significant concentrations or organic material when the water undergoes normal disinfection with chlorine. THM is considered a health hazard if concentrations in drinking water are high enough. New standards proposed by the Arizona Department of Health Services call for a maximum contaminant level of 0.1 mg/l for THM. Organic material in Colorado River water is present in significant quantities, making it possible that THM would be produced when Colorado River water is treated with chlorine. This would occur in the future-without and-with the project, and is therefore not an impact by itself; however, mixing of SRP and CAP water in Confluence Reservoir and subsequent distribution to M&I water users could place higher levels of organics in all treatment plants that currently take SRP water. Some of these plants may not take CAP water in the future-without-the-project. Eutrophic conditions at Confluence Reservoir could intensify the problems associated with THM production by increasing the levels of organic materials in the water subsequently delivered to domestic plants for disinfection.

The effect of Plan 3 on eutrophication potential is considered Significant Adverse because normal operation would probably produce eutrophic conditions which could alter the recreational use of the reservoir; additionally, eutrophication may increase THM production at existing water treatment plants.

(d) Plans 6, 7, and 9

Plans 6, 7, and 9 are similar in reservoir operation and would have similar impacts on the eutrophication potential at the New Waddell site. Conditions expected to occur in New Waddell Reservoir indicate that there is low to moderate potential for eutrophic conditions to occur during a typical year. The reservoir would be lowest during the months of September to November, but even at its low point the reservoir would be approximately 120 feet deep. During the summer months, flows from the Agua Fria River are usually small or nonexistent. With little or no inflow from the river, the reservoir could tend toward a stagnant condition. Given these physical parameters, eutrophic conditions could occur. However, lack of phosphorus in the New Waddell Reservoir (Lake Pleasant) would tend to limit algal growth.

The effects of Plans 6, 7, and 9 on eutrophication potential are considered Insignificant because no adverse eutrophic conditions are expected in New Waddell Reservoir under normal operation.

(2) Mitigation

The high eutrophication potential predicted for Confluence Reservoir and the moderate to low potential predicted for New Waddell Reservoir are based on analytical models. Further studies would need to be conducted for the Confluence and New Waddell sites to better define the extent of algal growth and effect on water quality. Mitigation, if required, could consist of notifying CAP and local surface water M&I users of unusual increases in algal growth in the reservoirs in order for treatment plants to adjust for any potential increase in THM production. Aeration of M&I water

released from the reservoir could also be required for mitigation during periods of unusual reservoir eutrophic conditions. This would cause precipitation of heavy metals which dissolve in the reservoir water under anaerobic conditions resulting from eutrophication.

(3) Residual Impacts

The eutrophication problems associated with the Confluence (high potential) and New Waddell (low to moderate potential) Reservoirs may be difficult to mitigate and may therefore become residual impacts.

d. Impacts with Modified Roosevelt and Modified Stewart Mountains Dams in Plans

If Roosevelt Dam were to be modified instead of replaced, water quality impacts would be the same. The same types of construction impacts would be possible, but present plans provide for working in dry conditions away from the reservoir water surface. This might require some drawdown of the reservoir for the modified dam but the water quality should not be affected. If SRP loses water as a result of the drawdown, the water would be replaced with CAP water delivered to users in the SRP service area who are already receiving CAP water.

Modified Stewart Mountain Dam would be the same as the new dam as far as water quality is concerned. There would be no drawdown of the reservoir and the potential for short term-construction impacts would be the same for both alternatives.

3. Recreation

a. Methodology

Within the recreation impact category, project plans were assessed as they affect the factors of stream-oriented and reservoir-oriented recreation opportunities. Reservoir-oriented recreation includes activities and experiences associated with flat-water bodies, while stream-oriented recreation is comprised of those activities and experiences oriented around flowing water bodies.

Recreation impacts are measured within each of these factors by the net loss or gain of water-related facilities and resources, and by the potential for recreation plans associated with the new or enlarged reservoirs to meet the water-related recreation needs of the 5-county study region.

For stream-oriented recreation, impacts are measured in terms of the following: net loss or gain in stream miles or adjacent land resources; net loss or gain in developed stream-related facilities; percentage needs met for stream-oriented fishing, tubing, non-powerboating, swimming, camping, and picnicking.

For reservoir-oriented recreation, impacts are measured in terms of the following: net loss or gain in acres of surface water and adjacent land resources; net loss or gain in developed reservoir-related recreation facilities; percentage needs met for reservoir-oriented boat fishing, powerboating, non-powerboating, swimming, camping, waterskiing, and picnicking.

The net loss or gain of recreation resources and facilities is an indication of how the supply of water-related recreation opportunities will be affected by project plans. To obtain a measurement of regional recreation needs that could be met by CAWCS plans, a needs assessment based on a capacity standards approach was conducted. The impact assessment takes the following form for each water-related recreation activity:

1. Resources		3. Appropriate Populations		
+				
Facilities				
x		x		
2. Capacity Standard		4. Participation Rates		
Recreation Days Supplied	-	Recreation Days Demanded	=	Recreation Days Needed

This procedure was performed for existing conditions, future-without-project conditions, and future-with-project conditions. The impact of the plans was measured by substracting the future-without from the future-with measurement.

Effects criteria were developed in consultation with the recreation advisory committee. Effects of reservoir-oriented recreation impacts are primarily beneficial, while those for stream-oriented recreation are primarily adverse. A plan was judged to have a significant impact on stream-oriented or reservoir-oriented recreation if more than 10 percent of the maximum annual recreation days for the aggregated site areas was gained or lost. A significant gain of recreation days has a beneficial effect and a significant loss has an adverse effect. Effects criteria are described in Stage III Methodology for Environmental Quality Methodology, Section 5.0.

b. Types of Impacts to Recreation

CAWCS recreation impacts are caused by construction of dams and creation of new or enlarged reservoirs. The reservoirs would be developed for recreation and for other CAWCS planning objectives. Conceptual recreation plans for the reservoirs call for the development of facilities such as camping areas, picnicking sites, beaches, boat launches, docks, and parking areas. The recreation plans are described in detail in Recreation Planning Report - Stage III Summary (USBR, 1982). The plans have been developed for all reservoirs in the action plans except for Cliff and Roosevelt Dams in Plan 2, which is a SOD-only plan.

While reservoirs would provide additional flat-water resources and facilities, they may also cause the loss of stream-oriented resources and facilities. In particular, stretches of the Salt and Verde River that are used for tubing, fishing, and stream-side picnicking and camping would be flooded by reservoirs in some plans, and would be lost for the life of the project. Stream-oriented facilities would be replaced-in-kind, to the extent possible.

For stream-oriented recreation, the impact analysis was based on the typical-year high reservoir level for each reservoir; and for reservoir-oriented recreation, the impact analysis was based on the average reservoir level during the recreation season of a typical year. This analysis accounted for fluctuating reservoir levels that affect boating capacity and attractiveness of the reservoir for certain recreational activities.

No designated Wilderness Areas will be directly impacted by the proposed project actions. However, two areas that are under study for Wilderness or Roadless Area designation by the U.S. Forest Service could be impacted by the proposed actions. The Forest Service has recommended that the Mazatzal Contiguous Area be added to the Mazatzal Wilderness Area. The area recommended for addition could be impacted by high water levels at Cliff Reservoir, approximately 1/5th mile north of the Sheep Bridge crossing. An analysis of the potential impacts indicated that they would be minimal and insignificant because (1) the occurrence of the events necessary to "back water" into the area is extremely rare, (2) the water would only intrude into the area for a short time, and (3) no impacts, which would cause the area to be removed from consideration for Wilderness designation, were noted. No further detailed assessment was conducted. If this area is added to the Mazatzal Wilderness Area, appropriate actions to address the potential impacts and to mitigate these impacts will be undertaken between Reclamation and the Forest Service.

