans, and Economics-Financial Supporting Document. A brief precis of each major supporting document is provided at the end of the reference list.

All the information in this chapter is extracted from the supporting documents, and therefore these documents should be consulted for more detailed information. A set of the supporting documents is available at the following Bureau of Reclamation locations: Arizona Projects Office, Phoenix Arizona; Engineering and Research Center, Denver, Colorado; Lower Colorado Regional Office, Boulder City, Nevada; and Office of the Commissioner, Washington, D.C.

A. Methodology

During CAWCS, methodologies were developed to meet the specific purposes of each of the stages in the study. For example, in Stage II of the study, when a large number of elements were evaluated, the methodology emphasized the development of adequate information to make decisions among a large array of alternatives. Detailed field surveys were not conducted for use during Stage II, and the impact assessment focused on using one or two indicators in a resource category to assess the impact.

At the beginning of Stage III, methodologies were developed that could be used for detailed evaluations of plans and that would provide the level of detail needed for preparation of the environmental impact statement. The methodologies balanced the need for detail against the requirement that the impacts be assessed for entire plans, so that they could be compared to each other. Since each plan contains at least three elements (dams), the methodologies provided a way to aggregate impacts and report the overall impact of the plan. Temporary, localized impacts were deemphasized with this approach, since the objective was to assess in detail the significant impacts that distinguished among the plans.

A detailed description of the methodologies used in the Stage III assessment may be found in the Stage III Methodology for Environmental Quality Assessment and Social Impacts and Effects of CAWCS Plans (Chapter 1).

1. Impact Assessment

The procedure for assessing impacts of the plans involved aggregating impacts of the elements (Cliff, New/Modified Roosevelt, New/Modified Stewart Mountain, Confluence, New Waddell Dams, Verde River Dams Modifications) that compose the plans. A more complete discussion of the separate impacts for each element may be found in the environmental, social, and economic supporting documents cited above.

The impact assessment methodology consisted of a series of steps whereby environmental conditions without the project were compared to conditions with the project. The measured difference between the two conditions for a factor (i.e., stream-oriented recreation) is the impact. The baseline condition without the project is a projection of all the relevant environmental factors into the year 2000. This future-without condition would occur if there was no project action and is therefore the condition associated with Plan 8, the No Action Alternative. The condition that would occur with each of the action alternatives (Plans 1, 2, 3, 6, 7) was compared against this future-without condition to arrive at the impact.

All aspects of project action were considered in assessing impacts, including construction activities such as borrow, roads, vegetation clearing, materials hauling, reservoir inundation, operation/maintenance, and secondary use. The project actions described in Chapter II detail the actions included in the impact assessment. Areas and facilities included in the assessment are shown on Plates 1 through 10.

A major source of environmental impact is reservoir inundation. Within a given reservoir, space can be dedicated for sediment, replacement storage (if the reservoir replaces an existing reservoir), new conservation, flood control, and flood surcharge. Reservoir impacts vary by environmental resource and depend on the frequency and duration of inundation. Figure IV-1 shows the various pools used in the CAWCS impact assessment and indicates the frequency of inundation associated with each. The precent of time pools are at various elevations over the life of the project is shown in Appendix C.

While all of the pools in a reservoir were used to assess impacts, the typical-year was used to "anchor" the assessment in most of the resource evaluation. The typical year scenario represents conditions that are expected to occur during most years when normal operations of all water delivery systems occur and normal runoff is experienced on both the local and Colorado River watershed. There would be no flooding or abnormal low flows in a typical year. CAP water users would take their allocations by priority and there would be no failures in any delivery systems. The typical-year variation in pool level (from high in the spring to low in late summer) describes the annual water fluctuation that affects a number of resources, including vegetation, fisheries, recreation, prehistoric and historic remains, and water quality.

Conservation pools and flood storage pools above the typical-year high pool fill less than annually. The conservation pools include replacement pools, new conservation for CAP, and regulatory storage for CAP. In the CAWCS analyses, the top of all types of conservation pools is indicated as the Maximum Storage Pool (MSP) elevation. The flood pools vary dramatically in size depending on the amount of storage available when the reservoir begins to fill with flood waters. The 200-year flood pool was used in CAWCS to indicate the maximum flood retention pool.

Many of the dams in CAWCS plans have been sized to suppress extraordinarily large floods by storing flows temporarily in flood surcharge space, rather than passing the flows over enlarged spillways. The area where these flows could theoretically be stored is the Inflow Design Flood (IDF) area. Impacts of IDF inundation are treated hypothetically in most resource

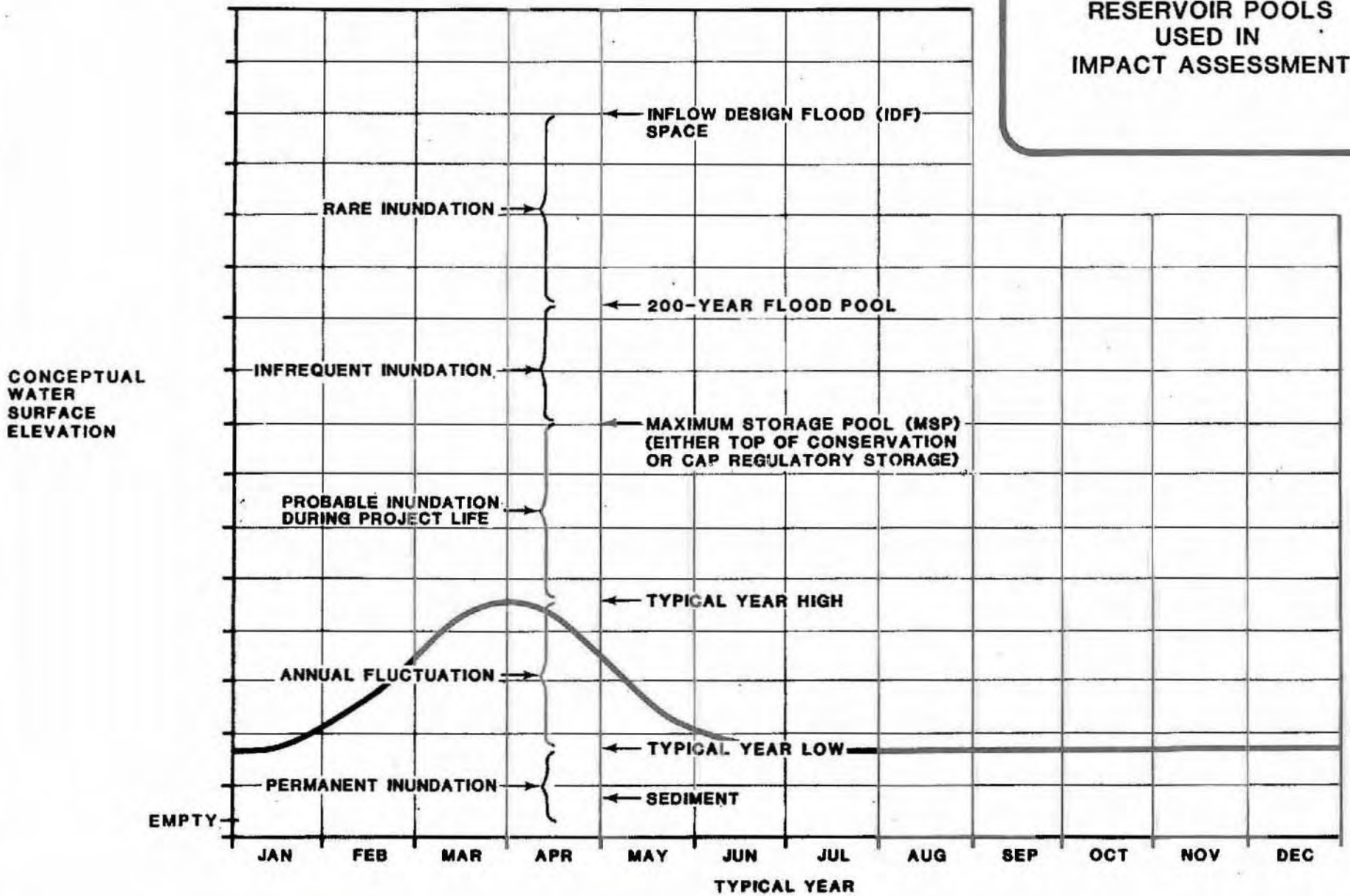
RESERVOIR POOLS
USED IN
IMPACT ASSESSMENT
INFLOW DESIGN FLOOD (IDF)
SPACE
RARE INUNDATION
200-YEAR FLOOD POOL
INFREQUENT INUNDATION
MAXIMUM STORAGE POOL (MSP)
(EITHER TOP OF CONSERVATION
OR CAP REGULATORY STORAGE)
PROBABLE INUNDATION
DURING PROJECT LIFE
TYPICAL YEAR HIGH
ANNUAL FLUCTUATION
TYPICAL YEAR LOW
PERMANENT INUNDATION
SEDIMENT
CONCEPTUAL
WATER
SURFACE
ELEVATION
EMPTY
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
TYPICAL YEAR

FIGURE IV-1

evaluations because a flood of this magnitude would occur very rarely, if ever.

All pools in the reservoir could conceivably affect resources, but the probability of impact decreases with pools higher than the typical-year high pool. For this reason, most impact descriptions in the EIS present typical-year impacts as the most probable and permanent of the reservoir impacts. The impacts of other pools are usually shown as a range, to indicate the potential extent of impact associated with the project.

For all resources, the same pools were used to make without-and with-project comparisons. For example, the typical-year future-without pool at Horseshoe Reservoir was compared to the typical-year future-with pool at Cliff Reservoir to calculate losses and gains in stream miles and habitat acreage. The pools used in the analysis are indicated in each of the impact evaluations in Section B of this Chapter.

2. Effects Evaluation

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

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

Criteria for determining effects were developed for each resource category during Stage III. The criteria were reviewed with agency representatives and professionals in the resource area. In most cases, several meetings were held to review and finalize the criteria. For some resource areas, no quantified numerical criteria could be agreed upon by the committee, but the effects were assigned by consensus. The process used to establish criteria and the criteria for each resource area are described in the Stage III Methodology for Environmental Quality Assessment.

3. Conceptual Mitigation

Mitigation concepts were developed for the impacts in each of the resource areas. These concepts are workable mitigation measures that could reduce or avoid impacts if implemented. They are conceptual, rather than specific, because they were developed to apply equally to impacts of all plans. The mitigation concepts provide a way to estimate the degree to which the impacts can be mitigated, and therefore provide another point of comparison among plans. For example, application of a mitigation concept to the impact of one plan could reduce the impact significantly, but it might not reduce the impact for another plan. The potential for mitigation is therefore indicated in a traceable and quantifiable way through the use of mitigation concepts.

With the selection of Plan 6 as the agency proposed action, Reclamation has developed a specific mitigation program. This process has begun, but the program is not complete. Section C. of this chapter describes the mitigation program for Plan 6.

B. Impacts of Plans

1. Biological Resources

a. Methodology

The Stage III methodology for biological resources focuses on six resource factors: 1) Riparian/Wetland Biotic Communities, 2) Other Terrestrial Biotic Communities, 3) Perennial Stream/Riverine Aquatic Communities, 4) Reservoir Aquatic Communities 5) Threatened and Endangered Plants and Wildlife, and 6) Management and Special Use Areas. These factors "capture" impacts to highly valued resources of riparian habitat, flowing perennial stream, and threatened and endangered species, and they permit an explicit means for assessing impacts to significant biological resources.

Data on vegetation and wildlife were compiled on the various biotic communities of the CAWCS area and were presented in the First Level Environmental Inventory (November 1979) and updated in the Second Level Environmental Inventory (April 1982). Baseline cover-type maps were prepared as Mylar overlays on 7-1/2 and 15 minute topographic maps of the site areas. Cover-type acreages were estimated by planimetric work, and faunal surveys were conducted in representative cover types to determine vertebrate wildlife composition. In addition, projections were made as to the future-without condition of the biotic resource base (see Regional Future Without the Project and Environmental Impacts and Effects of Plans).

The analytical procedure for calculating quantitative impact (i.e., the magnitude) models the difference in the resource condition with and without the project over a set of target years representing the proposed life of the project. A set of benchmark target years was established to quantify the baseline resource condition (baseline, calendar year 1980 and 1985), construction phase (1985 through 1990), and operation (post-1990 as target years 2000, 2030, and 2100). For example, construction impact

represents the integral change between 1985 and 1990 for impacts computed as follows:

I_i = Fw-Fw/o where
I_i = impact for target year i
Fw = resource measure for future with the project at target year i
Fw/o = resource measure for future without the project at target year i

The future-with condition precedes the future-without condition in the equation and thus the direction of impact is also computed simultaneously with the magnitude of impact.

Habitat acreage, miles of perennial stream, lake surface acres, acres of preferred habitat of endangered species, and range resource in animal-unit-months (AUMs) were used as the quantitative measures for computing I_is. Impacts were quantified and detailed for the target year 2000, with an estimate made as to the magnitude and duration of the impact to 2100.

The delineation of the site area for the Verde River Dams Modifications increased the total acres slightly in the various habitats for the future-without-the-project. However, these increases did not affect the determination of impacts. To avoid confusion the acreages for Plan 8 were not changed, future-without acreages for Plan 9 are presented in parentheses.

Conceptual mitigation recommendations were developed with coordinated support of the biological advisory team. Prioritized levels of mitigation are as follows: 1) mitigation through modification of proposed operation and feasible changes in construction activities, 2) institution of plan mitigation projects directed toward habitat modification and wildlife enhancement, 3) interagency coordination toward existing and proposed conservation, land management, and fish and wildlife management programs, and 4) special effort toward land acquisition or other forms of compensation to offset impacts which cannot be mitigated through other levels of effort.

Residual impacts were computed as the quantitative difference between the unmitigated impact and the quantitative mitigation effort.

Effects were assigned to unmitigated and mitigated impacts using criteria developed in consultation with the biological advisory committee (see Stage III Environmental Quality Assessment Methodology, Section 2.0).

Data generated for the impact analyses were also used as the quantitative input for the Habitat Evaluation Procedure (HEP) that was conducted under the direction of the Fish and Wildlife Service, Phoenix Office. The HEP analysis is being used to develop specific mitigation

measures for fish and wildlife impacts on Plan 6. A report documenting the HEP analysis and mitigation recommendations is in preparation by the Fish and Wildlife Service.

The status of threatened and endangered species was investigated and an assessment of project-related impacts to these species was completed in compliance with Section 7 of the Endangered Species Act. Findings are documented in A Biological Assessment of Endangered Species (November 1982). The U.S. Fish & Wildlife Service's biological opinion, based on the biological assessment, regarding project impacts to endangered species is included in Appendix F.

b. Types of Impacts to Biological Resources

Plan actions could directly modify biological resources through construction, inundation, and dam operation. Planned recreational facilities, new and improved roads, and larger lakes are expected to attract greater numbers of people into the site areas with the subsequent effect of habitat loss and human encroachment on wildlife (including the possibility of increased poaching and disturbance of nesting raptors, etc.). The direct impacts represent primarily quantitative gains or losses of resources. Indirect impacts represent changes to resource quality. For example, the quality of desert habitat would be affected by the probable decrease in numbers of long-lived cacti within 100-year flood pools.

(1) Construction and Inundation Impacts

Construction impacts (disruption of soil surface and removal of vegetation for borrow areas, clearing, roads and facilities, etc.)were evaluated for all site areas. Inundation impacts were evaluated for four reservoir pools and, therefore, four levels of potential impact. These are: 1) the characteristic impoundments for a typical year, 2) the impoundments at maximum storage capacity (MSP), 3) the 200-year flood pool, and 4) the maximum Inflow Design Flood (IDF) area (see Figure IV-1).

Although vegetation would be cleared to the MSP level during construction of reservoirs in all plans, some habitat recovery could take place within the zone between the typical-year high pool and the MSP. The recovery vegetation would consist largely of low-quality mixed scrub and salt-cedar habitats, however. Although growth of recovery vegetation would partially offset the acreage loss of riparian/wetland habitat, the low habitat quality of mixed scrub vegetation would not fully compensate for loss of high quality cottonwood-willow, mesquite woodlands, and cattail marsh.