In the re-evaluation of the Arizona Roadless Area Review Evaluation (RARE II) process the Forest Service has identified an area of Lime Creek, west of the Cliff Reservoir site, as a potential RARE II site. Cliff Reservoir could inundate a small portion of Lime Creek. The potential impacts of this action were not judged to be significant because (1) only a minor portion of the area would be affected, (2) most of the area is above the 2000 foot contour, and (3) the occurrence/likelihood of the events necessary to intrude water into the area is very infrequent. In addition, the Forest Service in their initial evaluation of the area recommended against further study or inclusion of the area in any Wilderness/Roadless designations. It appears that this recommendation will most likely be carried forward in the re-evaluation process. Discussions with the Forest Service have identified that impacts on the Lime Creek area would be insignificant.

c. Stream-Oriented Recreation

(1) Direct and Indirect Impacts

(a) Plan 8

No changes in stream-oriented recreation resources are expected in the future without CAWCS action, but some additional facilities are likely to be built. In the Cliff, Roosevelt, and New Waddell site areas, no new facilities are planned, and the number of maximum annual recreation days for stream-oriented activities is projected to remain the same as in the existing condition. In the Confluence site area, Alternative D of the Lower Salt River Recreation Area plan would be implemented, leading to more intensive use of the Salt River from Stewart Mountain Dam to the confluence with the Verde River. There would be approximately 2,250,000 stream-oriented maximum annual recreation days in the Confluence site area in the year 2000, most of them associated with tubing.

The number of estimated maximum annual recreation days for stream-oriented activities would be 2,281,000 in the aggregated site areas and 8,236,000 in the five-county region in the year 2000.

(b) Plan 1

With implementation of Plan 1, a total of 3 miles of the Verde River in the Cliff site area would be lost. Stream fishing occurs along the entire length of stream miles lost. As a result of Plan 1, regional needs for stream fishing would be intensified because demand would remain the same as in the future-without, but there would be fewer resources for fishing. Approximately 1,450 maximum annual recreation days for stream fishing would be lost.

Recreation development proposed for Cliff and Roosevelt in Plan 1 includes one stream-oriented recreation site in each site area. At Cliff, proposed facilities include picnic tables and developed campsites. At Roosevelt, plans call for development of a parking area for access to the Salt River. The implementation of the recreation plan for Plan 1 would result in a net gain of 5,850 maximum annual recreation days for stream-oriented recreation. The overall effect of the plan, taking into account losses and gains, has been evaluated as Insignificant.

(c) Plan 2

With implementation of Plan 2, a net gain of 1 mile of stream would occur on the Verde River in the Cliff site area. The gain represents reclaimed river in the lakebed of Horseshoe Reservoir. Losses occur along the reach of the river from Horseshoe Dam to proposed Cliff Dam, but 1 more mile of river would be gained in the lakebed than would be lost in the reach between the two dams. Because of the gain, there would be 696 additional maximum annual recreation days for stream-oriented activities in the year 2000.

During the years when Roosevelt Lake is full, the lake would be drawn down in September, October, and November. This would result in increased flows of about 700 cfs on the Salt River downstream of Stewart Mountain Dam. The recreation impacts of the increased flow in the river cannot be quantitatively assessed, but little change is expected to occur in recreation activities because of the increased flow.

The effect of Plan 2 on stream-oriented recreation has been evaluated as Insignificant.

(d) Plan 3

With implementation of Plan 3, a total of 16 miles of stream would be lost; 17 stream miles would be lost because of Confluence Reservoir and 1 stream mile would be gained because of recovery of a segment of the Verde River in the lakebed of Horseshoe Reservoir. Fishing occurs along the total length of stream miles lost, and tubing takes place on 16.8 miles. From a recreation perspective, the loss of stream miles associated with Plan 3 would constitute a major impact on tubing, an activity that is highly valued in central Arizona.

In a typical year, the entire stretch of river used for tubing would be inundated completely by the Confluence Reservoir at the beginning of the recreation season. As drawdown occurs over the spring and summer each year, more of the river channel would be exposed, but it would not be suitable for tubing. Resources for tubing as it is experienced today and in the future without the project would not exist on the Salt River.

The loss of 16.8 miles of river suitable for tubing represents a loss of half the tubing miles on the Salt and Verde Rivers in the study area. Remaining tubing areas with Plan 3 are the segment of the Salt River from Confluence Dam to Granite Reef Dam (3.3 miles) and the segment of the Verde River below Bartlett Dam to the Confluence Reservoir (14.2 miles). Other stream-oriented activities such as fishing would be similarly impacted by the loss of stream resources in the Confluence site area.

Implementation of the conceptual recreation plan for Plan 3 would result in the development of one stream-oriented recreation site in the Confluence site area, one in the Cliff site area, and one in the Roosevelt site area. The sites would be developed for picnicking, camping, and river access.

Implementation of Plan 3 would result in the net loss of approximately 1,054,800 stream-oriented maximum annual recreation days. The effect of this loss is evaluated as an Adverse Flag.

(e) Plan 6

With implementation of Plan 6, a total of 1 mile of stream would be gained on the Verde Rive where the stream segment in the lakebed of Horseshoe Reservoir would be reclaimed. There are no streams of recreational value in the New Waddell site area.

Recreational development proposed in the Cliff and Roosevelt conceptual recreation plans include one stream-oriented recreation site in each site area. In the Cliff site area, proposed facilities include picnicking and camping areas; in the Roosevelt site area, plans call for the development of a parking area for access to the Salt River.

As a result of Plan 6, regional needs for stream fishing would be partially met and an additional 700 maximum annual recreation days would be developed. A total of approximately 7,990 stream-oriented maximum annual recreation days would be added. Although the direction of this impact is beneficial, the overall effect has been evaluated as Insignificant.

(f) Plan 7

Impacts to stream-oriented recreation are the same in Plan 7 as in Plan 6, except that with implementation of Plan 7 a net loss of 2 stream miles would occur. Conceptual recreation plans for the site areas in Plan 7 are the same as in Plan 6. A total of approximately 6,386 stream-oriented maximum annual recreation days would be gained with implementation of the plan. The effect of this gain has been evaluated an Insignificant.

(g) Plan 9

With the implementation of Plan 9, stream-oriented recreational use would be the same as in Plan 8. Therefore, there are no impacts to stream-oriented recreation.

(2) Mitigation

The loss of stream resources cannot be mitigated effectively. The loss of tubing resources on the Salt and Verde Rivers caused by Plan 3 cannot be avoided if the Confluence Dam is built, nor can the resources be replaced elsewhere. The option of off-site mitigation was explored in the CAWCS, but it was concluded that the creation of tubing elsewhere was not feasible.

Partial mitigation for tubing losses might be possible by making the Verde River upstream from Confluence Reservoir to Bartlett Dam more suitable for tubing. This would involve maintaining flows of 500 cfs along this stretch of the river during the summer and providing better access to the river. It is probably not feasible for SRP to operate the system in such a way as to make these flows available during the summer. However, if adequate flows could be maintained, then some reduction in impact could be expected. If any minimum flows are incorporated into the project as a result of wildlife mitigation, their impact on recreational use of the river will be substantial and beneficial.