The typical-year scenario is a condition which is expected to be frequent and long in duration (Appendix C); therefore, the influence of lake inundation, drawdown, and release characteristics would have a direct and long-standing effect on biological resources. During typical-year operation, reservoir drawdown would result from winter storage and summer releases; hence the drawdown would occur during the productive biological season and would affect fish spawning and essentially eliminate sustained plant growth in and near the typical-year pool zone. The phenomenon

of bathtub ring (habitat hiatus) would occur at the reservoirs because of the typical drawdown operation. During years of sufficient runoff, reservoirs are expected to fill to the MSP level. This would be a less frequent condition than typical-year storage; water levels are expected to exceed the typical-year high less than 25 percent of the time in most cases (see Appendix C).

The probability of an occurrence of the 200-year flood in any given year is very low, so that impacts in this pool would be infrequent. Finally, the IDF area event is extremely rare, and the impact to biological resources is essentially hypothetical; therefore, direct project related impacts within the IDF area are not discussed in this section.

(2) Dam Operation Impacts

The operation of the dams in alternative plans would affect biological resources by altering flows on the rivers. While the inundation of perennial stream represents quantitative impact, alteration of flows would affect the quality of stream aquatic communities. Cessation or reduction of flows in the river could affect fish reproduction and movement.

Dam operation would also modify flows by curtailing peak flood flows that cause channel scouring. Scouring is a rejuvenating process whereby old stands of cottonwood and willow are destroyed, but new seedlings are established on newly cleared alluvial terraces. Reduction in scouring would, therefore, diminish this dynamic process and more stands would age beyond maturity and possibly die out.

Reservoir fluctuations resulting from dam operation would negatively affect fish spawning if drawdown of greater than two inches per day occurs during the spawning season.

c. Conceptual Mitigation

Conceptual mitigation measures for impacts to biological resource factors were developed by Reclamation in conjunction with the Fish and Wildlife Service, the Arizona Game and Fish Department, and other involved agencies. Mitigation measures presented below were developed to provide a basis for comparing the alternative plans. The detailed mitigation plan for Plan 6, the Agency Proposed Action, was developed in accordance with the Federal Fish and Wildlife Coordination Act. Commitments to the mitigation plan developed for Plan 6 are presented in Section IV.C.

Reclamation has developed conceptual mitigation plans that emphasize the full array of project objectives. Direct project mitigation represents conceptual measures which focus on reducing or avoiding adverse impacts. These conceptual measures, if implemented, would modify the project design and operation to alleviate or avoid biological resource impacts. For example, reduction of planned release rates during the spawning season would reduce impact on fish reproduction in the reservoirs.

Contingent project mitigation activities are additional measures which, if implemented, would offset impacts resulting from plan implementation. For example, revegetating the old Horseshoe Lake bottom with cottonwood, willow, and mesquite would enhance the quality of the riparian habitat over that expected through natural ecological succession.

There are a number of management programs in effect or proposed in the CAWCS area such as the Forest Service Habitat Rehabilitation Plan and the Arizona Game and Fish Department fish and wildlife management program. The interagency management level of mitigation would emphasize coordinated and cooperative management measures between the various conservation and land-management agencies and Reclamation. The measures proposed for this level of mitigation include support to augment existing management effort as well as new plans which could be implemented through cooperative agency effort.

Land acquisition or other forms of compensation are intended to offset impacts which cannot be mitigated through other levels of effort.

Table IV-1 summarizes the mitigation measures proposed for the six resource categories. The composite mitigation expected from these measures is presented in the following section and was used to assess residual impacts.

d. Riparian/Wetland Communities

(1) Direct and Indirect Impacts

(a) Plan 8

The site areas will have approximately 11,760 acres (12,020 acres for Plan 9) of riparian habitat in the year 2000. Some currently existing riparian habitat will be lost as a result of agricultural development on the Fort McDowell Indian Community lands. The Forest Service will plant approximately 270 acres of cottonwood and willow trees on alluvial benchs at several selected habitat rehabilitation sites on both the Salt and Verde Rivers. Riparian habitat will probably be enhanced by development of the Rio Salado project in the Salt River bed through Tempe; however, diversion of wastewater effluent downstream of 91st Avenue for the Palo Verde nuclear plant will degrade riparian habitat quality in the downstream reach. This effluent will, however, maintain salt-cedar bosques. Maricopa County Flood Control District will continue to clear salt-cedar from a 1,000-foot-wide channel in the Salt and Gila Rivers between 91st Avenue and Gillespie Dam.

Acreages of riparian and wetland communities in the site areas in the future-without-the-project and impacts of Plan 8 are shown in Table IV-2.

Table IV-1

CONCEPTUAL MITIGATION FOR BIOLGOCIAL RESOURCES

	BIOLOGICAL RESOURCE FACTOR					
Level of Mitigation	Riparian/ Wetland	Other Terrestrial	Perennial Stream	Reservoirs	Endangered Species	Special Use
Direct Mitigation	To promote growth of cottonwood-willow and wetland habitat, delay and/or reduce water releases from Cliff, Roosevelt, and Waddell Reservoirs to <2 inches/day at onset of wetland growing season and cottonwood bloom (mid-April to mid-May); applies for all plans.		To improve quality of riverine aquatic communities, assure flows in Salt and Verde Rivers ≥50 cfs for all Plans except 7; ≥200 cfs for Plan 7.	As a means to improve fish spawning habitat, when feasible reduce drawdown rate to <2 inches per day from mid-April to mid-May at Cliff Reservoir for all Plans and Waddell Reservoir for Plans 6 and 7.	To maintain foraging habitat and fish prey base, assure minimum flow described under perennial stream.	
Contingent Project Mitigation	Implement cottonwood habitat rehabilitation at Cliff site in old Horseshoe lake bed. Applies to all plans, except Plan 9. Reclaim 20 acres cattail marsh downstream of Granite Reef Diversion Dam. Applies to all plans.	To improve quality of range habitat (paloverde-mixed cacti and blue paloverde ironwood habitat), reclaim denuded sites lying adjacent the MSP pool. Applies to sites not reclaimed during construction and involves all reservoirs in all plans.	Establish bank cover and cobble ditches for pools and riffles on Verde and Salt Rivers upstream of Cliff and Roosevelt Reservoirs and elsewhere along perennial stream in the CAWCS area. Applies to all plans.	Do not clear the conservation pool; or modify clearing and add brush piles for fish spawning of all reservoirs in all plans. Construct coffer dams for fish spawning habitat at Cliff for all Plans, at Waddell Reservoir for Plans 6 and 7.	Implement cottonwood, cattail marsh rehabilitation; as a means of protecting bald eagle breeding control public access to bald eagle breeding areas at Cliff and Roosevelt. Applies to all plans.	Substitute dispersed recreation at Cliff Reservoir to reduce disturbance to wildlife. Applies to all plans.
Inter-Agency Management	Support U.S. Forest Service cottonwood habitat rehabilitation program and range management for cottonwood/mesquite. Applies to all plans.	Cooperative range management improvements: Coordinate with BLM at Waddell, Plans 6 and 7. Coordinate with U.S. Forest Service at Cliff and Roosevelt (all plans) and Confluence (Plan 3).	Coordinate with Salt River Project on maintaining flows in Salt and Verde Rivers. Applies to all plans.	Fish stocking of all reservoirs in all plans. Support operation and management of coffer dams with Arizona Game and Fish Department.	Support the U.S. Fish and Wildlife Service Endangered Species Recovery Plans for bald eagle, peregrine falcon, Yuma clapper rail, and Gila topminnow. Applies to all plans.	Coordination with land management and conservation agencies; improve range management. Applies to all plans. Set aside Salt-Verde area same as with riparian/ wetland. Applies to all plans except Plan 3.

Table IV-1 (Continued)

	BIOLOGICAL RESOURCE FACTOR					
Level of Mitigation	Riparian/ Wetland	Other Terrestrial	Perennial Stream	Reservoirs	Endangered Species	Special Use
Land Acquisition and Compensation	Acquire take line easements for habitat improvement and wildlife conservation at all reservoirs. Purchase private holdings along Tonto Creek for establishing cottonwood-willow and wetland habitat. Lease land at Piccacho Reservoir for waterfowl foraging habitat. Coordinate with BLM and assist Arizona Game & Fish Dept. in developing waterfowl habitat in Fred J. Weiler Greenbelt on Gila River. Applies to all plans.	Same as with riparian/ wetland.		Support construction of a fish hatchery on the Waddell delivery canal. Assist Arizona Game & Fish Dept. with operation (Plans 6 and 7 only).	Same as with riparian/wetland land requisition.	Redelegate take line easements for special resources use at Three Bar and Roosevelt Wildlife Area (all plans). Fund management and wildlife research programs of the U.S. Fish and Wildlife Service and Arizona Game and Fish Dept.

Table IV-2

ACREAGE OF RIPARIAN/WETLAND COMMUNITIES--IMPACTS OF PLAN 8

Acres of Habitat[a]	Cliff	Roosevelt	Confluence/ Stewart Mountain	New Waddell	Total
Existing Condition	1,550 (1,660)	3,080	8,900	580	14,110 (14,370)
Future-Without (Plan 8) Condition	1,680 (1,790)	3,080	6,420	580	11,760 (12,020)
Impact	+130	0	-2,480	0	-2,350

[a]Includes cottonwood willow, mixed broadleaf, mesquite, salt-cedarsalt-cedar mixed scrub, mixed scrub, and cattail habitats. For acreages by habitat type see Environmental Impacts and Effects of Plans.

(b) Plans 1, 2, 3, 6, 7, and 9

Impacts to riparian/wetland communities, as well as mitigation and residual impacts, are summarized in Table IV-3. The greatest quantitative loss of riparian/wetland habitat would occur with Plan 3 due to the inclusion of Confluence Reservoir. The Confluence Reservoir would inundate the cottonwood-willow and mesquite forest at the Salt-Verde confluence. Some 60 percent of the cottonwood-willow habitat of the Confluence area would be inundated. All of the cattail marsh would be lost. All of these habitats support essentially all of the riparian-obligate wildlife of central Arizona including the great blue heron, Harris hawk, black hawk, Bell's vireo, various warblers, and other wildlife.

Losses of high quality riparian communities in Plans 1, 2, 6, and 7 primarily along the Verde River between Horseshoe Dam and Cliff Dam would be partially offset by growth of mixed-scrub and salt-cedar-mesquite habitat expected as the successional community types that would grow in the typical year high-to-MSP zones of the reservoirs, particularly in the bed of Horseshoe Reservoir. However, the habitat quality of cottonwood-willow habitat lost in Plans 1, 2, 6, and 7 would not be recovered by mixed-scrub and salt-cedar growth at Horseshoe Reservoir. Recovery of cottonwood, willow, mesquite, and cattail marsh would occur only in a typical year to MSP zone where inundation would be infrequent. The concomitant loss of wildlife at the Cliff site (e.g., a heron nest in the Horseshoe Dam to Cliff Dam segment of the Verde River) in Plans 1, 2, 6, and 7, and additional losses of wildlife at the Waddell site area (Plans 6 and 7) are an unavoidable consequence of habitat destruction. Riparian mixed scrub habitat in Morgan City Wash would

Table IV-3

RIPARIAN/WETLAND COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (acres)	Typical Year M (acres)	Typical Year R (acres)	MSP I (acres)	200-Year Flood I (acres)
Plan 1					
Cliff	-640	360[a]	-390	-780	-1040
Roosevelt	+130	100	+230	-440	-1170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-510	480	-140	-1220	-2210
Plan 2					
Cliff	-200	670[a]	+220	-580	-580
Roosevelt	+160	100	+260	-410	-410
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-40	790	+500	-990	-990
Plan 3					
Cliff	-110	940[a]	+580	-780	-1040
Roosevelt	+130	100	+230	-440	-1170
Confluence/Stewart Mountain	-2310	20	-2290	-2730	-2730
Waddell	0			0	0
Total	-2290	1060	-1480	-3950	-4940
Plan 6					
Cliff	-110	940[a]	+580	-780	-1040
Roosevelt	+130	100	+230	-440	-1170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	-130		-130	-450	-450
Total	-110	1060	+700	-1670	-2660
Plan 7					
Cliff	-510	520[a]	-150	-780	-1040
Roosevelt	+520	100	+620	-440	-1170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	-130		-130	-450	-450
Total	-120	640	+360	-1670	-2660
Plan 9					
Verde River Dams Modifications	0	0	0	0	0
Roosevelt	+130	100	+230	-440	-1170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	-130	0	-130	-450	-450
Total	0	120	120	-890	-1620

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact
Mitigation would establish high quality habitat (cottonwood-willow, mesquite and cattail) in excess of that expected by natural recovery; this would produce net gains in total riparian habitat for Plans 2, 6, and 7. However, mitigation would not recover all the high quality habitat lost, so that the effect on high quality riparian wetland would remain adverse for all plans except Plan 6. For more detailed information on gains and losses by habitat type see Environmental Impacts and Effects of Plans.

[a]At Cliff Reservoir a portion of the total mitigation would replace low quality habitat with high quality habitat, and would not result in a quantitative gain.

be subjected to flood flows during spillway releases from New Waddell Dam. This would be an infrequent event (approximately a 200-year flood event), and habitat recovery is expected.

Furthermore, some of the existing cottonwood forest along the Salt and Verde Rivers downstream of Bartlett and Stewart Mountain Dams would be outside the modified scouring zone and would not, therefore, be susceptible to the rejuvenating scouring process previously described.

In Plan 9 riparian habitat would remain intact at the Verde River Dams Modifications site, except for construction losses in the borrow area. Opportunities for vegetation recovery are limited to sites in the typical year high to MSP inundation zones at Roosevelt and Waddell Reservoirs.

(2) Mitigation

Conceptual mitigation strategies for riparian and wetland communities are described in Table IV-1. The objectives of these mitigation measures are to recover acreage of high quality resources lost as a result of the project and to improve the quality of remaining riparian/wetland habitat over that which would occur through natural ecological succession. Because mitigating cannot quantitatively eliminate project-induced impacts to high quality riparian/wetland habitat, only qualitative enhancement of the resource can be achieved in much of the site areas. The opportunity for mitigation good quality riparian habitat in the Horseshoe Basin is precluded in Plan 9.

(3) Residual Impacts

Residual impacts to riparian/wetland communities are shown on Table IV-3.

e. Other Terrestrial Communities

(1) Direct and Indirect Impacts

(a) Plan 8

The site areas will have approximately 195,000 acres of other terrestrial habitat (shrubland and paloverdemixed cacti desert) in the year 2000, as shown in Table IV-4.

(b) Plans 1, 2, 3, 6, 7, and 9

Impacts to other terrestrial communities, as well as mitigation and residual impacts, are summarized on Table IV-5. The nonriparian communities that would be altered by construction and/or subjected to occasional flood storage inundation include mainly paloverde-mixed cacti, and blue paloverde-ironwood habitat. These community types cannot tolerate inundation of more than several days, and the full species complement would probably not occur within the flood storage zone at less than the 200-year

flood level, due to the maturation rates of the dominant cacti. This habitat type would be completely eliminated below the MSP level in areas inundated more than about 5 percent of the time. The least impact to this habitat type is expected in Plans 2 and 9 because reservoir pools would be nearly the same size as at present. Plans 6 and 7 both include a large storage pool at New Waddell Reservoir and would have the highest impact. However, because the losses involve only a small percentage of the total amount of this habitat type present in the site areas, the effect in all plans is considered insignificant.

Table IV-4
OTHER TERRESTRIAL COMMUNITIES - IMPACTS OF PLAN 8

Acres of Habitat[a]	Cliff	Roose-velt	Confluence/ Stewart Mountain	New Waddell	Total
Existing Condition	47,580 (67,590)	59,670	56,470	38,190	201,910 (223,460)
Future-Without (Plan 8) Condition	47,500 (67,510)	59,670	49,170	38,140	194,480 (216,030)
Impact	-80	0	-7,300	-50	-7,430

[a]Includes paloverde-mixed cacti and blue paloverde-ironwood associations.

(2) Mitigation

Conceptual mitigation strategies for terrestrial communities are outlined in Table IV-1. The objectives of these mitigation measures are to improve the quality of the habitat within the IDF area to be acquired by Reclamation. This would include overall reductions in grazing and seeding of areas peripheral to the maximum storage pool. Opportunities to reclaim desert vegetation lost through inundation are somewhat limited, however, due to the intolerance of the dominant plant species (saguaro cactus and paloverde) to periodic inundation. No enhancement of the resource is, therefore, expected.

(3) Residual Impacts

Residual Impacts are shown on Table IV-5. No quantitative gains in resource can be made through mitigation. However, the quality of the remaining resources could be improved.

Table IV-5

OTHER TERRESTRIAL COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (acres)	Typical Year M (acres)	Typical Year R (acres)	MSP I (acres)	200-Year Flood I (acres)
Plan 1					
Cliff	-1970	(50)[a]	-1970	-1280	-4000
Roosevelt	-1270	(2350)	-1270	-1400	-4640
Confluence/Stewart Mountain	-20		-20	-20	-20
Waddell	0			0	0
Total	-3260	(2400)	-3260	-2700	-8660
Plan 2					
Cliff	+420	(260)	+420	+910	+910
Roosevelt	-870	(2350)	-870	-1000	-1000
Confluence/Stewart Mountain	-10		-10	-10	-10
Waddell	0			0	0
Total	-460	(2610)	-460	-100	-100
Plan 3					
Cliff	-1300	(720)[a]	-1300	-1280	-4000
Roosevelt	-1270	(2350)	-1270	-1400	-4640
Confluence/Stewart Mountain	-3430	(280)	-3430	-3710	-3710
Waddell	0			0	0
Total	-6000	(3350)	-6000	-6390	-12350
Plan 6					
Cliff	-1300	(720)[a]	-1300	-1280	-4000
Roosevelt	-1270	(2350)	-1270	-1400	-4640
Confluence/Stewart Mountain	-20		-20	-20	-20
Waddell	-8470	(160)	-8470	-6460	-6460
Total	-11060	(3230)	-11060	-9160	-15120
Plan 7					
Cliff	-1970	(50)[a]	-1970	-1280	-4000
Roosevelt	-3080	(540)	-3080	-1400	-4640
Confluence/Stewart Mountain	-20		-20	-20	-20
Waddell	-8470	(160)	-8470	-6460	-6460
Total	-13540	(750)	-13540	-9160	-15120
Plan 9					
Verde River Dams Modifications	-70		-70	-70	-70
Roosevelt	-1270		-1270	-1400	-4640
Confluence/Stewart Mountain	-20		-20	-20	-20
Waddell	-8470		-8470	-6460	-6460
Total	-9830		-9830	-7950	-7950

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact

[a]Numbers in parentheses are areas peripheral to maximum storage pools in which recovery of desert vegetation could be enhanced through seeding of shrubs and/or grasses. This represents a qualitative rather than quantitative gain in resource, and does not reduce the quantitative residual impact.

f. Perennial Stream/Riverine Communities

(1) Direct and Indirect Impacts

(a) Plan 8

A total of 66 miles of perennial stream lie within the Confluence, Cliff, Roosevelt, and New Waddell site areas. Approximately 137 miles of perennial stream are within the CAWCS area boundaries. Present operating criteria on the SRP-controlled reaches of the Salt and Verde Rivers upstream of the confluence do not guarantee minimum flows for fish and wildlife benefits. This condition is expected to continue in the future. On average in these reaches, there are 106 days per year of flows equal to or less than 50 cfs on the Salt River, and 61 days per year on the Verde River.

Table IV-6 shows miles of perennial stream and riverine communities in the future-without-the-project and impacts of Plan 8.

TABLE IV-6
PERENNIAL STREAM/RIVERINE COMMUNITIES - IMPACTS OF PLAN 8

Perennial stream miles	Cliff	Roose-velt	Confluencence Stewart Mountain	New Waddell	Total
Existing Condition	20 (21)	15	31	0	66 (67)
Future-Without (Plan 8) Condition	20 (21)	15	31	0	66 (67)
Impact	0	0	0	0	0

(b) Plans 1, 2, 3, 6, 7, and 9

Impacts of plans, as well as mitigation and residual impacts, are summarized in Table IV-7. Loss of perennial stream is regarded as a significant impact due to the limited amount of perennial stream in Southwestern deserts. Perennial streams support riverine aquatic communities, riparian habitat, and wildlife including the endangered Yuma clapper rail and bald eagle.

The typical-year inundation represents the most likely recurrent event affecting stream loss. Plan 3 accounts for the greatest loss of stream due to the inclusion of Confluence Reservoir. Enlarging Lake Pleasant at the New Waddell site would not inundate perennial streams, thus the typical-year impact would be the same in Plans 2 and 6. With more storage planned at Cliff Reservoir in Plans 1 and 7, the impacts of these two plans are similar. In all plans except Plan 9, however, the net river mileage change at Cliff Reservoir represents loss of 6 miles of high-quality river between Horseshoe and Cliff Dams and recovery of river in

Table IV-7

PERENNIAL STREAM/RIVERINE COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

	Typical Year			MSP	200-Year Flood
	I (miles)	M (miles)	R (miles)	I (miles)	I (miles)
Plan 1					
Cliff	-3[a]	(17)[b]	-3	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	-3	(17)	-3	-6	-12
Plan 2					
Cliff	+1[a]	(21)[b]	+1	-1	-1
Roosevelt	0			-1	-1
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	+1	(21)	+1	-2	-2
Plan 3					
Cliff	+1[a]	(21)[b]	+1	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	-17	(14)	-17	-18	-18
Waddell	0			0	0
Total	-16	(31)	-16	-24	-30
Plan 6					
Cliff	+1[a]	(21)[b]	+1	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	+1	(21)	+1	-6	-12
Plan 7					
Cliff	-2[a]	(18)[b]	-2	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	-2	(18)	-2	-6	-12
Plan 9					
Verde River Dams Modifications	0	(0)	0	0	0
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	0				0
Waddell	0				0
Total	0	(0)	0	-1	-5

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impacts.

[a]At Cliff Reservoir 6 miles of perennial stream habitat will be lost downstream of Horseshoe Dam in Plans 1, 2, 3, 6 and 7. However, stream habitat will be gained in the reach formerly occupied by Horseshoe Reservoir. Impacts are the combined losses and/or gains in perennial stream. Stream habitat is not gained in Plan 9.

[b]Numbers in parentheses are miles of river in which qualitative improvements such as bank stabilization and flow augmentation could be made. Quantitative loss of stream miles cannot be mitigated.

the exposed Horseshoe lakebed. Seven miles would be recovered in Plans 2, 3, and 6; 3 and 4 miles, respectively, would be recovered in Plans 1 and 7. The quality of riverine habitat within the recovered segment would eventually improve as channel silt and sand wash downstream, but the perennial stream initially would be subjected to erosion and high turbidity, which creates poor habitat for most riverine aquatic life. With Plan 9 there would be no change in the amount of perennial stream.

(2) Mitigation

Conceptual mitigation for impacts to perennial stream/riverine communities is outlined on Table IV-1. Since mitigation of lost stream mileage is not feasible within the affected site areas, these conceptual mitigation measures are aimed at improving the quality of habitat in the remaining reaches of river. Stream habitat improvements as given in the conceptual mitigation table would not change the unmitigated effects. Plan 7, with sustained minimum flows, is the best option for this factor, and provides the only opportunity for fish and wildlife enhancement.

(3) Residual Impacts

Residual impacts are displayed in Table IV-7.

g. Reservoir Aquatic Communities

(1) Direct and Indirect Impacts

(a) Plan 8

Approximately 14,000 surface acres of habitat are available in Horseshoe Lake, Roosevelt Lake, Saguaro Lake, and Lake Pleasant; 35,000 surface acres of habitat are available within the CAWCS area. SRP lakes and Lake Pleasant do not have guaranteed minimum pools for fish and wildlife and recreation but, historically, reservoirs on the Salt River have maintained some minimum pools. This condition is expected to continue in the future.

Typical-year low reservoir surface acres in the future-without-the-project are expected to be 610 acres allocated to the Cliff site area, 11,930 acres at Roosevelt, 630 acres at Confluence site area, and 830 acres at New Waddell site area.

(b) Plans 1, 2, 3, 6, 7, and 9

Impacts of plans, as well as mitigation and residual impacts are summarized on Table IV-8. The gain of lake habitat has been assessed as the increase in typical-year low-pool surface acreage which would create a minimum pool to ensure a fish population carryover. However, the beneficial gain in lake habitat would be adversely affected where drawdown rates during the spawning season exceed 2 inches per day; rates greater than 2

Table IV-8

RESERVOIR AQUATIC COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (acres)	Typical Year M (acres)	Typical Year R (acres)	MSP I (acres)	200-Year Flood I (acres)
Plan 1					
Cliff	+400		+400	+2520	+5900
Roosevelt	0			+2350	+6510
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	+400[a]		+400	+4870	+12410
Plan 2					
Cliff	-360		-360	+100	+100
Roosevelt	0			+2350	+2350
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	-360[a]		-360	+2450	+2450
Plan 3					
Cliff	+130		+130	+2520	+5900
Roosevelt	0			+2350	+6510
Confluence/Stewart Mountain	+2950	(1850)[b]	+2950	+8850	+8850
Waddell	0			0	0
Total	+3080[a]		+3080	+13720	+21260
Plan 6					
Cliff	+130		+130	+2520	+5900
Roosevelt	0			+2350	+6510
Confluence/Stewart Mountain	0			0	0
Waddell	+1770	(1540)[b]	+1770	+6390	+6390
Total	+1900[a]		+1900	+11260	+18800
Plan 7					
Cliff	+980	(1030)[b]	+980	+2520	+5900
Roosevelt	+940		+940	+2350	+6510
Confluence/Stewart Mountain	0			0	0
Waddell	+1770	(1540)[b]	+1770	+6390	+6390
Total	+3690[a]		+3690	+11260	+18800
Plan 9					
Verde River Dams Modifications	0		0	0	0
Roosevelt	0		0	+2350	+6510
Confluence/Stewart Mountain	0		0	0	0
Waddell	+1770	(1540)[b]	+1770	+6390	+6390
Total	+1770		+1770	+8740	+12900

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact.

[a]Impacts represent the net loss/gain of typical-year low pools, which are the resource for sustaining fisheries.

[b]Numbers in parentheses are the surface areas of USBR design minimum pools. Mitigation involves reduction of drawdown rates to <2 inches in 1 day from mid-April to mid-May and would improve fish spawning habitat in the reservoirs.

inches per day are not conducive to productive fish spawning, and effectively eliminate spawning success in the group of species which includes bass, crappie, and the sunfishes.

The water quality at Waddell Reservoir would change due to Colorado River water delivery and subsequent mixing. Among the water quality parameters affecting the fishery, increases in total dissolved solids (TDS) appears to be the most important. Dissolved oxygen, turbidity, and pH would approximate baseline conditions at least within levels of tolerance of the sport fish occurring in Lake Pleasant. TDS would increase to a mean 722 ppm, which exceeds the limits of optimal tolerance (100 to 350 ppm) for the bass, crappie, catfish, and other sport fishes. However, fish surveys and studies conducted on the lower Colorado River and Lake Havasu (where CAP water will be withdrawn) indicate that these species reproduce and maintain viable populations (USFWS, 1980; Talbout, 1982; Lyces, 1982). Therefore, although the expected increase in TDS at Lake Pleasant would exceed the optimal range, reproduction is expected to continue, and in terms of viability, the critical factor which would influence spawning is reservoir drawdown rather than increased TDS.

Plan 7 would produce significant beneficial gains in surface acreage and typical-year low storage in excess of Reclamation-design minimum pools at Cliff and Lake Pleasant. This means that pools of 10,000 af and 5,000 af would be maintained (in excess of sediment) at Cliff Reservoir and Lake Pleasant, respectively. Increased TDS would, however, compromise some of the benefit gained from the enlarged Lake Pleasant in Plan 7 insofar as spawning is concerned.

Plan 3 would also increase pool acreage substantially, but only one minimum pool (7,000 af) would be gained, at Confluence Reservoir. Cliff Reservoir in Plans 1, 2, 3, and 6 would not maintain sufficient storage to maintain a minimum pool. Drawdown rates on Lake Pleasant would be approximately 5 inches per day. Roosevelt Lake drawdown would be 1.3 inches per day in all plans, the same condition which occurs in Plan 8. Horseshoe and Bartlett Reservoirs would remain as 9.2 and 1.5 inches per day respectively drawdown in Plan 9.

The Lake Pleasant sport fishery and the riverine fishery in the Salt-Verde drainage upstream of Granite Reef Diversion Dam are relatively isolated from potential contamination resulting from the introduction of predatory and competitive species which could be conveyed from the Colorado River via the CAP aqueduct. Intra-system contamination is also a potential hazard; white bass in Lake Pleasant, if conveyed into the regulated reach of the Salt-Verde system, would be effective picsivorous predators on the native and sport fish populations. It is not presently known whether Colorado River species would be conveyed or survive in the CAP aqueduct, whether they would be introduced into either Lake Pleasant or the Salt-Verde system, or what the effects of such introduction would be. Reclamation is conducting studies to determine whether the potential conveyance and introduction of tilapia, striped bass, and other predatory species represents a possible hazard to the central Arizona sport fisheries (see Appendix B).

(2) Mitigation

Conceptual mitigation measures for reservoir aquatic community impacts are described in Table IV-1. The objectives of these measures are to improve spawning conditions and to sustain fish populations. If the conceptual mitigation measures are implemented, particularly modification of drawdown rates, fish and wildlife enhancement would occur.

(3) Residual Impacts

Residual impacts are displayed in Table IV-8.

h. Threatened and Endangered Plants and Wildlife

(1) Direct and Indirect Impacts

(a) Plan 8

Six endangered species occur in the CAWCS study area, four of which occur in the vicinity of the site areas. These four are the bald eagle, peregrine falcon, Yuma clapper rail, and Gila topminnow. The bald eagle is the only species known to breed within the affected site areas.

The peregrine falcon has been observed in the CAWCS area on the Salt River and upstream of Lake Pleasant on the Agua Fria River.

A population of Gila topminnows lives in Tule Creek upstream of the New Waddell site area.

There are 13 confirmed bald eagle breeding areas in the Southwestern United States, six of which are located along the Salt and Verde Rivers in the CAWCS area. The two most productive of these six areas are in the Confluence site area and the third most productive area (Bartlett) is located downstream of the Verde River Dams Modifications site area. Table IV-9 shows the productivity of these breeding areas in recent years.

Yuma clapper rails have been observed in the Confluence area and downstream of the Granite Reef Diversion Dam. Although observation data indicate that the species may breed in the area where observed, there has been no direct evidence to substantiate that breeding is in fact occurring.

Approximately 1,910 acres of cottonwood willow and mixed broadleaf communities, which are preferred habitat for the bald eagle, currently occur within the site areas. Also, 30 acres of cattail wetland which is preferred habitat for the endangered Yuma clapper rail occur in the Confluence site area.

Breeding areas and productivity for the bald eagle are expected to remain status quo or to improve slightly because of efforts of the Bald Eagle Recovery Team in conjunction with conservation

management by the Fish and Wildlife Service and the Forest Service (Tonto National Forest). By the year 2000, bald eagle preferred habitat is expected to increase to 2,180 acres within the site areas on the Tonto National Forest due to habitat rehabilitation by the Forest Service. Yuma clapper rail preferred habitat is expected to remain the same (30 acres at the Confluence site area).

TABLE IV-9
PRODUCTIVITY OF BALD EAGLE BREEDING AREAS

Breeding Area	Average Productivity (Number Fledges	Years Occupied[a]
Blue Point/Stewart Mountain breeding area (Confluence)	3.00	2
Fort McDowell breeding area (Confluence)	1.40	10
Bartlett breeding area (Confluence and Verde River Dams)	1.10	10
Redmond Flat (CAWCS study area but not in a site area)	0.75	8
Pinal Creek breeding area (Roosevelt)	0.80	5
Chalk Mountain breeding area (Cliff)	0.40	10

[a]Period of record for breeding area occupation: 1973-1982

Table IV-10 shows acreages of preferred habitat for these species in the future-without-the-project and impacts of Plan 8. Perennial stream is also an important habitat utilized by breeding bald eagles. Table IV-6 shows river mileage of perennial stream in the future-without-the-project.

TABLE IV-10
THREATENED AND ENDANGERED SPECIES PREFERRED HABITATS - IMPACTS OF PLAN 8

Acres of Habitat[a]	Cliff	Roose velt	Confluence/ Stewart Mountain	New Waddell	Total
Existing Condition	650	380	910	10	1,950
Future-Without (Plan 8) Condition	830	380	1,000[a]	10[b]	2,220
Impact	+180	0	+90	0	+270

[a] Includes 30 acres Yuma clapper rail preferred habitat
[b] Yuma clapper rail

b. Plans 1, 2, 3, 6, 7, and 9

Impacts of plans, as well as mitigation and residual impacts, of preferred habitat are summarized in Table IV-11. The impacts to perennial streams are summarized in Table IV-7. The impact assessment and effects evaluation focus on impacts to the endangered bald eagle. The proposed operation of Confluence Reservoir would eliminate 60 percent of the cottonwood-willow habitat and 17 miles of perennial stream which includes segments of river known to be foraging sites of the Fort McDowell and Blue Point/Stewart Mountain bald eagle breeding areas. The impact to preferred habitat and perennial streams at the Cliff site area will be the same as Plan 6 (discussed below). In all plans Roosevelt Lake will remain the same as its current pool size.