(3) Residual Impacts

Because stream losses cannot be mitigated, the mitigated impact and effect are the same as the unmitigated impact and effect.

Unmitigated/mitigated effects evaluations for the plans are as follows: Plans 1, 2, 6, 7, and 9 - Insignificant; Plan 3- Adverse Flag.

d. Reservoir-Oriented Recreation

(1) Direct and Indirect Impacts

(a) Plan 8

No changes in reservoir resources are expected in the future without CAWCS action, but considerable change will occur in reservoir-oriented facilities in each of the site areas by the year 2000.

The Forest Service plans to develop a reservoir-oriented campsite on the western shoreline of Horseshoe Reservoir in the Cliff site area. The only access road to the reservoir would not be improved; thus, the type of boaters that visit the lake would not be expected to change from the existing condition. Almost 60,000 reservoir-oriented maximum annual recreation days for developed and water surface activities would exist in the Cliff site area in the year 2000.

Forest Service developments in the Roosevelt site area in the year 2000 include a campground with 100 developed campsites and boat launching facilities. Maximum annual recreation days for reservoir-oriented activities would increase to a total of almost 410,000 by the year 2000.

In the Confluence site area, there would be no development of reservoir-oriented recreation resources or facilities in the future-without CAWCS action.

In the New Waddell site area, additional picnic areas, campgrounds, and boat launches are proposed by the Maricopa County Parks and Recreation Department for the Upper and Lower Lakes. Maximum annual recreation days for reservoir-oriented activities would total approximately 250,000 in the year 2000.

The number of maximum annual recreation days for reservoir-oriented recreation would be approximately 822,000 in the aggregated site areas and 6,479,000 in the five-county region in the year 2000.

(b) Plan 1

Plan 1 would result in the net gain of 683 surface acres of water at Cliff Reservoir for recreation. With the construction of Cliff Dam, vehicular access to Cliff Reservoir would be improved over that to Horseshoe Reservoir. Because of better access, the composition of boating activities at Cliff would be likely to change from primarily fishing and non-powerboating to a mix of activities similar to those at Bartlett Lake, where waterskiing and powerboating dominate.

Conceptual recreation plans proposed for the reservoirs at Cliff and Roosevelt call for the development of three reservoir-oriented recreation sites at Cliff and nine at Roosevelt. With this development and the changes in boating mix at Cliff, regional boat fishing, powerboating, and non-powerboating needs would be intensified; waterskiing needs would be partially met. A total of approximately 670,520 maximum annual recreation days for reservoir-oriented activities would be developed with Plan 1. This gain has been evaluated as Significant Beneficial.

(c) Plan 2

With Plan 2, reservoir resources would decrease by approximately 850 surface acres. All of this decrease would be in the Cliff site area, where Cliff Reservoir would essentially replace Horseshoe Reservoir. With construction of Cliff Dam, vehicular access to the site area would be improved over the access to Horseshoe Reservoir. As described in Plan 1, because of improvements in access to the reservoir, the composition of boating activities at Cliff is likely to be different from the activities at Horseshoe Reservoir. Waterskiing and powerboating are expected to be the primary boating activities at Cliff Reservoir, while fishing and non-powerboating are the main activities at Horseshoe Reservoir.

With Plan 2, regional boat fishing, powerboating, and non-powerboating needs would be intensified; waterskiing needs would be partially met. A total of approximately 48,650 reservoir-oriented maximum annual recreation days would be lost with Plan 2, partially because of the loss of surface acres of water. In addition, Plan 2 does not provide for new recreation development at Cliff and Roosevelt because it is a SOD-only plan. The overall effect of the plan on reservoir-oriented recreation has been evaluated as Insignificant.

(d) Plan 3

Plan 3 would result in the net gain of approximately 5,240 surface acres of water for recreation, representing an increase of approximately 30 percent over future-without conditions for reservoir-oriented resources in the study area. An increase of 5,320 surface acres would occur in Confluence Reservoir and a decrease of 77 surface acres would occur with Cliff Reservoir. The size of Confluence Reservoir would fluctuate from approximately 8,000 acres to 3,000 acres in a typical year. The impact of this fluctuation would be greatest on the Verde River arm of the reservoir where the flat topography would make the drawdown more apparent.

With the implementation of the conceptual recreation plan for Plan 3, 7 reservoir-oriented sites would be developed at Confluence Reservoir, 9 would be developed at Roosevelt Lake, and 3 would be developed at Cliff Reservoir. Facilities for picnicking, swimming, boat launching, and camping are included in the development plans. At the Confluence Reservoir, no recreation sites are planned for the Verde arm, which extends into the Fort McDowell Indian Reservation, because of the unattractiveness of the shoreline that would result for reservoir fluctuation.

Implementation of Plan 3 would have an impact on the mix of boating activities in the Cliff site area, as described in Plan 1. With Plan 3 approximately 3,537,380 additional maximum annual recreation days for reservoir-oriented activities would be developed. Regional recreation needs for all reservoir-oriented activities except boat fishing would be partially met by implementation of Plan 3. The effect of the gains associated with Plan 3 has been evaluated as Significant Beneficial.

(e) Plan 6

Implementation of Plan 6 would result in the net gain of approximately 4,200 surface acres of water for recreation. At New Waddell, a net increase of approximately 4,300 surface acres would occur. This takes into account a gain of 4,266 surface acres on the Upper Lake and a loss of 33 surface acres on the Lower Lake. In the Cliff site area, a decrease of approximately 80 surface acres would occur and improved access to the new reservoir would change the mix of boating activities as described in Plan 1.

Recreation plans call for the development of 4 reservoir-oriented sites at New Waddell, 3 at Cliff, and 9 at Roosevelt. Facilities for camping, picnicking, and boat launching are included in the plans. With Plan 6, a total of an estimated 1,066,000 reservoir-oriented maximum annual recreation days would be gained. The effect of Plan 6 on reservoir-oriented recreation has been evaluated as Significant Beneficial.

(f) Plan 7

Implementation of Plan 7 would result in the net gain of approximately 5,100 surface acres of water for recreation. At New Waddell, a net increase of approximately 4,300 surface acres would occur, taking into account gains on the Upper Lake and losses on the Lower Lake. At Cliff, an increase of approximately 800 surface acres would occur. The same recreation plans apply to Plan 7 as to Plan 6. A net total of approximately 1,085,870 reservoir-oriented maximum annual recreation days would be gained with Plan 7. In addition, this plan provides for an assured water supply for the downstream Rio Salado Development District. Although the secondary development of recreation opportunities because of this supply of water has not been assessed in quantitative terms, it has been taken into consideration in the effects evaluation. The overall effect of Plan 7 has been evaluated as a Beneficial Flag.

(g) Plan 9

Implementation of Plan 9 would result in the net gain of approximately 4,200 surface acres of water for recreation at New Waddell. This takes into account a gain of 4,266 surface acres on the Upper Lake and a loss of 33 surface acres on the Lower Lake.

Recreation plans call for the development of 4 reservoir-oriented sites at New Waddell and 9 at Roosevelt. Facilities for camping, picnicking, and boat launching are included in the plans. With Plan

9, a total of an estimated 884,000 reservoir-oriented maximum annual recreation days would be gained. The effect of Plan 9 on reservoir-oriented recreation has been evaluated as Significant Beneficial.

(2) Mitigation

Because the effects of the plans are either insignificant or beneficial, no mitigation measures are required. However, with Plan 3 further analysis to provide for a more stable lake on the Verde River arm of Confluence Reservoir is recommended. The flat topography and the wide water fluctuation on this arm of the reservoir would result in the annual exposure of large expanses of unvegetated saturated soil, thereby diminishing the attractiveness of that portion of the reservoir for shoreline activities. Also, during the latter months of the recreation season (August through October), the Verde arm may experience an algal growth of sufficient magnitude that some types of boating may be restricted (see Water Quality, Section 2c). Fishing activities, on the other hand, may benefit from the early stages of algal growth, which would provide food for fish. Although algal growth could occur on the Salt River arm of the reservoir, the potential is less than on the Verde arm.

(3) Residual Impacts

The unmitigated and mitigated impact and effect are the same for the plans. Effects evaluations are as follows: Plan 1 - Significant Beneficial; Plan 2 - Insignificant; Plan 3- Significant Beneficial; Plan 6 - Significant Beneficial; Plan 7 - Beneficial Flag; and Plan 9 - Significant Beneficial.

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

Construction impacts for a modified dam at Roosevelt would be the same as the new dam option; existing recreational facilities affected by construction of either alternative would be relocated and/or replaced. Operational impacts would be the same 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 Roosevelt for recreation. No additional recreation facilities are proposed for Saguaro Lake with either a New or Modified Stewart Mountain Dam, and no change in existing recreation resources would occur under either option.

4. Cultural Resources

The cultural resources impacts and effects analysis was prepared in accordance with 36 CFR Part 800, "Advisory Council on Historic Preservation Procedures for the Protection of Historic and Cultural Properties", and with Sections 106 and 110(f) of the National Historic Preservation Act as amended, which requires that Federal agencies take into account the effects of their undertakings on properties included in or eligible for inclusion on the National Register of Historic Places.

a. Types of Impacts to Cultural Resources

Impacts to cultural resources will result from construction, inundation and reservoir operation activities. For purposes of analysis and discussion four general types of site impacts have been defined. These are derived from criteria of effect as defined in 36 CFR 800 but are not to be confused with an actual determination of effect.

destruction - the elimination of significant values which characterize a site. Site destruction may result from a number of direct and indirect actions such as project-specific construction, operation, and maintenance actions.

alteration - the physical destruction of a portion of the data values which characterize a site.

impairment of setting - would occur when the physical or environmental setting is modified to the extent that it creates an adverse visual impact to that site, or to the extent that such modification would detract from the site's interpretive development as a public educational or recreational resource.

enhancement - a site's qualities may be enhanced through various management procedures which might include restoration, reconstruction, long-term preservation, or public-use interpretation.

The first three categories of site impact would result in adverse effects; the fourth category would result in a beneficial effect. All of the above types of impacts may occur either as a direct or indirect consequence of a project action.

The effects of the above impacts on the significant data values of a site may be expressed as the relationship between potential impacts to a site and the quality of that site. Four criteria have been recognized in evaluating a site's value or quality:

- historical association with significant events or persons
- public interpretive distinctive characteristics that have educational potential
- research potential
- social, religious, or ethnic significance

Construction activities produce the most severe type of impact imposed on cultural resources. They involve all earth-moving activities related to the construction of haul roads, recreation sites, transmission lines, and dams. In the extreme, the result of such impacts is to irreversibly destroy structures and artifacts and their spatial relationships within a cultural deposit and to eliminate the potential for additional studies. Not all construction activities are equally destructive. Some activities, such as the paving of a parking lot, may even serve to cap archaeological deposits and preserve them for the future. The potential for such beneficial effects are limited, however, and opportunities of this nature will be pursued as construction plans are finalized. In general, construction

related activities are the source of the most severe types of impacts anticipated for cultural resources.

Flooding of a site can result in relatively light to moderately severe impacts. In general, inundation will alter some of the contents and the physical relationships within a site, but it will not usually result in the total destruction of a site. Processes associated with inundation which are responsible for the impacts to cultural deposits include mechanical disturbances, chemical deterioration, and biological decay (Garrison, 1977; Lenihan et. al., 1981). The severity of impacts varies with the frequency and duration of inundation.

Secondary impacts are defined as those which result from secondary use of a facility. These are predominantly recreational activities associated with the reservoirs. The creation of recreational facilities often encourages vandalism of sites by increasing the ease with which they may be reached. Other types of recreation impacts occur when sites are used as locations for campgrounds, parking areas, or picnicking areas. Vehicular and pedestrian traffic serves to displace the material and enhance erosion by decreasing vegetation cover. Unusual forms of artifacts are often picked up by collectors thereby biasing the overall assemblage of artifacts recoverable by the archaeologist. The impacts associated with secondary use of a dam are thus fairly substantial. These impacts will also occur in the upper reservoir zones that are infrequently inundated. Although the sites are not totally destroyed, they will, unless protected or specifically managed, be considerably degraded over a 50-to 100-year period with most of the damages occurring during the early life of the project.

The procedures for assessing impacts and evaluating effects within this conceptual framework have been presented in detail in the Stage III Methodology for Environmental Quality Assessment (CAWCS, 1981), and are summarized below.

b. Methodology

(1) Prehistoric Resources

The archaeological survey at the Cliff site area covered most of the area included in and below the IDF area (2,143 foot elevation contour line), and most of the construction zones (principally the borrow and recreation areas, with relatively less emphasis on roads, transmission lines, etc.). To determine the number of sites in the secondary impact zone, information from sample surveys was used to calculate densities for each site type, feature, and acreage of remains. The densities were calculated to control for environmental variability. For instance, site density decreases with distance from the Verde River and this information was incorporated into the predictions.

At the Roosevelt site area, all areas located below the 2,200 foot contour line, which closely corresponds to the IDF area, have been surveyed by Arizona State University (1979 and 1981), the Arizona State Museum (1976), or the Tonto National Forest (1977). In addition, Arizona

State University sample surveyed about 440 acres of the secondary impact zone. This information was used in conjunction with site record data obtained from the Tonto National Forest to develop an estimate of site density in the secondary impact zone (the area above the 2,200 foot contour line).

The primary impact zone at the Confluence site area had previously been surveyed by the Arizona State Museum as part of the original Orme Alternatives Study (Canouts, 1976). These data were also used for the CAWCS impact analysis. Site data on the secondary impact zone were estimated by developing density estimates for different categories of archaeological sites. Two different sets of figures, which are related to variation in topography, were used in arriving at these projections. Areas in the secondary impact zone bordering the Verde and Salt Rivers had higher overall density figures than upland areas away from each of the two rivers. To obtain as accurate an estimate as possible, this variation was taken into account in the calculation of density for each site type and feature type.

The archaeological survey at Lake Pleasant covered all of the inundation pool and a large portion of the secondary impact and construction zones. As estimate of the total number of sites in the secondary impact zone was calculated by using the survey areas to develop a site density per acre (for each category of site). The density figure was then multiplied by the acreage of the impact area to arrive at the estimate for the total number of sites in the secondary impact zone.

The archaeological survey of the Bartlett Dam study area includes a 12 percent sample survey of the area around Lake Bartlett. The sample survey consisted of 22 quadrants, each measuring 40 acres in size, and was conducted by Arizona State University in 1979. A total of 5 sites were found in these quadrats, one of which was associated with a rock-lined ball court. An additional 9 field loci were recorded but not assigned site numbers. These loci represent various types of agricultural field systems (terraces, cleared areas, and three-walled field houses). Site densities have been estimated for the area in the immediate vicinity of Lake Bartlett, and added to those already recorded for the Cliff Project area.