The changes in quantities of preferred habitat and miles of perennial stream vary among the action plans. Approximately 10 miles of river will be excavated for fill material downstream of Horseshoe Dam. The new reservoir will inundate 6 miles of perennial stream between Horseshoe Dam and the new Cliff Dam in all action plans. Approximately 350 acres of preferred habitat will be lost in this 6-mile reach. The plans also include breaching Horseshoe Dam which will cause the relocation of Horseshoe Reservoir at the new damsite. The lakebed of Horseshoe Reservoir will become exposed; the extent of exposure varying among the plans depending on the size of the typical-year pools. "New" river will develop in the exposed lakebed upstream of Cliff Reservoir and alluvial flats will provide sites for the growth of vegetation. The gain of river and riparian habitat will occur in the vicinity of several known nest sites of the Chalk Mountain breeding area. The gain in river mileage and riparian habitat upstream of Cliff Reservoir will be as follows: 7 miles of river and 660 acres of riparian habitat in Plans 3 and 6; 7 miles of river and 370 acres of riparian habitat in Plan 2; 3 miles of river and 130 acres of habitat in Plan 1; and 4 miles of river and 260 acres of habitat in Plan 7.

Consultation under Section 7 of the Endangered Species Act was undertaken only for Plan 6. The Biological Opinion stated that "the proposed action is likely to jeopardize the continued existence of the southwest eagle population. However, reasonable and prudent alternatives have been identified to alter the proposed plan to a degree that the action would no longer jeopardize the continued existence of this species." Commitments to modification of Plan 6 in accordance with the reasonable and purdent alternatives are contained in Section IV.C and Appendix F.

The existing conditions at Bartlett and Horseshoe Reservoirs will remain essentially unaltered in Plan 9. No major impact is anticipated for either the Chalk Mountain or Bartlett bald eagle breeding areas. Episodes of nest inundation which have disrupted breeding of the Chalk Mountain bald eagles are expected to continue. Opportunities for riparian woodland growth in the Horseshoe Reservoir Basin within the Chalk Mountain breeding area are precluded in Plan 9.

Table IV-11

THREATENED AND ENGANGERED PLANTS AND WILDLIFE--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (preferred habitat acres)	Typical Year M (preferred habitat acres)	Typical Year R (preferred habitat acres)	MSP I (acres)	200-Year Flood I (acres)
Plan 1					
Cliff	-350	110	-240	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-440	230	-210	-360	-650
Plan 2					
Cliff	-340	250	-90	-330	-330
Roosevelt	-90	100	+10	-20	-20
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-430	370	-60	-350	-350
Plan 3					
Cliff	-350	250	-100	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	-590	20	-570	-590	-590
Waddell	0			0	0
Total[a]	-1,030	370	-660	-950	-1240
Plan 6					
Cliff	-350	250	-100	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-440	370	-70	-360	-650
Plan 7					
Cliff	-350	160	-190	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-440	280	-160	-360	-650
Plan 9					
Verde River Dams Modifications	-80	0	-80	-80	-80
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-170	120	-50	-100	-250

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact.

[a]Impacts in Plan 3 are for bald eagle preferred habitat (cottonwood-willow) and Yuma clapper rail preferred habitat (cattail marsh) combined. Impacts for all other plans are for cottonwood willow only. Reestablishment of 20 acres of cattail marsh below Granite Reef Dam would enhance Yuma clapper rail habitat in Plans 1, 2, 6, and 7, and would mitigate loss of marsh at the Confluence in Plan 3.

The Yuma clapper rail will be adversely affected by the complete loss of its known habitat in the Confluence area. The concomitant loss of breeding habitat for bald eagles and 100 percent loss of Yuma clapper rail habitat are considered an Adverse Flag effect for Plan 3.

Plans 6 and 7 will produce a large lake at the New Waddell site area. The lake will inundate a nest site tenatively considered a bald eagle nest. The Agua Fria River - Tule Creek confluence would also be inundated at peak storage; predatory and competitive lake fish would invade Gila topminnow habitat during periods when the creek is flowing into the lake. The potential threat to the endangered topminnow would increase in Plans 6 and 7, but the opportunity for invasion already exists (that is, the possibility of simultaneous flows in the Agua Fria River and Tule Creek). The impacts at the New Waddell site area are therefore somewhat conjectural.

(2) Mitigation

Conceptual mitigation strategies for impacts to endangered species are described in Table IV-1. The objectives of these mitigation measures are to minimize or eliminate impacts on productivity and to improve preferred habitat. Adverse impacts to the bald eagle could be alleviated in Plans 1, 2, 3, 6, 7, and 9. Plan 3 represents an unmitigatable loss of productivity in the two most productive breeding areas of the Southwest bald eagle population. Opportunities exist to enhance Yuma clapper rail habitat in all plans except Plan 3. The security of the topminnow habitat could be improved by placement of a drop-structure fish barrier on Tule Creek upstream of the IDF lake elevation. Opportunities to mitigate preferred habitat in the Horseshoe Reservoir Basin are precluded in Plan 9.

(3) Residual Impacts

Residual impacts are displayed in Table IV-11.

i. Special Use and Management Areas

(1) Direct and Indirect Impacts

(a) Plan 8

Special use range resources will include approximately 23,560 (25,240 for Plan 9) Animal Unit Months (AUM) in the site areas. The Animal Unit Month is a measure of the resource base available not only to livestock but to wildlife as well. Other special use resources for wildlife include: wildlife areas at Roosevelt Lake and Three Bar Wildlife Area; the Fred J. Weiler Greenbelt on the Gila drainage; limited-access areas near bald eagle breeding areas; six reservoirs on the Salt and Verde Rivers for continued use as State warmwater fisheries; and the Confluence area as an area of special interest for research and wildlife diversity. There is likely to be an increase in special use sites for cottonwood rehabilitation in the Tonto National Forest, plus development of the Lower Salt River Recreation Area plan in the Confluence site area.

Table IV-12 shows range and wildlife resources in the future-without-the-project in terms of AUMs, and impacts of Plan 8.

TABLE IV-12
SPECIAL USE AND MANAGEMENT AREAS - IMPACTS OF PLAN 8

AUMs	Cliff	Roosevelt	Confluence/ Stewart Mountain	New Waddell	Total
Existing Condition	6,103 (8,602)	9,639	11,155	3,633	30,530 (33,239)
Future-Without (Plan 8) Condition	3,798 (5,351)	6,647	9,486	3,629	23,560 (25,113)
Impact	-2,305 (-3,251)	-2,992	-1,669	-4	-6,970 (-7,995)

(b) Plans 1, 2, 3, 6, 7, and 9

Impacts of plans, as well as mitigation and residual impacts, are summarized in Table IV-13. The greatest quantitative loss of range resources and special use areas would occur under Plan 3 due to the inclusion of Confluence Reservoir. Under this plan the Blue Point cottonwood area and the site for the Forest Service Lower Salt River Recreation area would be inundated along with several habitat rehabilitation sites in the Confluence and Cliff site areas. Riparian communities in the Confluence vicinity which are good birding areas would be lost in Plan 3. Under Plans 1, 2, 6, and 7, only habitat rehabilitation sites in the Cliff site area would be inundated. This would not occur in Plan 9. Implementation of recreation plans at the Roosevelt Site in Plans 1, 3, 6, 7, and 9 would increase the number of people using areas adjacent to the waterfowl refuge maintained by the Arizona Game and Fish Department; however, recreation sites immediately adjacent to waterfowl areas are currently, and would continue to be, closed to access during the period of waterfowl occupation (November to February). Impacts resulting from increased human use result in qualitative losses to the waterfowl area.

Losses of range resource, expressed as AUM's, would be greatest under Plan 7; however, the net effect is insignificant compared to the total range resource in the site areas, since reductions in stocking rates will be implemented by management agencies in the future-without-the-project.

Table IV-13

SPECIAL USE AND MANAGEMENT AREAS--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

	Typical Year			MSP	200-Year Flood
	I (AUMs)	M	R	I (AUMs)	I (AUMs)
Plan 1					
Cliff	-202			-159	-389
Roosevelt	-121			-195	-615
Confluence/Stewart Mountain	-3			-3	-3
Waddell	0			0	0
Total	-326	TBD	-326	-357	-1007
Plan 2					
Cliff	+17			+25	+25
Roosevelt	-75			-149	-149
Confluence/Stewart Mountain	-1			-1	-1
Waddell	0			0	0
Total	-59	TBD	-59	-125	-125
Plan 3					
Cliff	-109			-159	-389
Roosevelt	-121			-195	-615
Confluence/Stewart Mountain	-979			-1099	-1099
Waddell	0			0	0
Total	-1209	TBD	-1209	-1453	-2103
Plan 6					
Cliff	-109			-159	-389
Roosevelt	-121			-195	-615
Confluence/Stewart Mountain	-3			-3	-3
Waddell	-806			-647	-647
Total	-1039	TBD	-1039	-1004	-1654
Plan 7					
Cliff	-192			-159	-389
Roosevelt	-271			-195	-615
Confluence/Stewart Mountain	-3			-3	-3
Waddell	-806			-647	-647
Total	-1272	TBD	-1272	-1004	-1654
Plan 9					
Verde River Dams Modifications	-5			-11	-11
Roosevelt	-121			-195	-615
Cliff	-3			-3	-3
Confluence/Stewart Mountain	-806			-647	-647
Waddell	-935	TBD	-935	-856	-1276

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact;
[a]TBD = To be determined. Mitigation will involve range improvements and gain of new special use areas, to be negotiated with involved agencies; however, the quantitative improvement is not determined at this time.

(2) Mitigation

Conceptual mitigation strategies for management and special use areas are described in Table IV-1. The purpose of these mitigation measures is to replace wildlife habitat and/or range resources lost due to the project. Mitigated effects of Plan 3 are worse than for the other plans because the plan would cause inundation of special use sites at the Confluence and preclude setting aside of additional sites there as mitigation.

(3) Residual Impacts

Residual impacts are displayed in Table IV-13.

j. Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans

Construction impacts for a modified dam at Roosevelt or Stewart Mountain would be the same as the new dam option except construction activities for a modified dam would be shorter in duration and require less area. Operational impacts would be the same at Roosevelt or Stewart Mountain because lake elevations, size, and storage allocations would be identical for a new structure or modified dam. Therefore, there is no significant difference in impact at either location for biological resources due to construction and operation. However, impacts would occur to endangered species and special use areas due to increased recreational use of the area. The nature and extent of the impacts will depend on management policies for recreational use.

k. Summary

The mitigated and unmitigated impacts and effects of Plans 1, 2, 3, 6, 7, and 9 are summarized in Tables IV-14, IV-15, IV-16, IV-17, IV-18 and IV-19. A range of impacts and effects is shown for the typical-year, MSP, and 200-year flood pool levels.

(1) Notes on Summary Tables

The net impact is the cumulative change between the future-without project and future-with project condition.

Effects are displayed as adverse flag (AF), significant adverse (SA), insignificant (I), significant beneficial (SB), or beneficial flag (BF). The effect that best represents the impact significance is shown with an asterisk (*). Typical-year impacts reflect both quantitative and qualitative resource changes. Maximum conservation storage and flood events are assumed to be less frequent and shorter in duration than the typical-year condition; impacts are not as recurrent or qualitatively continuous. The effects are therefore described as conditional for the 200-year flood pool. Flood-related impacts involve changes in resource quality but not necessarily quantitative changes since natural recovery and succession are likely.

Table IV-14

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 1

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 510 ac	*SA	480ac	SA
	b. MSP	- 1,220 ac	SA		
	c. 200-Year Flood	- 2,210 ac	Conditional SA		
2. Other Terrestrial Biotic Communities	a. typical year	- 3,260 ac	*I	(2400ac)	I
	b. MSP	- 2,700 ac	I		
	c. 200-Year Flood	- 8,660 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	- 3 mi/no change in flow	*I	(17 mi)	I
	b. MSP	- 6 mi	SA		
	c. 200-Year Flood	-12 mi	Conditional SA		
4. Reservoir Aquatic Biotic Communities	a. typical year	+ 400 ac	*I	Reduce drawdown rates	SB
	b. MSP	+ 4,870 ac	I		
	c. 200-Year Flood	+12,410 ac	Conditional I		
5. Threatened/Endangered Species (bald eagle)	a. typical year	- 440 ac/1 Breeding area	*SA	230ac	I
	b. MSP	- 360 ac/2 Breeding areas	AF		
	c. 200-Year Flood	- 650 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 326 AUM	*I	TBD	I
	b. MSP	- 357 AUM	I		
	c. 200-Year Flood	- 1,007 AUM	Conditional I		

* The effects are displayed as adverse flag (AF), significant adverse (SA), insignificant (I), significant beneficial (SB), or beneficial flag (BF). The effect that best represents the impact significance is shown with an asterisk.

Table IV-15

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 2

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 40 ac	*SA	790ac	SA
	b. MSP	- 990 ac	SA		
	c. 200-Year Flood	- 990 ac	Conditional SA		
2. Other Terrestrial Biotic Communities	a. typical year	- 460 ac	*I	(2,610ac)	I
	b. MSP	- 100 ac	I		
	c. 200-Year Flood	- 100 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	+ 1 mi/no change in flow	*I	(21 mi)	I
	b. MSP	- 2 mi	I		
	c. 200-Year Flood	- 2 mi	Conditional I		
4. Reservoir Aquatic Biotic Communities	a. typical year	- 360 ac	*I	Reduce drawdown rates	SB
	b. MSP	+ 2,450 ac	I		
	c. 200-Year Flood	+ 2,450 ac	Conditional I		
5. Threatened/Endangered Species (bald eagle)	a. typical year	- 430 ac	*I	370ac	I
	b. MSP	- 350 ac/2 Breeding areas	AF		
	c. 200-Year Flood	- 350 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 59 AUM	*I	TBD	I
	b. MSP	- 125 AUM	I		
	c. 200-Year Flood	- 125 AUM	Conditional I		

* The effects are displayed as adverse flag (AF), significant adverse (SA), insignificant (I), significant beneficial (SB), or beneficial flag (BF). The effect that best represents the impact significance is shown with an asterisk.

Table IV-16

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 3

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 2,290 ac	*AF	1,060 ac	AF
	b. MSP	- 3,950 ac	AF		
	c. 200-Year Flood	- 4,940 ac	Conditional AF		
2. Other Terrestrial Biotic Communities	a. typical year	- 6,000 ac	*I	(3,350ac)	I
	b. MSP	- 6,390 ac	I		
	c. 200-Year Flood	- 12,350 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	-16 mi/no change in flow	*AF	(39 mi)	AF
	b. MSP	-24 mi	AF		
	c. 200-Year Flood	-30 mi	Conditional AF		
4. Reservoir Aquatic Biotic Communities	a. typical year	+ 3,080 ac/+1 Minimum pool	*SA	Reduce drawdown rates	SB
	b. MSP	+13,720 ac	SA		
	c. 200-Year Flood	+21,260 ac	Conditional SA		
5. Threatened/Endangered Species (bald eagle and Yuma clapper rail)	a. typical year	- 1,030 ac/2 Breeding areas	*AF	370 ac	AF
	b. MSP	- 950 ac/4 Breeding areas	AF		
	c. 200-Year Flood	- 1,240 ac/4 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 1,209 AUM	*I	TBD	I
	b. MSP	- 1,453 AUM	I		
	c. 200-Year Flood	- 2,103 AUM	Conditional I		

* The effects are displayed as adverse flag (AF), significant adverse (SA), insignificant (I), significant beneficial (SB), or beneficial flag (BF). The effect that best represents the impact significance is shown with an asterisk.

Table IV-17

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 6 (AGENCY PROPOSED ACTION)

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 110 ac	*SA	1,060 ac	I
	b. MSP	- 1,670 ac	SA		
	c. 200-Year Flood	- 2,660 ac	Conditional SA		
2. Other Terrestrial Biotic Communities	a. typical year	- 11,060 ac	*SA	(3,230ac)	I
	b. MSP	- 9,160 ac	SA		
	c. 200-Year Flood	- 15,120 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	+ 1 mi/no change in flow	*I	(21 mi)	I
	b. MSP	- 6 mi	SA		
	c. 200-Year Flood	-12 mi	Conditional SA		
4. Reservoir Aquatic Biotic Communities	a. typical year	+ 1,900 ac/+1 Minimum pool	*SA	Reduce drawdown rates	SB
	b. MSP	+11,260 ac	SA		
	c. 200-Year Flood	+18,800 ac	Conditional SA		
5. Threatened/Endangered Species (bald eagle) and Yuma clapper rail	a. typical year	- 440 ac	*I	370 ac	I
	b. MSP	- 360 ac/2 Breeding areas	AF		
	c. 200-Year Flood	- 650 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 1,039 AUM	*I	TBD	I
	b. MSP	- 1,004 AUM	I		
	c. 200-Year Flood	- 1,654 AUM	Conditional I		

* The effects are displayed as adverse flag (AF), significant adverse (SA), insignificant (I), significant beneficial (SB), or beneficial flag (BF). The effect that best represents the impact significance is shown with an asterisk.

Table IV-18

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 7

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 120 ac	*SA	640 ac	SA
	b. MSP	- 1,670 ac	SA		
	c. 200-Year Flood	- 2,660 ac	Conditional SA		
2. Other Terrestrial Biotic Communities	a. typical year	- 13,540 ac	*SA	(750ac)	I
	b. MSP	- 9,160 ac	SA		
	c. 200-Year Flood	- 15,120 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	- 2 mi/200 cfs minimum flow	*SB	(18 mi)	SB
	b. MSP	- 6 mi	I		
	c. 200-Year Flood	-12 mi	Conditional SA		
4. Reservoir Aquatic Biotic Communities	a. typical year	+ 3,690 ac/+2 Minimum pools	*SA	Reduce drawdown rates	BF
	b. MSP	+11,260 ac	SA		
	c. 200-Year Flood	+18,800 ac	Conditional SA		
5. Threatened/Endangered Species (bald eagle)	a. typical year	- 440 ac/1 Breeding area	*SA	280 ac	I
	b. MSP	- 360 ac/2 Breeding areas	AF		
	c. 200-Year Flood	- 650 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 1,272 AUM	*I	TBD	I
	b. MSP	- 1,004 AUM	I		
	c. 200-Year Flood	- 1,654 AUM	Conditional I		

* The effects are displayed as adverse flag (AF), significant adverse (SA), insignificant (I), significant beneficial (SB), or beneficial flag (BF). The effect that best represents the impact significance is shown with an asterisk.

Table IV-19

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 9

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 0 ac	I	120 ac	I
	b. MSP	- 890 ac	SA		
	c. 200-Year Flood	- 1,620 ac	Conditional SA		
2. Other Terrestrial Biotic Communities	a. typical year	- 9,830 ac	*I	(3,230ac)	I
	b. MSP	- 7,950 ac	I		
	c. 200-Year Flood	- 7,950 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	no change in flow	*I	(21 mi)	I
	b. MSP	-1 mi	I		
	c. 200-Year Flood	-5 mi	Conditional SA		
4. Reservoir Aquatic Biotic Communities	a. typical year	+ 1,770 ac/+1 Minimum pool	*SA	Reduce drawdown rates	SB
	b. MSP	+ 8,740 ac	SA		
	c. 200-Year Flood	+12,900 ac	Conditional SA		
5. Threatened/Endangered Species (bald eagle) and Yuma clapper rail	a. typical year	- 170 ac	*I	120 ac	I
	b. MSP	- 100 ac/1 Breeding area	SA		
	c. 200-Year Flood	- 250 ac/1 Breeding area	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 935 AUM	*I	TBD	I
	b. MSP	- 856 AUM	I		
	c. 200-Year Flood	- 1,276 AUM	Conditional I		

* The effects are displayed as adverse flag (AF), significant adverse (SA), insignificant (I), significant beneficial (SB), or beneficial flag (BF). The effect that best represents the impact significance is shown with an asterisk.

For riparian/wetland biotic communities, cumulative net impact is for total riparian; unmitigated and mitigated effects were evaluated for high quality riparian. Mitigation would establish high quality habitat (cottonwood-willow, mesquite and cattail) on the acreages shown, but would not fully compensate project-related losses of such habitat.

2. Water Quality

a. Methodology

A water quality methodology was developed to assess the impacts and effects of each of the candidate plans. This methodology was formulated with the guidance of persons representing agencies concerned with the quality of water in central Arizona. The methodology appears in the Stage III Methodology for Environmental Quality Assessment, Section 3.2.

The methodology identifies changes in water quality brought about by the reservoir mixing of Colorado River and local surface water sources. The analysis presented in the water quality constituents section below uses only water quality data from samples taken by the U.S. Geological Survey and uses weighted averages to estimate "after-mix" constituent levels. A weighted average does not take into account the effects of the reservoir itself or the chemical interactions between various constituents.

The methodology also identifies potential eutrophication problems as significant impacts. Eutrophication potentials were computed for the Confluence and New Waddell Reservoirs where mixing of Colorado River and local surface waters would occur. The computations used the Canfield and Bachman equations described in the USBR Technical Memorandum titled Guidelines for Studies of Potential Eutrophication, 1981.

After the impacts to water quality constituents and eutrophication were assessed, the effect of the impacts was determined. The same group of advisors who provided consultation during the methodology formulation assisted in determining the process for assigning effects levels. The effects evaluation for the water quality constituents analysis examined the amount(s) of water affected by the impact, the magnitude of the impact, whether any applicable water quality criteria were exceeded, and the designated use(s) of the affected water.

b. Types of Impacts to Water Quality

(1) Operational Impacts

The water quality analysis has identified three types of significant operational impacts to water quality in the study area: 1) salt loading impacts, 2) impacts to water quality constituents, and 3) impacts to reservoir eutrophication potential.

(a) Salt Loading

Because of regulatory storage, additional CAP water could be developed and used in the study area. The development of this additional water (the regulatory storage yield) would not increase the salt concentration in the CAP water but would increase the total volume of salts imported (salt loading) to central Arizona. Without regulatory storage, the CAP would import an average of about 1,020,000 tons of salts each year. The salt loading impacts of the plans range from Plan 8, which would not change the salt loading, to Plan 3, which would increase the imported salts by about 16 percent each year.

While the imported salts to the basin will increase, such importation will work to reduce the total application of salts to the land. This is because the increment of additional water will replace ground water, which on the average is of poorer quality than the imported CAP water. Because the ground water quality varies throughout the area, this effect is dependent on the specific relationships of the quality of the ground water and the applied surface water at each point in the service area.

The major salt loading impacts of the CAP occur with the baseline CAP (no regulatory storage). The small increase in imported salts resulting from Plans 1, 2, 3, 6, 7, and 9 is considered insignificant in comparison to the salts imported by the entire CAP system and is therefore not considered in detail in this EIS. For further information see Water Allocations and Water Service Contracting Environmental Impact Statement, USBR 1982.

(b) Water Quality Constituents

Because of regulatory storage, CAP water could be mixed with or substituted for local water sources. The mixing could occur in a reservoir (New Waddell or Confluence) or in the delivery system (CAP water in a local delivery system). As a consequence of mixing, changes would occur in concentrations of various constituents in the local waters and in the CAP water. This is important because much of the natural surface water in the study area is diverted for uses which require good-quality water. It is important to note that if the constituent level of one source of water is increased by mixing, the constituent level of the other source of water will be decreased by mixing.

The current users of natural local waters affected by the plans would experience some water quality impacts. The Salt River Project (SRP) currently diverts Salt and Verde River water at Granite Reef Diversion Dam, and Maricopa County Municipal Water Conservation District #1 (MCMWCD) diverts waters of the Agua Fria River from Lake Pleasant. These waters are delivered to SRP users and MCMWCD user via open canals which are subject to the effects of aeration, temperature changes, detention time, and algal growth before delivery. Other quality effects on this water are the addition of pumped groundwater and chemical or physical effects of any treatment applied by the districts. Some of the CAWCS alternatives involve mixing of water from various sources or upstream exchanges which introduce

Colorado River water into existing delivery systems. For both the future-without and the future with regulatory storage, CAP water will be introduced or exchanged into these district delivery systems. Because the water delivered to the SRP and MCMWCD users undergoes a substantial change during transport, water quality differences with or without regulatory storage may not be detectable by the SRP or MCMWCD users.

For plans which include regulatory storage mixing of Colorado River and local surface water (Plans 3, 6, 7, 9), and have any potential for eutrophication, facilities to ensure that water delivered from the reservoir is adequately aerated during discharge will be provided. Aeration of water released from the reservoir would precipitate any dissolved heavy metals that might occur if eutrophication is present, before the water is delivered to users. The source of these heavy metals, with respect to reservoir operations, would likely be from bottom sediments which may redissolve in an oxygen deficient environment, if and when the reservoir becomes anaerobic.

(c) Eutrophication Potential

Regulatory storage mixing could produce changes in nutrient concentrations and ratios, leading to potential problems of eutrophication in the storage reservoirs or subsequently in the canal delivery system.

(2) Construction Impacts

There could be water quality impacts to existing surface water sources during the construction period of dams included in alternative plans. Except during severe floods, flows in the rivers would be diverted around the construction sites and otherwise controlled by the upstream dams. Potential water quality impacts, in the form of increased turbidity and sedimentation from clearing in the reservoir basin and from borrow areas, would be minimized wherever possible by holding the water in temporary sedimentation basins before release from the reservoir area. Water quality would also be adversely affected by point sources of wastewater, such as aggregate processing, concrete batching, and foundation draining. These small amounts of water would be contained on-site and allowed to evaporate, diposed of off-site, or treated to meet applicable criteria and released to the river channel. Sanitary wastes would have no impacts on water quality, since they would be removed to approved sites for disposal.

All plans (except Plan 8) would have potential for the same types of construction impacts. However, no construction impacts have been identified that could not be mitigated on site.

b. Water Quality Constituents

(1) Direct and Indirect Impacts

Direct impacts to water quality constituents would be the changes in constituent levels which result from the mixing or exchange of CAP and local surface waters. The indirect impacts would be experienced by the subsequent users of the affected CAP or local water.

Impacts to water quality constituents are compared with the future-without conditions in the following sections. Table IV-20 shows state and Federal regulated water contituents.

(a) Plan 8

In the future-without, Colorado River water would be imported to central Arizona by the CAP, but would not be stored in a reservoir. Distribution would occur through conveyance systems connected to the CAP aqueduct. M&I users of Colorado River water near Las Vegas report high levels of trihlomethane (THM) after chlorine disinfection, so normal disinfection of Colorado River water by CAP recipients could also produce high levels of THM.

In Plan 8 there would be no reservoir mixing of Colorado River and local waters prior to delivery. Water quality constituents of surface waters (SRP and MCMWCD#1) would not be affected by this plan. Concentrations of constituents in these waters are presented in the water quality section of Chapter III.

(b) Plan 1

Water quality constituent impacts of this plan would be caused by the direct substitution of Colorado River water for SRP water during the winter months and the introduction of SRP water into the CAP aqueduct during the summer months. It is estimated that only about 70,000 af of water, or 8 percent of the average annual SRP surface water supply, would be exchanged. The impacts to average CAP and SRP water beyond the exchange point and during the exchange period are shown on Table IV-21. During normal operation of the SRP system the Verde River supplies most of the SRP surface water during the proposed exchange period. CAP and Verde River water quality data is shown on Table IV-22 with the information in the last three columns showing the change that would occur during the exchange period.

The impacts of Plan 1 on water quality constituents are considered to be Insignificant because of the small amount of water affected and the fact that adequate notice for the exchange period would enable water users to plan for the different quality of the Colorado River water.

Table IV-20

STATE AND FEDERAL REGULATED WATER CONSTITUENTS
Units: mg/l Unless Noted Otherwise

	Arizona State Maximum Allowable Limits for Untreated Surface Water Protected Uses[a]					Federal and State Drinking Water Regulations for Treated Domestic Water[b]	
Constituents	Domestic Water (DWS)	Recreation Full Body (FBC)	Aquatic and Wildlife (A&W)	Agricultural Irrigation (AgI)	Livestock Watering (AgL)	Primary Maximum Contaminant Level (MCL)	Secondary Maximum Contaminant Level (SMCL)
Ammonia as NH_3	--	--	0.020	--	--	--	--
Arsenic, Diss	0.050	0.050	0.050	--	--	--	--
Arsenic, Total	--	--	--	2.000	0.200	0.050	--
Barium, Diss	1.000	1.000	--	--	--	--	--
Barium, Total	--	--	--	--	--	1.000	--
Boron, Total	--	--	--	1.000	--	--	--
Cadmium, Diss	--	--	0.010	--	--	--	--
Cadmium, Total	0.010	0.010	--	0.050	0.050	0.010	--
Chloride, Total	--	--	--	--	--	--	250.[d]
Chromium, Hexa	0.050	0.050	0.050	--	--	--	--
Chromium, Total	--	--	--	1.000	1.000	0.05	--
Copper, Diss	1.000	--	0.050	--	--	--	--
Copper, Total	--	--	--	5.000	0.500	--	1.[d]
Cyanides	0.200	0.200	0.020	--	0.200	--	--
Oxygen, Diss	--	GT 6.0	GT 6.0	--	--	--	--
Fluoride	--	--	--	--	--	1.4[c]	--
Iron, Total	--	--	--	--	--	--	0.3[d]
Lead, Diss	0.050	0.050	0.050	--	--	--	--
Lead, Total	--	--	--	10.000	0.100	0.05	--
Manganese	--	--	--	10.000	--	--	0.05[d]
Mercury, Total	0.002	0.002	0.002	--	0.010	0.002	--
Nitrate as N	--	--	--	--	--	10.	--
pH (pH Units)	--	6.5-9.0	6.5-9.0	4.5-9.0	6.5-9.0	--	6.5-8.5[d]
Phenolics	0.005	0.005	0.005	--	0.005	--	--
Selenium, Diss	0.010	0.010	--	--	--	--	--
Selenium, Total	--	--	0.050	0.020	0.050	0.01	--
Silver, Diss	0.050	0.050	0.050	--	--	--	--
Silver, Total	--	--	--	--	--	0.05	--
Sulfate	--	--	--	--	--	--	250.[d]
Sulfides	--	--	0.100	--	--	--	--
TDS	--	--	--	--	--	--	500.[d]
Turbidity (NTU)[e]	--	25.	25.	--	--	LT 5.[f]	--
Zinc, Diss	5.000	--	0.500	--	--	--	--
Zinc, Total	--	--	--	10.00	25.00	--	5.[d]

[a]ADHS, Rules and Regulations Title 9, Chapter 21, 1982. The above table does not list allowable limits for temperature alteration, coliform bacteria, organic compounds and radiochemicals. The partial body contact (PBC) protected use is not shown since there are no limits for the constituents listed, except pH.

[b]Code of Federal Regulation 40 CFR 141 and 143, 1980. ADHS, Rules and Regulations Title 9, Chapter 8, 1982. The above table does not list the MCL's for coliform bacteria, organic compounds and radiochemicals. Also not listed are SMCL's for color, corrosity, foaming agents and odor.

[c]Fluoride MCL ranges from 1.4 mg/l to 2.4 mg/l, depending on annual average of maximum daily local air temperatures which is assumed proportional to water intake. Average maximum daily air temperatures for Phoenix (85.1°F) and Tucson (81.5°F) have a MCL of 1.4 mg/l. USNOAA 1980.

[d]Federal SMCL's, the State of Arizona does not yet have any SMCL's (1982).

[e]Nephelometric turbidity units (NTU) are considered comparable to previously reported Formazin (FTU) and Jackson (JTU) turbidity units. Turbidity allowable limits apply to warm water lakes. Allowable limits for streams and cold water fisheries are not listed.

[f]The MCL is 1 NTU. However, 5 or less NTU's may be allowed if it does not cause interference with disinfection, maintenance or microbiological determinations.

Abbreviations: -- = No numeric standard established, GT = greater than, LT = les than, Diss = Dissolved Fraction, Total = Total Recoverable.