(2) Historic Resources

The methodology for the study of historic cultural resources in relation to proposed CAWCS flood control and regulatory water storage actions involves: 1) the definition of historic sites within the CAWCS study area (data collection), and 2) an evaluation of historic site data in relation to proposed CAWCS actions in order to determine if these sites would be affected.

Information on historic sites was initially obtained through the review of archaeological site files and historical documentary sources pertaining to specific elements of the study area. The presumed location of each historically documented site was then field-checked in order to determine if the site was present. In addition, historic sites identified during the course of Arizona State University's archaeological field surveys at each site area were subsequently field-checked by Archaeological Research

Services (ARS). All field-verified sites were documented at a level necessary for evaluation in terms of National Register of Historic Places eligibility criteria. ARS also performed intensive surveys in several areas which appeared to have a particularly high concentration of historic sites; these areas are located at Roosevelt Dam, on the Tonto Creek and the Salt River above the dam, and to a lesser extent at the Stewart Mountain, New Waddell, and Cliff Dam sites.

Each historic site was subsequently assessed in order to determine if it would be subject to impacts as a result of potential CAWCS actions. Four categories of site impact were defined, as previously described (destruction, alteration, impairment of setting, and enhancement). Quantitative value was assigned to each of these categories as follows: destruction (-3), alteration (-2), impairment (-1), and enhancement (+1).

An effects evaluation was then performed based on the relationship between potential impacts to a site, and the quality of that site. Four criteria were considered in determining a site's quality for effects evaluation purposes: its research potential; its interpretive/educational potential; it historical association; and its social, religious, or ethnic significance. A numerical value was then assigned to each criterion (2, 1, 1, and 1 respectively) if it existed at a particular site. For each site these values were then totalled to produce a numerical value reflecting resource quality.

An effects value (or effects factor expressed numerically) was then computed for each historic site (and for all historic sites within each affected site area and plan) by multiplying the applicable impact and quality figures. With the exception of low quality resources which would only be impaired, all sites having a negative effects factor would be adversely affected by CAWCS actions. High quality resources which would either be destroyed or altered were flagged to indicate an adverse effect of a particularly high magnitude. Flagged sites would normally include those on the National Register, or those clearly eligible to the National Register, which would either be destroyed or substantially altered.

c. Direct and Indirect Impacts

(1) Prehistoric Cultural Resources

All sites within the construction zone will be destroyed. The impacts resulting from inundation have been divided into four categories of alteration which include 1) the typical-year high (TYH) pool, 2) the maximum storage pool (MSP), 3) the 200-year flood pool ,and 4) the Inflow Design Flood (IDF) area.

All plans are compared to each other as well as to the future-without condition. This comparison is based on four factors:

- the estimated number of prehistoric archaeological sites

- the estimated acreage of archaeological remains
- the quality of the resource base
- the severity of the impact

Table IV-27 shows the estimated number and types of prehistoric archaeological sites in the CAWCS affected site areas.

Table IV-28 presents the number of sites in each plan according to plan number, type of impact, and site type. Qualitative and quantitative analyses resulted in an Adverse Flag effect rating for all action plans, in the following ranking:

	Plan Number
BEST	2
	9
	1
	6/7
WORST	3

(a) Plan 8

In the future-without-the-project in the affected site areas there will be approximately 3,350 prehistoric archaeological sites covering 12,027 acres (see Table IV-26). The site areas are within a perimeter about 1 mile beyond the maximum water surface elevation of each reservoir.

Natural decay through forces such as erosion, animal burrowing, plant and root growth, and oxidation will affect archaeological sites. Sites currently located along the perimeter of Lake Roosevelt and Lake Pleasant will be affected by inundation and subsequent drying as a result of fluctuations in the water level. Cultural factors which will affect prehistoric resources include activities such as land development, vandalism, or vehicular disturbances as a result of increased use of the area, predominantly for recreational purposes. Most of the deterioration which is anticipated to occur will result from pot hunting and fluctuations in the water level. In some areas, recent State legislation should help to counteract the negative effects of some of these conditions.

(b) Plans 1 and 2

Plans 1 and 2 are similar in the total number of sites impacted, but Plan 2 is preferable to Plan 1. Plan 1 impacts 60 additional sites through construction, 18 additional sites in the TYH pool, 19 additional sites in the MSP, and 220 additional sites in the 200-year floodpool. Under Plan 2, these sites would be impacted in the IDF and secondary impact zone where the impacts are less severe.

Each of these site areas also contain numerous large and special sites with features such as ball courts, trash mounds, and

Table IV-27

TOTAL NUMBER OF ARCHAEOLOGICAL SITES IN AFFECTED SITE AREAS[a/]

	Cliff	Roosevelt	New Waddell	Bartlett	Total[b]
Artifact Scatters	476	458	67	530	1,256
1 room	347	493	26	498	1,022
2-5 rooms	461	293	12	530	858
6-20 rooms	133	175	5	151	332
21-100 rooms	9	45	0	9	57
101+ rooms	3	4	0	3	7
Petroglyph Only	3	1	10	3	36
Agricultural Sites	32	9	0	32	52
Total Number of Sites	1,464	1,478	120	1,756	3,620
Special Features					
Trash Mounds	87	216	5	96	952
Ball Courts	2	0	0	3	16
Water-Soil Control Features	1,273	780	67	1,300+	2,156+
Acreage of Archaeological Remains	1,489	2,783	102	1,752	12,380

[a]The number of sites and features are estimates based on various types of survey data. For more information, see Second Level Environmental Inventory.

[b]The Bartlett area also includes the Cliff area. So in order to not count the Cliff sites twice, the Cliff values have not been included in the totals.

Table IV-28

IMPACTS TO ARCHAEOLOGICAL RESOURCES, BY IMPACT TYPE AND SITE TYPE

		Largely Destroyed Over the Short Term			Altered Over the Long Term			
	PLAN	CONSTRUCTION	TYH	MSP	200-YEAR	IDF	SECONDARY IMPACT ZONE	TOTALS
ARTIFACT SCATTERS	1	36	19	10	60	72	737	934
	2	22	11	6	--	126	769	934
	3	54	52	17	60	87	865	1135
	6	47	28	16	60	75	775	1001
	7	47	28	16	60	75	775	1001
	9	18	14	4	36	37	946	1055
1 ROOM SITES	1	42	9	17	64	107	601	840
	2	21	3	11	--	137	668	840
	3	43	8	20	64	107	603	845
	6	49	8	21	64	108	616	866
	7	49	8	21	64	108	616	866
	9	15	2	7	31	52	1169	1276
2-5 ROOM SITES	1	29	9	5	49	52	610	754
	2	15	6	3	--	91	639	754
	3	32	10	7	49	54	625	777
	6	32	10	7	49	53	615	776
	7	32	10	7	49	53	615	776
	9	9	3	1	30	22	770	835
6-20 ROOM SITES	1	15	2	7	16	22	246	308
	2	9	2	4	--	27	246	308
	3	15	1	8	16	23	246	309
	6	20	1	8	16	22	246	313
	7	20	1	8	16	22	246	313
	9	7	0	3	10	14	297	331

Table IV-28 (continued)