TABLE IV-21

WATER QUALITY IMPACTS
PLAN 1

(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions					
		CAP Water[b]			SRP Water[c]			CAP Water[d]			SRP Water[e]		
		Minimum	Average	Maximum	Minimum[f]	Average[g]	Maximum[f]	New Ave.	Change[h]	% Change[h]	New Ave.	Change[h]	% Change[h]
	Alkalinity as $CaCO_3$	98.0	128.	150.	15.0	154.	350.	131.	+ 3.0	+ 2	128.	- 26.0	- 17
D	Arsenic	0.00400	0.00400	0.00400	0.00200	0.00761	0.0180	0.00443	+ 0.00043	+ 11	0.00400	- 0.00361	- 47
T	Arsenic	BDL	0.00284	0.00500	0.00100	0.00792	0.0210	0.00345	+ 0.00061	+ 21	0.00284	- 0.00508	- 64
D	Barium[i]	BDL	BDL	BDL	BDL	0.0676	0.200	—	—	—	BDL	—	—
T	Barium[h]	BDL	0.135	0.500	BDL	0.100	0.200	0.131	- 0.004	- 3	0.135	+ 0.035	+ 35
	Bicarbonate	120.	156.	177.	18.0	193.	427.	160.	+ 4.00	+ 3	156.	- 37.0	- 19
T	Boron	0.0500	0.196	0.360	0.140	0.187	0.230	0.195	- 0.001	- <1	0.196	+ 0.009	+ 5
D	Cadmium	BDL	0.000286	0.00100	BDL	0.00113	0.0140	0.000387	+ 0.000101	+ 35	0.000286	- 0.000844	- 75
T	Cadmium	BDL	0.00462	0.0130	BDL	0.00648	0.0100	0.00484	+ 0.00022	+ 5	0.00462	- 0.00186	- 29
	Calcium	73.0	85.6	100.	19.0	47.0	420.	80.9	- 4.70	- 5	85.6	+ 38.6	+ 82
T	Carbon (organic)	1.90	4.55	14.0	1.80	4.54	18.0	4.55	0	0	4.55	+ 0.01	+< 1
	Carbonate	BDL	0.0288	4.00	BDL	0.879	35.0	0.131	+ 0.102	+ 354	0.0288	- 0.85	- 97
	Chloride	75.0	94.5	140.	2.00	141.	610.	100.	+ 5.5	+ 6	94.5	- 46.5	- 33
	Chromium (Hexa)	0.00100	0.00100	0.00100	—	—	—	—	—	—	0.00100	—	—
T	Chromium	BDL	0.00357	0.0200	BDL	0.00268	0.0100	0.00346	- 0.00011	- 3	0.00357	+ 0.00089	+ 33
D	Copper[i]	BDL	BDL	BDL	BDL	0.00261	0.00700	—	—	—	BDL	—	—
T	Copper	BDL	0.00793	0.0290	BDL	0.00877	0.0200	0.00803	+ 0.00037	+ 5	0.00793	- 0.00084	- 10
T	Cyanide	BDL	0.000862	0.0200	—	—	—	—	—	—	0.000862	—	—
	Oxygen (Dissolved)	5.10	8.53	11.7	1.60	8.76	17.8	8.56	+ 0.03	+ <1	8.53	- 0.23	- 3
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	1.00	16.1	470.	6.14	+ 1.36	+ 28	4.78	- 11.3	- 70
D	Fluoride (84.7°F)	0.200	0.378	0.500	BDL	0.363	1.10	0.376	- 0.002	- <1	0.378	+ 0.015	+ 4
	Hardness (Total, as $CaCO_3$)	290.	339.	380.	79.0	194.	413.	322.	-17.0	- 5	339.	+145.	+ 75
	Hardness (noncarbonate)	170.	211.	243.	BDL	36.3	182.	190.	-21.0	- 10	211.	+175.	+482
T	Iron	0.0300	0.159	0.550	BDL	0.189	3.50	0.163	+ 0.004	+ 3	0.159	- 0.03	- 16
D	Lead	BDL	0.00144	0.00400	BDL	0.00507	0.0600	0.00188	+ 0.00044	+ 31	0.00144	- 0.00363	- 72
T	Lead	BDL	0.0408	0.100	BDL	0.0731	0.100	0.0447	+ 0.0039	+ 10	0.0408	- 0.0323	- 44
	Magnesium	26.0	30.9	40.0	5.50	18.9	55.0	29.5	- 1.40	- 5	30.9	+ 12.0	+ 63
T	Manganese	BDL	0.0208	0.0400	BDL	0.0743	0.380	0.0272	+ 0.0064	+ 31	0.0208	- 0.0535	- 72
T	Mercury	BDL	0.0000431	0.000600	BDL	0.000138	0.00260	0.0000545	+ 0.0000114	+ 26	0.0000431	- 0.0000949	- 69
T	Nitrate (as N)	0.170	0.170	0.170	BDL	0.0720	0.160	0.158	- 0.012	- 7	0.170	+ 0.098	+136
	pH (pH units)	7.10	7.95	8.80	4.50	7.86	9.10	7.94	- 0.01	- <1	7.95	+ 0.09	+ 1
T	Phosphorus (as P)	BDL	0.0258	0.100	BDL	0.216	8.30	0.0486	+ 0.0228	+ 88	0.0258	- 0.19	- 88
	Potassium	4.50	5.21	6.80	1.30	4.78	42.0	5.16	- 0.05	- <1	5.21	+ 0.43	+ 9
D	Selenium	0.00300	0.00300	0.00300	BDL	0.000430	0.00300	0.00269	- 0.000308	- 10	0.00300	+ 0.00257	+598
T	Selenium	BDL	0.00279	0.00500	BDL	0.000410	0.00200	0.00250	- 0.00029	- 10	0.00279	+ 0.00238	+580
	Specific Cond. (µ℧/cm)	950.	1120.	1720.	150.	869.	2340.	1090.	-30.0	- 3	1120.	+251.	+ 29
D	Silver[i]	BDL	BDL	BDL	BDL	BDL	BDL	—	—	—	BDL	—	—
T	Silver	BDL	0.00350	0.0100	BDL	0.000975	0.0100	0.00320	- 0.0003	- 9	0.00350	+ 0.00253	+259
	Sodium	90.0	107.	120.	4.20	105.	382.	107.	0	0	107.	+ 2.0	+ 2
	Sodium Adsorption Ratio (no units)	2.20	2.54	2.88	0.210	3.30	10.4	2.63	+ 0.09	+ 4	2.54	- 0.76	- 23
	Sulfate	240.	309.	380.	11.0	52.0	360.	278.	-31.0	- 10	309.	+257.	+494
	Dissolved solids (180°C)	602.	722.	848.	109.	497.	1300.	695.	-27.0	- 4	722.	+225.	+ 45
	Turbidity (JTU)	1.00	2.58	10.0	1.00	37.5	2800.	6.77	+ 4.19	+ 162	2.58	- 35.	- 93
D	Zinc	BDL	0.00889	0.0200	BDL	0.0121	0.120	0.00928	+ 0.00039	+ 4	0.00889	- 0.00321	- 27
T	Zinc	BDL	0.0239	0.310	0.0100	0.0342	0.200	0.0251	+ 0.0012	+ 5	0.0239	- 0.0103	- 30
	Phenolics	BDL	0.00127	0.00700	—	—	—	—	—	—	0.00127	—	—

Note: D = Dissolved Fraction; T = Total Recoverable; -- = Data Not Available; BDL = Below Detection Level

a Levels shown rounded to three significant figures.
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d In CAP aqueduct after impacts of water exchange with SRP.
e At Granite Reef Diversion Dam. During exchange period, SRP water would be the same as CAP water.
f Minimum and maximum values are for the Salt or Verde Rivers and could be experienced only if one river was flowing.
g Weighted average based on STORET data and USGS flow records resulting in a 43 percent Verde River and 57 percent Salt River mix at the confluence of the two rivers.
h Changes are relative to future without average values.
i Constituents with "below detection level" future without average values could not be used to calculate future with values.

TABLE IV-22

WATER QUALITY IMPACTS
PLAN 1
(Special Case)
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions		
		CAP Water[b]			Verde River Water[c]			SRP Water[d]		
		Minimum	Average	Maximum	Minimum	Average	Maximum	New Ave.	Change[e]	% Change[e]
	Alkalinity as $CaCO_3$	98.0	128.	150.	28.0	185.	350.	128.	- 57.0	- 31
D	Arsenic	0.00400	0.00400	0.00400	0.00500	0.0121	0.0180	0.00400	- 0.0081	- 67
T	Arsenic	BDL	0.00284	0.00500	0.00700	0.0133	0.0210	0.00284	- 0.0105	- 79
D	Barium[f]	BDL	BDL	BDL	BDL	0.0550	0.100	BDL	--	--
T	Barium	BDL	0.135	0.500	BDL	0.100	0.200	0.135	+ 0.035	+ 35
	Bicarbonate	120.	156.	177.	34.0	236.	427.	156.	- 80.0	- 34
T	Boron	0.0500	0.196	0.360	0.190	0.190	0.190	0.196	+ 0.006	+ 3
D	Cadmium	BDL	0.000286	0.00100	BDL	0.00156	0.0140	0.000286	- 0.00127	- 81
T	Cadmium	BDL	0.00462	0.0130	BDL	0.00619	0.0100	0.00462	- 0.00157	- 25
	Calcium	73.0	85.6	100.	19.0	42.5	75.0	85.6	+ 43.1	+ 101
T	Carbon (Organic)	1.90	4.55	14.0	1.80	4.20	9.60	4.55	+ 0.35	+ 8
	Carbonate	BDL	0.0288	4.00	BDL	1.57	15.0	0.0288	- 1.54	- 98
	Chloride	75.0	94.5	140.0	2.00	18.8	130.	94.5	75.7	+ 403
	Chromium (Hexa)	0.00100	0.00100	0.00100	--	--	--	0.00100	--	--
T	Chromium	BDL	0.00357	0.0200	BDL	0.00375	0.0100	0.00357	- 0.00018	- 5
D	Copper[f]	BDL	BDL	BDL	BDL	0.00275	0.00700	BDL	--	--
T	Copper	BDL	0.00793	0.0290	0.00300	0.00888	0.0200	0.00793	- 0.00095	- 11
T	Cyanide	BDL	0.000862	0.0200	--	--	--	0.000862	--	--
	Oxygen (Dissolved)	5.10	8.53	11.7	8.60	11.6	17.8	8.53	- 3.07	- 26
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	1.00	8.35	99.0	4.78	- 3.57	- 43
D	Fluoride (84.7°F)	0.200	0.378	0.500	BDL	0.340	0.800	0.378	+ 0.038	+ 11
	Hardness (Total, as $CaCO_3$)	290.	339.	380.	79.0	212.	413.	339.	+127.	+ 60
	Hardness (noncarbonate)	170.	211.	243.	BDL	18.9	182.	211.	+192.	+1016
T	Iron	0.0300	0.159	0.550	BDL	0.192	3.50	0.159	- 0.033	- 17
D	Lead	BDL	0.00144	0.00400	BDL	0.00300	0.0120	0.00144	- 0.00156	- 52
T	Lead	BDL	0.0408	0.100	0.00400	0.0714	0.100	0.0408	- 0.0306	- 43
	Magnesium	26.0	30.9	40.0	6.40	25.7	55.0	30.9	+ 5.2	+ 20
T	Manganese	BDL	0.0208	0.0400	BDL	0.0900	0.380	0.0208	- 0.0692	- 77
T	Mercury[f]	BDL	0.0000431	0.000600	BDL	0.000263	0.00260	0.0000431	- 0.00022	- 84
T	Nitrate (as N)	0.170	0.170	0.170	0.0200	0.0967	0.140	0.170	+ 0.0733	+ 76
	pH (pH units)	7.10	7.95	8.80	6.80	8.01	8.80	7.95	- 0.06	- <1
T	Phosphorus (as P)	BDL	0.0258	0.100	BDL	0.206	0.400	0.0258	- 0.18	- 87
	Potassium	4.50	5.21	6.80	1.30	3.39	7.40	5.21	+ 1.82	+ 54
D	Selenium	0.00300	0.00300	0.00300	BDL	0.000750	0.00300	0.00300	+ 0.00225	+ 300
T	Selenium	BDL	0.00279	0.00500	BDL	0.000600	0.00100	0.00279	+ 0.00219	+ 365
	Specific Cond. (µb/cm)	950.	1120.	1720.	150.	510.	929.	1120.	+610.	+ 120
D	Silver[f]	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--
T	Silver[f]	BDL	0.00350	0.0100	BDL	BDL	BDL	0.00350	--	--
	Sodium	90.0	107.	120.	4.20	30.4	290.	107.	+ 76.6	+ 252
	Sodium Adsorption Ratio (no units)	2.20	2.54	2.88	0.210	0.880	8.21	2.54	+ 1.66	+ 189
	Sulfate	240.	309.	380.	11.0	52.9	107.	309.	+256.	+ 484
	Dissolved solids (180°C)	602.	722.	848.	109.	314.	550.	722.	+408.	+ 130
	Turbidity (JTU)	1.00	2.58	10.0	1.00	83.3	2800.	2.58	- 80.7	- 97
D	Zinc	BDL	0.00889	0.0200	BDL	0.00700	0.0300	0.00889	+ 0.00189	+ 27
T	Zinc	BDL	0.0239	0.310	0.0100	0.0356	0.200	0.0239	- 0.0117	- 33
	Phenolics	BDL	0.00127	0.00700	--	--	--	0.00127	--	--

Note: D = Dissolved Fraction; T = Total Recoverable; -- = Data Not Available; BDL = Below Detection Level

a Levels shown rounded to three significant figures.
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d At Granite Reef Diversion Dam. During the exchange period, SRP water would be the same as CAP water.
e Changes are relative to future without average values.
f Constituents with "below detection level" future without average values could not be used to calculate future with values.

(c) Plan 2

There would be no regulatory storage of Colorado River water associated with this plan. The resulting water quality impacts would be associated only with changes in detained flood waters and in flood flows. In general this plan would provide for flood flows over a longer period at smaller flow rates. There would be no impacts to water quality constituents associated with this plan.

(d) Plan 3

Water quality constituent impacts during the operation of this plan would primarily be caused by the mixing of Colorado River water with local surface water at the Confluence sites. The impacts to both the average CAP and SRP surface water supplies are shown in Table IV-23. A special impact assessment showing impacts to SRP water during the period when operations would deliver only Verde River water is shown in Table IV-24.

The impacts of Plan 3 on water quality constituents are considered to be Significant Adverse because of the large amount of SRP water affected and the large percentage of the SRP water which is normally treated for municipal and industrial use.

(e) Plans 6, 7, and 9

Water quality constituent impacts of these plans would be caused by the regulatory storage mixing of CAP Colorado River water with MCMWCD#1 Agua Fria River water at the New Waddell site and by the addition of SRP water to the CAP aqueduct near Granite Reef Diversion Dam. Plans 6, 7, and 9 would have the same impacts to water quality constituents since both plans use the same operation at the New Waddell and Granite Reef sites. SRP water quality would not be affected by either plan. The impacts of regulatory storage to both the average CAP and MCMWCD#1 surface water supplies are shown on Table IV-25. The additional impacts to average CAP water which result from adding SRP water near the Granite Reef site are shown on Table IV-26.