IMPACTS TO ARCHAEOLOGICAL RESOURCES, BY IMPACT TYPE AND SITE TYPE

		Largely Destroyed Over the Short Term			Altered Over the Long Term			
	PLAN	CONSTRUCTION	TYH	MSP	200-YEAR	IDF	SECONDARY IMPACT ZONE	TOTALS
21-100 ROOM SITES	1	1	0	2	9	11	31	54
	2	1	0	2	--	14	37	54
	3	2	2	2	9	11	31	57
	6	1	0	2	9	11	31	54
	7	1	0	2	9	11	31	54
	9	1	0	2	6	5	40	54
101+ ROOM SITES	1	3	0	1	2	0	1	7
	2	1	0	0	--	5	1	7
	3	3	0	1	2	0	1	7
	6	3	0	1	2	0	1	7
	7	3	0	1	2	0	1	7
	9	1	0	0	2	0	4	7
SITES WITH PETROGLYPHS ONLY	1	1	1	1	1	0	0	4
	2	1	0	1	--	2	0	4
	3	2	9	2	1	1	11	26
	6	1	1	1	1	0	10	14
	7	1	1	1	1	0	10	14
	9	0	0	0	1	0	3	4
AGRICULTURAL SYSTEMS	1	5	0	3	19	14	0	41
	2	2	0	0	--	34	5	41
	3	5	1	3	19	15	10	52
	6	5	0	3	19	14	0	41
	7	5	0	3	19	14	0	41
	9	2	0	0	4	3	32	41

Table IV-28 (continued)

IMPACTS TO ARCHAEOLOGICAL RESOURCES, BY IMPACT TYPE AND SITE TYPE

		Largely Destroyed Over the Short Term			Altered Over the Long Term			
	PLAN	CONSTRUCTION	TYH	MSP	200-YEAR	IDF	SECONDARY IMPACT ZONE	TOTALS
TOTAL	1	132	40	46	220	278	2,226	2,942
	2	72	22	27	--	436	2,385	2,942
	3	156	82	60	220	298	2,392	3,208
	6	158	48	59	220	283	2,294	3,062
	7	158	48	59	220	283	2,294	3,062
	9	53	19	17	120	133	3,261	3,603
TRASH MOUNDS	1	26	12	9	71	37	148	303
	2	20	4	11	--	95	173	303
	3	77	149	11	71	128	502	938
	6	31	10	11	71	37	148	308
	7	31	10	11	71	37	148	308
	9	17	0	4	51	24	221	317
BALL COURTS	1	1	0	0	0	1	0	2
	2	1	0	0	--	0	1	2
	3	3	3	0	0	2	7	15
	6	1	0	0	0	1	0	2
	7	1	0	0	0	1	0	2
	9	0	0	0	0	1	2	3
WATER-SOIL CONTROL FEATURES	1	77	7	46	299	261	1,363	2,053
	2	36	5	0	--	502	1,510	2,053
	3	77	7	48	299	262	1,369	2,062
	6	90	12	49	299	261	1,409	2,120
	7	90	12	49	299	261	1,409	2,120
	9	27	7	1	61	65	2,086	2,247
ACREAGE OF ARCHAEOLOGICAL REMAINS	1	497	96	64	280	548	2,787	4,272
	2	173	79	50	--	869	3,101	4,272
	3	577	1,105	111	280	732	9,210	12,015
	6	532	82	87	280	554	2,839	4,374
	7	532	82	87	280	554	2,839	4,374
	9	297	8	38	127	341	3,877	4,688

platform mounds not common to the majority of locations in the region. In each of these site areas there is evidence for inter-regional interaction between the groups which occupied the areas prehistorically. This type of information is critical to an understanding of the prehistory of central Arizona. As such, to impact even one of these areas would cause the irreplaceable loss of information on intra- and inter-regional trade, interaction, and organization.

The effect of Plans 1 and 2 on prehistoric resources is considered an Adverse Flag.

(c) Plan 3

Plan 3 is considered to have the most severe impacts and effects on prehistoric resources because it would destroy the greatest number of sites with the highest acreage of archaeological remains. It combines Cliff, Roosevelt, and Confluence which all contain high quality, unique resources. In addition to the resources at Cliff and Roosevelt described in Plans 1 and 2, the high quality resources at the Confluence site would be negatively affected.

Research in the Confluence area indicates several differences between sites on the Salt River arm and sites on the Verde arm. Together, the Cliff, Roosevelt, and Confluence site areas represent a large social network which interacted on a regular basis. Because of this, Plan 3 would have an irreversible effect on a major data base which can provide valuable information on local and regional patterns of trade, interaction, social organization, and political organization in the central Arizona area.

Because of the severity of impacts of Plan 3 to prehistoric resources, this effect is considered an Adverse Flag.

(d) Plans 6 and 7

Plans 6 and 7 have identical impacts to prehistoric resources. These plans are preferable to Plan 3 because the impacts at New Waddell are much less severe than at the Confluence site. While the number of sites is relatively close, the acreage of archaeological remains is much higher at Confluence.

The effect of Plans 6 and 7 to prehistoric resources is considered an Adverse Flag.

(e) Plan 9

More sites are predicted to occur within the Plan 9 area than in any other plan. Nevertheless, Plan 9 is estimated to have a relatively low level of impact upon archaeological resources with only Plan 2 resulting in less adverse impacts. Because this plan involves no new reservoirs and increased size of three existing reservoirs, only 53 sites are estimated to be within construction zones where impacts would be severe.

Almost 95 percent of the Plan 9 sites lie in high flood pools or secondary impact zones where impacts will be infrequent and less damaging.

(2) Historic Cultural Resources

(a) Plan 8

None of the 192 inventoried historic sites within the CAWCS study area will be affected by the project under this alternative even though some of these sites may deteriorate, the sites will probably continue to be present in the future. Many of these sites will increase in significance due to their increased age and uniqueness. In addition, existing sites which were not considered during this study due to their relatively recent age will achieve significance in the future as they become older and more representative of the past.

(b) Plans 1 and 2

A total of 103 inventoried historic sites are present at the 3 affected site areas within both of these plans. Of this total, 89 sites possess scientific or historical values which would suggest that they are potentially eligible for inclusion on the National Register of Historic Places. Between 29 (typical-year reservoir) and 64 (maximum reservoir) sites would be impacted as a result on Plan 1; 27 and 59, respectively, would be destroyed; and 2 and 4 sites, respectively, would be altered. One site would be impaired. The effect of these impacts is expressed as an Adverse Flag with a comparative effect factor rating of between minus 173 and minus 370.

(c) Plan 3

A total of 177 inventoried historic sites are present at the four affected site areas within this plan. Of this total, 163 are potentially eligible for nomination to the National Register of Historic Places. Between 73 and 90 sites, respectively, would be impacted as a result of this plan; 72 and 85 of these respective totals would be destroyed; 1 and 4 sites would be altered, and one site would be impaired. Included is Fort McDowell, a particularly important site which would either be altered or partially destroyed. The effect of these impacts is expressed as an Adverse Flag with a comparative effect factor rating of between minus 434 and minus 798.

(d) Plans 6 and 7

A total of 118 inventoried historic sites are present at the 4 affected site areas included in these plans. Of this total 100 sites are potentially eligible for nomination to the National Register of Historic Places. Between 39 and 73 sites, respectively, would be impacted as a result of Plan 6; 39 of these respective totals would be destroyed. Between 3 and 6 would be altered; and ? to 3 sites would be impaired. The effect of these impacts is expressed as an Adverse Flag with a comparative effect factor rating of between minus 225 and minus 422.

(e) Plan 9

A total of 121 inventoried historic sites are present at the four affected site areas within this plan. Of this total, 103 are potentially eligible for nomination to the National Register of Historic Places. Between 37 and 67 sites would be affected by this plan; 32 to 58 of these would be destroyed; 3 to 6 would be altered, and 2 to 3 would be impaired. The effect of these impacts is expressed as an Adverse Flag with a comporative effect factor rating of between minus 207 and minus 383.

Impacts and effects of each plan are presented below and are summarized in Table IV-29 for comparative purposes.

TABLE IV-29

HISTORIC SITE IMPACT/EFFECT BY PLAN

	Plan 8	Plan 1	Plan 2	Plan 3	Plans 6-7	Plan 9
Number of Sites	192	103	103	177	118	121
Number of "Significant" Sites	174[a]	89	89	163	100	103
Total Number of Sites Impacted (Range)[b]		29-64	29-64	73-90	39-73	37-67
-Destroyed (Range)		27-59	27-59	72-85	34-64	32-58
-Altered (Range		2-4	2-4	1-4	3-6	3-6
-Impaired (Range)		1	1	1	2-3	2-3
Effects Factor[c] (Range)		-173 to -370	-173 to -370	-434 to -798	-225 to -422	-207 to -383

[a]Sites will in general tend to deteriorate

[b]Range indicates the smallest number of sites affected to the largest number of sites affected, and reflect different reservoir pool levels.

[c]Comparative effect factor ratings are based on the severity of impact to the site and the value or importance of the site. The higher the rating the more severe are the impacts. This index is more fully explained in Stage III Methodology for Environmental Quality Assessment, Section 4.4.2.

d. Mitigation

The Advisory Council on Historic Preservation (Council) "Procedures for Protection of Historic and Cultural Properties" (36 CFR 800) require that Federal agencies make a determination of effect in consultation with the appropriate State Historic Preservation Officer (SHPO). The criteria of effect as defined in 36 CFR 800 are applied when it is determined that

cultural properties on or eligible for listing on the National Register of Historic Places may be affected by the agency's project. Reclamation has determined that CAP, as a whole, will adversely affect cultural resources, and in accordance with 36 CFR 800 has entered into a programmatic memorandum of agreement (PMOA) with the Council and the appropriate SHPOs. As stipulated in the PMOA, an historic preservation plan is being developed for the entire CAP and this plan will be used to guide development of a specific mitigation plan for CAWCS.

Mitigation of adverse impacts upon cultural resources is aimed at preserving the significant values of sites. This can be accomplished by avoiding sites and leaving them intact or by recovering the information they embody prior to their alteration or destruction. Because cultural resources are nonrenewable, the preferred general strategy is to protect sites in place. It may be feasible to avoid some sites where it would not involve a major modification of planned construction or operation activities. In addition, a substantial number of sites could be protected by development and implementation of a long-term management plan for sites in upper reservoir flood pools or secondary impact zones. Impacts to many sites, however, could not be avoided and mitigation would require data recovery studies. Data recovery efforts will therefore be guided by priorities based on relative site significance as well as magnitude and probability of impacts.

e. Residual Impacts

The data recovery approach to impact mitigation assumes that it is not necessary or possible to recover all information from each site; therefore, unrecovered information would remain at some sites and would be lost or destroyed as a result of project implementation. Even though the impact analysis presented above displays considerable variations among the plans, all are ranked as an Adverse Flag because of these residual impacts. Because of overriding public benefits to be realized through project implementation, the loss of cultural resource data or value losses may be deemed acceptable. Presumably, any unrecovered information would be of low research value.

f. Impacts with Modified Roosevelt and Modified Stewart Mountain in Plans

There is no difference in impacts to prehistoric cultural resources between New and Modified Stewart Mountain Dam since the water level would remain the same and borrow material would be obtained from outside of the site area. There would also be no difference between the New and Modified Roosevelt Dam because no sites are recorded in the vicinity of the new dam

site. The difference in maximum water level is also minimal, although in some rare instances sites located on the 2,136-foot contour could be inundated for a longer period of time.

The effects on historic sites are also similar whether new dams or modified dams are constructed. The difference between New and Modified Roosevelt is that with a new dam, the existing dam would have to be partially dismantled and breached. Any remnants would be inundated during normal operation; modification requires raising the existing dam, a change that would severely alter its physical structure. Either action would alter the original architectural integrity of the dam. Modification of the structure would not totally detract from the association of the dam with historic water development and would potentially allow for preservation of the downstream transformer building and parts of the power house which date from the period of original dam construction. New Stewart Mountain Dam would result in the destruction of the existing dam which is potentially eligible for inclusion on the National Register of Historic Places. Modified Stewart Mountain Dam would moderately alter the existing dam; the addition of a new spillway may not affect the potential of the dam to be placed on the National Register.

5. Social Resources

a. Types of Impacts to People

The social impacts analysis focuses on (1) impacts of relocation to individuals, families, and communities and (2) impacts of flood reduction on transportation, health, and safety.

Relocation would occur at the following dams and would involve the communities or entities indicated:

- Confluence Dam - Fort McDowell Indian Community (Plan 3)
- Roosevelt Dam - Rockhouse Farm, Roosevelt Lake Estates, North Bay Estates, and Roosevelt Gardens East (all action plans)
- Cliff Dam - KA Ranch (all action plans except Plan 9)

Flood reduction impacts would occur in the 200-year flood plain of the Salt and Gila Rivers through the Phoenix metropolitan area. Affected communities include the cities of Mesa, Tempe, and Phoenix; the town of Buckeye and surrounding areas; the Salt River and Gila River Indian Communities; and the area surrounding and including the Holly Acres subdivision.

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

Relocation and flood reduction impacts would be the same for New or Modified Roosevelt or Stewart Mountain because lake elevations, size, storage allocations, and flood control operations would be identical for a new structure or modified dam. Therefore, there is no significant difference in impact between either option.

c. Methodology

Numerous factors were identified for both relocation and flood reduction impacts that were judged to best "capture" the social consequences of project actions. These factors were grouped into three categories: individual, interpersonal, and community factors. The selection of factors was based upon an extensive review of the research literature and on discussions with members of the affected populations. Both primary and secondary sources of data were incorporated into the assessment.

The literature review yielded a list of characteristics associated with success in adapting to relocation and with the ability to cope with disaster. The affected populations were compared with these lists of characteristics, and projections were made about the general level of expected impacts. The factors were measured for existing conditions, based on primary data that were collected using three techniques. First, case histories were conducted with members of the affected populations. These histories were recorded and transcribed; they contained information about the recent characteristics of the population and about the factors that would be traced across the project conditions. Second, interviews were conducted with key informants who were chosen for their specialized knowledge about some aspect of the impact assessment. Third, field observations were made and recorded by researchers who visited affected communities; they attended community functions and public meetings, and made notes on their observations.

Secondary data were used extensively in the assessment as well. Information relevant to the impact assessment that was collected in conjunction with several research projects was incorporated, as well as demographic information obtained from census data and local, state, and federal government agencies.

Data analysis consisted of making impact projections, rating the level of the impact, and assessing the probable effect of the impacts. Impacts were rated according to one of five levels. Changes were rated as follows, depending on the probability of occurrence, likely duration, number of people affected, reversibility of the impact, and the extent to which many areas of life were affected: 1) no change, 2) slight change, 3) moderate change, 4) substantial change, or 5) extreme change. For example, an extreme impact would have the following characteristics: it is very likely to occur, would last for a long time, would be difficult to reverse and would affect many areas of a person's life. In contrast, an impact described as slight may be irreversible, but may only affect a few people or alter some factor that is not highly valued.