Table IV-25 shows that several MCMWCD#1 constituents undergo noticeable increases as a result of mixing with Colorado River water. The magnitude of these increases is determined by the relative volumes of water in the MCMWCD#1 and CAP pools during normal operations. During the period from 1928 to 1980, MCMWCD#1 delivered to its users about 66,000 af of water each year. However only 25,000 af, or about 41 percent, of this was surface water from Lake Pleasant (MCMWCD#1, Unpublished Data, 1981). This average annual surface water yield is relatively small when compared to the estimated 660,000 af of CAP water to be stored in New Waddell Reservoir; even though there are likely to be significant changes in constituents levels of MCMWCD#1 water, the amount of water affected each year is relatively small. Since the MCMWCD#1 water is not used as a source of domestic water, only the State of Arizona criteria for full body contact, aquatic and wildlife uses, agricultural irrigation, and livestock watering apply to the MCMWCD#1 water at the New Waddell site. None of these criteria will be exceeded as a result of

TABLE IV- 23

WATER QUALITY IMPACTS
PLAN 3
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions					
		CAP Water[b]			SRP Water[c]			CAP Water[d]			SRP Water[e]		
		Minimum	Average	Maximum	Minimum[f]	Average[g]	Maximum[f]	New Ave.	Change[h]	% Change[h]	New Ave.	Change[h]	% Change[h]
	Alkalinity as $CaCO_3$	98.0	128.	150.	15.0	154.	350.	133.	+ 5.0	+ 4	147.	- 7.0	- 5
D	Arsenic	0.00400	0.00400	0.00400	0.00200	0.00761	0.0180	0.00471	+ 0.00071	+ 18	0.00664	- 0.00097	- 13
T	Arsenic	BDL	0.00284	0.00500	0.00100	0.00792	0.0210	0.00384	+ 0.001	+ 35	0.00656	- 0.00136	- 17
D	Barium[i]	BDL	BDL	BDL	BDL	0.0676	0.200	—	—	—	—	—	—
T	Barium	BDL	0.135	0.500	BDL	0.100	0.200	0.128	- 0.007	- 5	0.109	+ 0.009	+ 9
	Bicarbonate	120.	156.	177.	18.0	193.	427.	163.	+ 7.0	+ 4	183.	- 10.0	- 5
T	Boron	0.0500	0.196	0.360	0.140	0.187	0.230	0.194	- 0.002	- 1	0.189	+ 0.002	+ 1
D	Cadmium	BDL	0.000286	0.00100	BDL	0.00113	0.0140	0.000451	+ 0.000165	+ 58	0.000904	- 0.000226	- 20
T	Cadmium	BDL	0.00462	0.0130	BDL	0.00648	0.0100	0.00498	+ 0.00036	+ 8	0.00598	- 0.0005	- 8
	Calcium	73.0	85.6	100.	19.0	47.0	420.	78.0	- 7.6	- 9	57.3	+ 10.3	+ 22
T	Carbon (Organic)	1.90	4.55	14.0	1.80	4.54	18.0	4.55	0	0	4.54	0	0
	Carbonate	BDL	0.0288	4.00	BDL	0.879	35.0	0.195	+ 0.166	+576	0.651	- 0.228	- 26
	Chloride	75.0	94.5	140.	2.00	141.	610.	104.	+ 9.5	+ 10	129.	- 12.0	- 9
	Chromium (Hexa)	0.00100	0.00100	0.00100	—	—	—	—	—	—	—	—	—
T	Chromium	BDL	0.00357	0.0200	BDL	0.00268	0.0100	0.00340	- 0.00017	- 5	0.00292	+ 0.00024	+ 9
D	Copper[i]	BDL	BDL	BDL	BDL	0.00261	0.00700	—	—	—	—	—	—
T	Copper	BDL	0.00793	0.0290	BDL	0.00877	0.0200	0.00809	+ 0.00097	+ 12	0.00854	- 0.00023	- 3
T	Cyanide	BDL	0.000862	0.0200	—	—	—	—	—	—	—	—	—
	Oxygen (Dissolved)	5.10	8.53	11.7	1.60	8.76	17.8	8.58	+ 0.05	+ <1	8.70	- 0.06	- <1
	Fecal Coliforms (cols/100 ml)	0.990	4.76	41.9	1.00	16.1	470.	7.00	+ 2.22	+ 46	13.1	- 3.0	- 19
D	Fluoride (84.7°F)	0.200	0.378	0.500	BDL	0.363	1.10	0.375	- 0.003	- <1	0.367	+ 0.004	+ 1
	Hardness (Total, as $CaCO_3$)	290.	339.	380.	79.0	194.	413.	311.	-28.0	- 8	233.	+ 39.0	+ 20
	Hardness (noncarbonate)	170.	211.	243.	BDL	36.3	182.	177.	-34.0	- 16	83.1	+ 46.8	+129
T	Iron	0.0300	0.159	0.550	BDL	0.189	3.50	0.165	+ 0.006	+ 4	0.181	- 0.008	- 4
D	Lead	BDL	0.00144	0.00400	BDL	0.00507	0.0600	0.00215	+ 0.00071	+ 49	0.00410	- 0.00097	- 19
T	Lead	BDL	0.0408	0.100	BDL	0.0731	0.100	0.0471	+ 0.0063	+ 15	0.0644	- 0.0087	-119
	Magnesium	26.0	30.9	40.0	5.50	18.9	55.0	28.5	- 2.4	- 8	22.1	+ 3.20	+ 17
T	Manganese	BDL	0.0208	0.0400	BDL	0.0743	0.380	0.0313	+ 0.0105	+ 50	0.0600	- 0.0143	- 19
T	Mercury	BDL	0.0000431	0.000600	BDL	0.000138	0.00260	0.0000617	+ 0.0000186	+ 43	0.000113	- 0.000025	-181
T	Nitrate (as N)	0.170	0.170	0.170	BDL	0.0720	0.160	0.151	- 0.019	- 11	0.0983	+ 0.0263	+ 37
	pH (pH units)	7.10	7.95	8.80	4.50	7.86	9.10	7.93	- 0.02	- <1	7.88	+ 0.02	+ <1
T	Phosphorus (as P)	BDL	0.0258	0.100	BDL	0.216	8.300	0.0631	+ 0.0373	+145	0.165	- 0.051	- 24
	Potassium	4.50	5.21	6.80	1.30	4.78	42.0	5.13	- 0.08	- 2	4.90	+ 0.12	+ 3
D	Selenium	0.00300	0.00300	0.00300	BDL	0.000430	0.00300	0.00250	- 0.0005	- 17	0.00112	+ 0.00069	+160
T	Selenium	BDL	0.00279	0.00500	BDL	0.000410	0.00200	0.00232	- 0.00047	- 17	0.00105	+ 0.00064	+156
	Specific Cond. (µS/cm)	950.	1120.	1720.	150.	869.	2340.	1070.	-50.0	- 4	936.	+ 67.0	+ 8
D	Silver[i]	BDL	BDL	BDL	BDL	BDL	BDL	—	—	—	—	—	—
T	Silver	BDL	0.00350	0.0100	BDL	0.000975	0.0100	0.00301	- 0.00049	- 14	0.00165	+ 0.000675	+ 69
	Sodium	90.0	107.	120.	4.20	105.	382.	107.	0	0	106.	+ 1.0	+ <1
	Sodium Adsorption Ratio (no units)	2.20	2.54	2.88	0.210	3.30	10.4	2.69	+ 0.15	+ 6	3.10	- 0.2	- 6
	Sulfate	240.	309.	380.	11.0	52.0	360.	259.	-50.0	- 16	121.	+ 69.0	+133
	Dissolved Solids (180°C)	602.	722.	848.	109.	497.	1300.	678.	-44.1	- 6	557.	+ 60.0	+ 12
	Turbidity (JTU)	1.00	2.58	10.0	1.00	37.5	2800.	9.42	+ 6.84	+265	28.18	- 9.40	- 25
D	Zinc	BDL	0.00889	0.0200	BDL	0.0121	0.120	0.00952	+ 0.00063	+ 7	0.0112	- 0.0009	- 7
T	Zinc	BDL	0.0239	0.310	0.0100	0.0342	0.200	0.0259	+ 0.002	+ 8	0.0314	- 0.0028	- 8
	Phenolics	BDL	0.00127	0.00700	—	—	—	—	—	—	—	—	—

Note: D = Dissolved Fraction; T = Total Recoverable; -- = Data Not Available; BDL = Below Detection Level

a Levels shown rounded to three significant figures.
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d In CAP aqueduct after regulatory storage mixing. CAP deliveries before Granite Reef would not be affected by impacts at the Confluence Reservoir.
e At Granite Reef Diversion Dam.
f Minimum and maximum values are for the Salt or Verde Rivers and could be experienced only if one river was flowing.
g Weighted average based on STORET data and USGS flow records resulting in a 43 percent Verde River and 57 percent Salt River mix at the confluence of the two rivers.
h Changes are relative to future without average values.
i Constituents with "below detection level" future without average values could not be used to calculate future with values.

TABLE IV-24

WATER QUALITY IMPACTS
PLAN 3
(Special Case)
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions		
		CAP Water[b]			Verde River Water[c]			SRP Water[d]		
		Minimum	Average	Maximum	Minimum	Average	Maximum	New Ave.	Change[e]	% Change[e]
	Alkalinity as $CaCO_3$	98.0	128.	150.	28.0	185.	350.	160.	- 25.0	- 14
D	Arsenic	0.00400	0.00400	0.00400	0.00500	0.0121	0.0180	0.00855	- 0.00355	- 29
T	Arsenic	BDL	0.00284	0.00500	0.00700	0.0133	0.0210	0.00872	- 0.00458	- 34
D	Barium[f]	BDL	BDL	BDL	BDL	0.0550	0.100	--	--	--
T	Barium	BDL	0.135	0.500	BDL	0.100	0.200	0.115	+ 0.015	+ 15
	Bicarbonate	120.	156.	177.	34.0	236.	427.	201.	- 35.0	- 15
T	Boron	0.0500	0.196	0.360	0.190	0.190	0.190	0.193	+ 0.003	+ 2
D	Cadmium	BDL	0.000286	0.00100	BDL	0.00156	0.0140	0.00100	- 0.00056	- 36
T	Cadmium	BDL	0.00462	0.0130	BDL	0.00619	0.0100	0.00550	- 0.00069	- 11
	Calcium	73.0	85.6	100.	19.0	42.5	75.0	61.4	+ 18.9	+ 44
T	Carbon (Organic)	1.90	4.55	14.0	1.80	4.20	9.60	4.35	+ 0.15	+ 4
	Carbonate	BDL	0.0288	4.00	BDL	1.57	15.0	0.895	- 0.675	- 43
	Chloride	75.0	94.5	140.	2.00	18.8	130.	51.9	+ 33.1	+176
	Chromium (Hexa)	0.00100	0.00100	0.00100	--	--	--	--	--	--
T	Chromium	BDL	0.00357	0.0200	BDL	0.00375	0.0100	0.00367	- 0.00008	- 2
D	Copper[f]	BDL	BDL	BDL	BDL	0.00275	0.00700	--	--	--
T	Copper	BDL	0.00793	0.0290	0.00300	0.00888	0.0200	0.00846	- 0.00042	- 5
T	Cyanide	BDL	0.000862	0.0200	--	--	--	--	--	--
	Oxygen (Dissolved)	5.10	8.53	11.7	8.60	11.6	17.8	10.3	- 1.3	- 11
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	1.00	8.35	99.0	6.79	- 1.56	- 19
D	Fluoride (84.7°F)	0.200	0.378	0.500	BDL	0.340	0.800	0.357	+ 0.017	+ 5
	Hardness (Total, as $CaCO_3$)	290.	339.	380.	79.0	212.	413.	268.	+ 56	+ 26
	Hardness (noncarbonate)	170.	211.	243.	BDL	18.9	182.	103.	+ 84.1	+445
T	Iron	0.0300	0.159	0.550	BDL	0.192	3.50	0.178	- 0.014	- 7
D	Lead	BDL	0.00144	0.00400	BDL	0.00300	0.0120	0.00232	- 0.00068	- 23
T	Lead	BDL	0.0408	0.100	0.00400	0.0714	0.100	0.0580	- 0.0134	- 19
	Magnesium	26.0	30.9	40.0	6.40	25.7	55.0	27.9	+ 2.20	+ 9
T	Manganese	BDL	0.0208	0.0400	BDL	0.0900	0.380	0.0597	- 0.303	- 34
T	Mercury	BDL	0.0000431	0.000600	BDL	0.000263	0.00260	0.000167	- 0.000096	- 37
T	Nitrate (as N)	0.170	0.170	0.170	0.0200	0.0967	0.140	0.129	+ 0.323	+ 33
	pH (pH units)	7.10	7.95	8.80	6.80	8.01	8.80	7.98	- 0.03	- <1
T	Phosphorus (as P)	BDL	0.0258	0.100	BDL	0.206	0.400	0.127	- 0.079	- 38
	Potassium	4.50	5.21	6.80	1.30	3.39	7.40	4.19	+ 0.8	+ 24
D	Selenium	0.00300	0.00300	0.00300	BDL	0.000750	0.00300	0.00174	+ 0.00099	+132
T	Selenium	BDL	0.00279	0.00500	BDL	0.000600	0.00100	0.00156	+ 0.00096	+160
	Specific Cond. (µ℧/cm)	950.	1120.	1720.	150.	510.	929.	777.	+267.	+ 52
D	Silver[f]	BDL	BDL	BDL	BDL	BDL	BDL	--	--	--
T	Silver[f]	BDL	0.00350	0.0100	BDL	BDL	BDL	--	--	--
	Sodium	90.0	107.	120.	4.20	30.4	290.	64.0	+ 33.6	+111
	Sodium Adsorption Ratio (no units)	2.20	2.54	2.88	0.210	0.880	8.21	1.61	+ 0.73	+ 83
	Sulfate	240.	309.	380.	11.0	52.9	107.	165.	+112.	+212
	Dissolved solids (180°C)	602.	722.	848.	109.	314.	550.	493.	+179.	+ 57
	Turbidity (JTU)	1.00	2.58	10.0	1.00	83.3	2800.	47.9	- 35.4	- 42
D	Zinc	BDL	0.00889	0.0200	BDL	0.00700	0.0300	0.00783	+ 0.00083	+ 12
T	Zinc	BDL	0.0239	0.310	0.0100	0.0356	0.200	0.0305	- 0.0051	- 14
	Phenolics	BDL	0.00127	0.00700	--	--	--	--	--	--

Note: D = Dissolved Fraction; T = Total Recoverable; -- = Data Not Available; BDL - Below Detection Level

a Levels shown rounded to three significant figures.
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d At Granite Reef Diversion Dam.
e Changes are relative to future without average values.
f Constituents with "below detection level" future without average values could not be used to calculate future with values.

TABLE IV-25

WATER QUALITY IMPACTS
PLANS 6, 7, AND 9 - IMPACTS FROM REGULATORY STORAGE AT WADDELL
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions					
		CAP Water[b]			MCMWCD#1 Water[c]			CAP Aqueduct Water[d]			MCMWCD#1 Water[e]		
		Minimum	Average	Maximum	Minimum	Average	Maximum	New Ave.	Change[f]	% Change[f]	New Ave.	Change[f]	% Change[f]
	Alkalinity as $CaCO_3$	98.0	128.	150.	140.	175.	190.	129.	+ 1.0	+ <1	130.	- 45.0	- 26
D	Arsenic[g]	0.00400	0.00400	0.00400	0.00900	0.0100	0.0110	0.00414	+ 0.00014	+ 4	0.00420	- 0.0058	- 58
T	Arsenic	BDL	0.00284	0.00500	0.00900	0.0133	0.0160	0.00309	+ 0.00025	+ 9	0.00320	- 0.0101	- 76
D	Barium[gh]	BDL	BDL	BDL	0.0650	0.0750	0.0810	--	--	--	--	--	--
T	Barium[h]	BDL	0.135	0.500	<0.100	<0.100	0.100	0.134	- 0.001	- <1	0.134	+ 0.034	+ 34
	Bicarbonate	120.	156.	177.	--	--	--	--	--	--	--	--	--
T	Boron	0.0500	0.196	0.360	0.0900	0.165	0.230	0.195	- 0.001	- <1	0.195	+ 0.03	+ 18
D	Cadmium[gh]	BDL	0.000286	0.00100	<0.00300	<0.00300	<0.00300	0.000351	+ 0.000065	+ 23	0.000378	- 0.00262	- 87
T	Cadmium[h]	BDL	0.00462	0.0130	<0.00100	<0.00150	0.00200	0.00455	- 0.00007	- 2	0.00451	+ 0.00301	+201
	Calcium	73.0	85.6	100.	39.0	50.8	58.0	84.8	- 0.8	- <1	84.4	+ 33.6	+ 66
T	Carbon (Organic)	1.90	4.55	14.0	2.50	4.10	5.20	4.54	- 0.01	- <1	4.53	+ 0.43	+ 10
	Carbonate	BDL	0.0288	4.00	--	--	--	--	--	--	--	--	--
	Chloride	75.0	94.5	140.	32.0	36.0	40.0	93.1	- 1.4	- 1	92.5	+ 56.5	+157
	Chromium (Hexa)	0.00100	0.00100	0.00100	--	--	--	--	--	--	--	--	--
T	Chromium	BDL	0.00357	0.0200	0.00300	0.00725	0.0190	0.00366	+ 0.00009	+ 3	0.00370	- 0.00355	- 49
D	Copper[gh]	BDL	BDL	BDL	0.00700	0.00750	0.00800	--	--	--	--	--	--
T	Copper	BDL	0.00793	0.0290	0.00700	0.0138	0.0290	0.00807	+ 0.00014	+ 2	0.00815	- 0.00567	- 41
T	Cyanide[h]	BDL	0.000862	0.0200	<0.0100	<0.0100	<0.0100	0.00108	+ 0.000218	+ 25	0.00117	- 0.00883	- 88
	Oxygen (Dissolved)	5.10	8.53	11.7	8.60	8.88	9.10	8.54	+ 0.01	+ <1	8.54	- 0.34	- 4
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	4.00	36.3	120.	5.54	+ 0.76	+ 16	5.85	- 30.4	- 88
D	Fluoride (84.7°F)	0.200	0.378	0.500	0.300	0.325	0.400	0.377	- 0.001	- <1	0.376	+ 0.051	+ 16
	Hardness (Total, as $CaCO_3$)	290.	339.	380.	160.	215.	240.	336.	- 3.0	- <1	335.	+120.	+ 56
	Hardness (noncarbonate)	170.	211.	243.	23.0	41.3	54.0	207.	- 4.0	- 2	205.	+164.	+397
T	Iron	0.0300	0.159	0.550	0.0600	2.04	6.40	0.204	+ 0.045	+ 28	0.223	- 1.82	- 89
D	Lead[g]	BDL	0.00144	0.00400	0.00200	0.00200	0.00200	0.00145	+ 0.00001	+ <1	0.00146	- 0.00054	- 27
T	Lead	BDL	0.0408	0.100	0.00100	0.00425	0.00800	0.0399	- 0.0009	- 2	0.0396	+ 0.0354	+832
	Magnesium	26.0	30.9	40.0	16.0	21.8	25.0	30.7	- 0.2	- <1	30.6	+ 8.8	+ 40
T	Manganese	BDL	0.0208	0.0400	0.0100	0.0850	0.270	0.0223	+ 0.0015	+ 7	0.0230	- 0.062	- 73
T	Mercury[gh]	BDL	0.0000431	0.000600	<0.000100	<0.000100	<0.000100	0.0000445	+ 0.0000014	+ 3	0.0000450	- 0.000055	- 55
T	Nitrate (as N)	0.170	0.170	0.170	3.20	3.85	4.50	0.258	+ 0.088	+ 52	0.295	- 3.56	- 92
	pH (pH units)	7.10	7.95	8.80	8.30	8.43	8.60	7.96	+ 0.01	+ <1	7.97	- 0.46	- 5
T	Phosphorus (as P)	BDL	0.0258	0.100	0.0900	0.150	0.180	0.0288	+ 0.003	+ 12	0.0300	- 0.12	- 80
	Potassium	4.50	5.21	6.80	1.60	1.98	2.30	5.13	- 0.08	- 2	5.10	+ 3.12	+158
D	Selenium[gh]	0.00300	0.00300	0.00300	<0.00100	<0.00100	<0.00100	0.00295	- 0.00005	- 2	0.00293	+ 0.00193	+193
T	Selenium[h]	BDL	0.00279	0.00500	<0.00100	<0.00100	0.00100	0.00275	- 0.00004	- 2	0.00273	+ 0.00173	+173
	Specific Cond. (µU/cm)	950.	1120.	1720.	420.	582.	676.	1110.	-10.0	- <1	1100.	+518.	+ 89
D	Silver[gh]	BDL	BDL	BDL	<0.00100	<0.00100	<0.00100	--	--	--	--	--	--
T	Silver[h]	BDL	0.00350	0.0100	<0.00100	<0.00100	<0.00100	0.00344	- 0.00006	- 2	0.00342	+ 0.00242	+242
	Sodium	90.0	107.	120.	25.0	37.8	45.0	105.	- 2.0	- 2	105.	+ 67.2	+178
	Sodium Adsorption Ratio (no units)	2.20	2.54	2.88	0.900	1.20	1.40	2.51	- 0.03	- 1	2.49	+ 1.29	+108
	Sulfate	240.	309.	380.	53.0	85.0	100.	304.	- 5.0	- 2	301.	+216.	+254
	Dissolved Solids (180°C)	602.	722.	848.	257.	358.	401.	713.	- 9.0	- 1	710.	+352.	+ 98
	Turbidity (JTU)[i]	1.00	2.58	10.0	0.600	31.6	110.	--	--	--	--	--	--
D	Zinc[gh]	BDL	0.00889	0.0200	<0.0120	<0.0120	<0.0120	0.00896	+ 0.00007	+ <1	0.00900	- 0.003	- 25
T	Zinc	BDL	0.0239	0.310	0.0200	0.0325	0.0600	0.0241	+ 0.0002	+ <1	0.0242	- 0.0083	- 26
	Phenolics	BDL	0.00127	0.00700	--	--	--	--	--	--	--	--	--

Note: D = Dissolved Fraction; T = Total Recoverable; -- = Data Not Available; BDL = Below Detection Level

a Levels shown rounded to three significant figures.
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c U.S. Geological Survey from U.S. Bureau of Reclamation, 1982; period of record January-April 1982.
d In CAP aqueduct after regulatory storage mixing at Waddell site. CAP deliveries before the Waddell site would not be affected by impacts at the Waddell site.
e At Lower Lake Pleasant.
f Changes are relative to future without average values.
g MCMWCD#1 samples for these constituents taken from below Lake Pleasant.
h These constituents show "below detection level " or "less than" average values. The future with conditions assumed the less than values to be representative. As a result, the change and % change may show exaggerated or wrong direction changes. Constituents with below detection level future without average values could not be used to calculate future with values.
i MCMWCD#1 turbidity is in NTU.

TABLE IV-26

WATER QUALITY IMPACTS
PLANS 6, 7 AND 9
IMPACTS FROM ADDITION OF SRP WATER
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions					
		CAP Aqueduct Water[ab]			SRP Water[ac]			CAP Water[d]			SRP Water		
		Minimum	Average	Maximum	Minimum[e]	Average[f]	Maximum[e]	New Ave.	Change[g]	% Change[g]	New Ave.	Change	% Change
	Alkalinity as $CaCO_3$	98.0	129.	190.	15.0	154.	350.	131.	+ 3.00	+ 2			
D	Arsenic	0.004	0.00414	0.0110	0.00200	0.00761	0.0180	0.00441	+ 0.00041	+ 10			
T	Arsenic	BDL	0.00309	0.0160	0.00100	0.00792	0.0210	0.00347	+ 0.00063	+ 22			
D	Barium	BDL	—	0.0810	BDL	0.0676	0.200	—	—	—			
T	Barium[h]	BDL	0.134	0.500	BDL	0.100	0.200	0.131	- 0.004	- 3			
	Bicarbonate	—	—	—	18.0	193.	427.	—	—	—			
T	Boron	0.0500	0.195	0.360	0.140	0.187	0.230	0.194	- 0.002	- 1			
D	Cadmium[h]	BDL	0.000351	<0.00300	BDL	0.00113	0.0140	0.000412	+ 0.000126	+ 44			
T	Cadmium[h]	BDL	0.00455	0.0130	BDL	0.00648	0.0100	0.00470	+ 0.00008	+ 2			
	Calcium	39.0	84.8	100.	19.0	47.0	420.	81.9	- 3.7	- 4			
T	Carbon (Organic)	1.90	4.54	14.0	1.80	4.54	18.0	4.54	- 0.01	- <1			
	Carbonate	BDL	—	—	BDL	0.879	35.0	—	—	—			
	Chloride	32.0	93.1	140.	2.00	141.	610.	96.8	+ 2.30	+ 2			
	Chromium (Hexa)	—	—	—	—	—	—	—	—	—			
T	Chromium	BDL	0.00366	0.0200	BDL	0.00268	0.0100	0.00358	+ 0.00001	+ <1			
D	Copper	BDL	—	0.00800	BDL	0.00261	0.00700	—	—	—			
T	Copper	BDL	0.00807	0.0290	BDL	0.00877	0.0200	0.00812	+ 0.00019	+ 2			
T	Cyanide	BDL	0.00108	0.0200	—	—	—	—	—	—			
	Oxygen (Dissolved)	5.10	8.54	11.7	1.60	8.76	17.8	8.56	+ 0.03	+ <1			
	Fecal Coliforms (cols/100 ml)	0.990	5.54	120.	1.00	16.1	470.	6.36	+ 1.58	+ 33			
D	Fluoride (84.7°F)	0.200	0.377	0.500	BDL	0.363	1.10	0.376	- 0.002	- <1			
	Hardness (Total, as $CaCO_3$)	160.	336.	380.	79.0	194.	413.	325.	-14.0	- 4			
	Hardness (noncarbonate)	23.0	207.	243.	BDL	36.3	182.	194.	-17.0	- 8			
T	Iron	0.0300	0.204	6.40	BDL	0.189	3.50	-0.203	+ 0.044	+ 28			
D	Lead	BDL	0.00145	0.00200	BDL	0.00507	0.0600	0.00173	+ 0.00029	+ 20			
T	Lead	BDL	0.0399	0.100	BDL	0.0731	0.100	0.0425	+ 0.0017	+ 4			
	Magnesium	16.0	30.7	40.0	5.50	18.9	55.0	29.8	- 1.10	- 4			
T	Manganese	BDL	0.0223	0.0400	BDL	0.0743	0.380	0.0264	+ 0.0056	+ 27			
T	Mercury[h]	BDL	0.0000445	<0.0001	BDL	0.000138	0.00260	0.0000518	+ 0.0000087	+ 20			
T	Nitrate (as N)	0.170	0.258	4.50	BDL	0.0720	0.160	0.243	+ 0.073	+ 43			
	pH (pH units)	7.10	7.96	8.80	4.50	7.86	9.10	7.95	0	0			
T	Phosphorus (as P)	BDL	0.0288	0.180	BDL	0.216	8.30	0.0434	+ 0.0176	+ 68			
	Potassium	1.60	5.13	6.80	1.30	4.78	42.0	5.10	- 0.11	- 2			
D	Selenium[h]	<0.00100	0.00295	0.00300	BDL	0.000430	0.00300	0.00275	- 0.00025	- 8			
T	Selenium[h]	BDL	0.00275	0.00500	BDL	0.000410	0.00200	0.00257	- 0.00022	- 8			
	Specific Cond. (µ0/cm)	420.	1110.	1720.	150.	869.	2340.	1090.	-30.0	- 3			
D	Silver[h]	BDL	—	<0.00100	BDL	BDL	BDL	—	—	—			
T	Silver[h]	BDL	0.00344	0.0100	BDL	0.000975	0.0100	0.00325	- 0.00025	- 7			
D	Sodium	25.0	105.	120.	4.20	105.	382.	105.	- 2.0	- 2			
	Sodium Adsorption Ratio (no units)	0.900	2.51	2.88	0.210	3.30	10.4	2.57	+ 0.03	+ 1			
	Sulfate	53.0	304.	380.	11.0	52.0	360.	284.	-25.0	- 8			
	Dissolved solids (180°C)	257.	710.	848.	109.	497.	1300.	693.	-29.0	- 4			
	Turbidity (JTU)	—	—	—	1.00	37.5	2800.	—	—	—			
D	Zinc[h]	BDL	0.00896	0.0200	BDL	0.0121	0.120	0.00920	+ 0.00031	+ 3			
T	Zinc	BDL	0.0241	0.310	0.0100	0.0342	0.200	0.0249	+ 0.001	+ 4			
	Phenolics	BDL	—	—	—	—	—	—	—	—			

There would be no reservoir mixing of CAP and SRP water with this plan. However, water from the Cliff, Horseshoe, Bartlett and Roosevelt sites would be naturally mixed at the confluence of the Verde and Salt Rivers and then pumped up into the CAP aqueduct. There would be no significant impacts to SRP water quality.

Note: D = Dissolved Fraction; T = Total Recoverable; -- = Data Not Available; BDL = Below Detection Level

a Levels shown rounded to three significant figures.
b In CAP aqueduct after regulatory mixing at Waddell site.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d In CAP aqueduct after regulatory storage mixing at Waddell site and addition of SRP water at Granite Reef. CAP deliveries before Granite Reef would not be affected by impacts of adding SRP water to CAP water at Granite Reef.
e Minimum and maximum values are for the Salt or Verde Rivers and could be experienced if only one river was flowing.
f Weighted average based on STORET data and USGS flow records resulting in a 43 percent Verde River and 57 percent Salt River mix at the confluence of the two rivers.
g Changes are cumulative including impacts from MCMWCD#1 and SRP water and are relative to CAP future without average values given in previous table.
h These constituents show "below detection level" or "less than" average values, or were derived from "less than" average values. The "less than" average values were assumed to be representative. As a result, the change and percent change may show exaggerated or wrong direction changes. Constituents with "below detection level" future without average values could not be used to calculate future with values.

Plans 6,7, or 9. The impacts of Plans 6, 7, and 9 on water quality constituents are therefore considered Insignificant.

(2) Mitigation for Water Quality Constituent Impacts

Since there are no water quality constituents impacts associated with Plan 2 and the impacts of Plans 1, 6, 7, and 9 are considered Insignificant, no mitigation measures are proposed for these plans.

The impacts of Plan 3 are judged to be Significant Adverse, mainly because of the large quantity of water affected and the large percentage (30-35) which would be used for M&I. While it is possible to mitigate these impacts by modifying existing water treatment plants and providing different types and/or higher levels of water treatment, such measures are extremely costly. Therefore, because Plan 3 is not the proposed action, mitigation measures are not being proposed. Should the decision be made to implement Plan 3 in the future, appropriate measures will be developed to mitigate adverse water quality constituents impacts.

While specific mitigation measures are not proposed for any of the plans, Reclamation recognizes the need for further studies to develop more accurate data regarding water quality impacts of regulatory storage.

Each regulatory storage reservoir should include a reservoir water quality sampling network capable of monitoring CAP Colorado River and local source water inflows and reservoir outflows. This will provide data for downstream water users to utilize during planning for water treatment or irrigation operations. Monitoring both the inflow and outflow will help to establish how the reservoir affects water quality and may provide information on reservoir operations which minimize water quality impacts.

Reclamation, in conjunction with the U.S. Geological Survey, has initiated a water quality monitoring system to establish baseline data for the New Waddell site. Monthly sampling of the Agua Fria River inflow and releases from Lake Pleasant releases was started In January 1982. Continuation of this sampling program is recommended for the agency proposed action (Plan 6). Plans 6, 7, and 9 would affect only MCMWCD#1 agricultural water at the New Waddell Reservoir. The after-mix water released from New Waddell Reservoir is not expected to exceed criteria for agricultural water use and no mitigation would there be required.

More detailed studies should also be conducted to assess the combined (synergistic) effects of reservoir water quality impacts. It may also be necessary to establish a monthly sampling program to monitor the SRP water quality near the point where SRP water would be diverted into the CAP aqueduct. Depending on results of such studies, Plans 1 and 3, which would directly affect SRP water delivered to existing water treatment plants, could require additional or modified water treatment.

If the need is identified for further water treatment for impacts resulting from the implementation of a plan, appropriate mitigation measures would be formulated.

(3) Residual Impacts

Plans 1 and 3 may impact local municipal and industrial waters. For instance, the increased non-carbonate hardness in the SRP water released from Confluence Reservoir could increase soap usage for domestic water users. The normal leaching of agricultural fields may not be adequate to prevent salt build-up in the crop root zone brought about by the increased salt levels in water released from the regulatory storage reservoirs. Additional water may need to be applied to flush the salts away from the root zones in order to maintain historic crop yield levels. Any need for additional water treatment could become a residual impact.

c. Eutrophication Potential

(1) Direct and Indirect Impacts

Impacts would be experienced by reservoir water users if water in a reservoir is affected by eutrophication, as discussed below.

(a) Plan 8

With Plan 8, there would be no reservoir storage of Colorado River water. Risk of eutrophication was not determined for the existing reservoirs which would be in the future-without (Plan 8) scenerio.

(b) Plans 1 and 2

There would be no storage of Colorado River water in the reservoirs affected by Plans 1 and 2. Risk of eutrophication was determined only for reservoirs which would store Colorado River water.

(c) Plan 3

Conditions expected in the Confluence Reservoir indicate that there is high potential for eutrophic conditions to occur during part of each year. The reservoir would be drawn down significantly in the very hot months of July and August. The greatest amount of direct sunlight for photosynthesis would also be available in these months. During the summer months, flows from the Verde River are usually small or nonexistent. With little or no inflow from the Verde River, the Verde arm of the reservoir could tend toward a stagnant condition.

Given these physical parameters and the presence of abundant nutrients (phosphorus and nitrogen), it is likely that eutrophic conditions would occur.

One downstream impact of eutrophication in Confluence Reservoir concerns THM, which is a compound produced in water with