The effect rating is contingent upon the value system of those experiencing the impact; the magnitude, duration, extent, and probability of impact; and the professional judgment of the analyst.

d. Relocation

The consequences of relocation vary, both on the individual and community level. Depending on the nature of the relocation and

on the characteristics of affected individuals and communities, the consequences of relocation could range from temporary stress to permanent lifestyle disruption. The impact of relocation depends on two general conditions: (1) how much change is generated by relocation, and (2) how that change is interpreted and tolerated by the people who are relocated.

Stress and its manifestations are the primary impacts of relocation to individuals, families, and communities.

Relocations would occur at the Fort McDowell Indian Community (Plan 3) and the Roosevelt Lake communities (Plans 1, 2, 3, 6, 7, and 9). While impacts at both areas are adverse, relocation of the Fort McDowell Community assumes an extraordinary adverse dimension because of characteristics of the community. By comparison, Roosevelt Lake impacts are less severe; however, they are still rated as Significant Adverse prior to mitigation.

(1) Fort McDowell Indian Community

Table IV-30 summarizes the impacts and effects of relocation for the Fort McDowell community, which are discussed below.

(a) Direct and Indirect Impacts of Plan 8 and Plans 1, 2, 6, 7, and 9

The existing conditions at Fort McDowell reflect changes in the community that are a result of long-proposed relocation. The future-without condition will be significantly altered. For example, health problems resulting from proposed relocation will be reduced and illness rates will return to normal.

The potential for economic self-sufficiency, community autonomy, and viability will be higher in the future-without condition than the present condition. The tribe's economy will no longer be stymied by the prospects of impending relocation, and the stature of community leaders and tribal government will be enhanced because they succeeded in preventing the community's relocation.

Identical conditions are predicted to occur with Plans 1, 2, 6, 7, and 9. It is probable that conditions would be even better with these plans than with Plan 8 because any future potential for a Confluence Dam would be eliminated by implementation of these plans.

(b) Direct and Indirect Impacts of Plan 3

The Confluence Dam and Reservoir would inundate a large portion of Fort McDowell Indian Community lands. Approximately 13,000 acres of the total 25,000 acres owned by the tribe would be acquired by the Bureau of Reclamation for the dam and reservoir. Some 290 members of the 374-member community would be relocated.

Table IV-30

FORT McDOWELL INDIAN COMMUNITY
IMPACTS AND EFFECTS OF RELOCATION

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 3	Plans 1, 2, 6, 7 and 9
Social Factors	No Relocations (374 people in affected community)	290 Relocations (77% of affected population)	No Relocations
Individual			
1. Changes in physical and mental health problems	1. Normal incidence of physical and mental health problems given age distribution of population	1. High incidence of physical and mental health problems which is expected to result in increased mortality rates	1. There are no impacts because no individuals are relocated
2. Changes in personal autonomy: (the degree to which individuals believe they have freedom and power to control their lives)	2. High levels of personal autonomy	2. Extreme decline in levels of personal autonomy	
3. Satisfaction with way of life	3. High satisfaction with way of life	3. Extreme decrease in satisfaction with way of life	
4. The potential for financial self-sufficiency	4. High potential for increased financial self-sufficiency	4. Substantial decrease in potential for sustained financial self-sufficiency	
Interpersonal			
1. The nature and extensiveness of family ties and informal support networks	1. High levels of extended family ties; highly integrated support systems within the family and tribe	1. Substantial decrease in extended family ties and family support networks	1. No Impact
2. Incidence of family problems such as divorce, child abuse and neglect, and alcohol and drug abuse	2. Normal incidence of family problems	2. Substantial increase in incidence of family problems such as divorce, child abuse and neglect, and drug abuse; moderate incidence of alcohol abuse	
Community			
1. Community Cohesiveness (the extent to which a community is unified with individuals mutually depending on each other for support)	1. High community cohesion; high levels of informal support networks	1. Extreme decrease in community cohesion. Substantial decline in number and efficacy of informal networks	1. No impact
2. Community Viability	2. High community viability (significant increase from present condition); strong community leadership; high potential for tribal autonomy	2. Extreme decrease in community viability; substantial decline in autonomy (ability to control the direction of the community) and in efficacy of tribal leadership; elimination of trend toward self-determination	

Table IV-30 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 3	Plans 1, 2, 6, 7 and 9
	No Relocations (374 people in affected community)	290 Relocations (77% of affected population)	No Relocations
Community (Con't)			
3. Economic self-sufficiency (the degree to which a community is/is not reliant on outside agencies for economic support); unemployment rate	3. High potential for increased tribal economic self-sufficiency; moderate level of unemployment	3. Substantial decrease in potential for tribal economic self-sufficiency (increased dependency on governmental services); substantial increase in unemployment	
4. Potential for sustaining the Yavapai culture	4. High potential for sustaining Yavapai culture	4. Extreme decrease in potential to sustain Yavapai culture	
Conceptual Mitigation			
	1. NA	1. Relocate the entire community together; do not relocate on an individual basis	1. NA
		2. Provide the tribe with additional land equal to or greater in size than that acquired, and of the highest quality available which is contigous to the reservation boundaries	
		3. Monetary compensation should cover all expenditures and new expenses incurred by the residents as a result of relocation and should be distributed according to the tribe's wishes	
		4. Provide special services to meet needs that are unique to this community	
		5. Initiate a plan that ensures the participation of the entire community in all decisions and plans related to the relocation	
		6. Provide an accurate, reliable system for disseminating information to residents so that they are constantly informed about the relocation proceedings; provide a means by which residents can participate in the relocation planning	

Table IV-30 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 3	Plans 1, 2, 6, 7 and 9
	No Relocations (374 people in affected community)	290 Relocations (77% of affected population)	No Relocations
Residual Impacts			
1. Residual impacts are those that cannot be eliminated by mitigation measures	1. NA	1. Mitigation could not eliminate any of the impacts of relocation among Fort McDowell residents. At best it could only slightly reduce a few of the impacts.	1. None
Unmitigated/Mitigated Effects			
	1. NA	AF/AF	No Effect

The consequence of this project action would be a marked increase in stress at both the individual and community level. The stress that would result from relocation of the Yavapai would be made manifest in three general ways: physiologically, psychologically, and socioculturally. Each of the following predicted impacts is a specific manifestation of one of these three forms of stress.

(i) Increase in Physical and Mental Health Problems: Following relocation, the Yavapai would experience increased physical and mental health problems that are expected to result in an increase in the community's mortality rates. Residents have experienced escalated stress levels resulting from threats of relocation, and medical utilization rates have significantly increased as the stress has escalated.

(ii) Extreme Decline in Levels of Autonomy: Relocation would result in an extreme decline in both personal and tribal autonomy. For many residents, their opposition to relocation has become the most critical issue in their lives. If, despite years of activity in which virtually every resident participated, they failed to prevent the construction of a Confluence Dam, residents inevitably would feel a sense of defeat. This defeat would be construed as evidence that they are powerless to protect their own interests and effect change.

(iii) Substantial Decrease in Potential for Sustained Economic Self-Sufficiency: Past experience with resettlement programs indicates that forced relocation for an Indian community does not improve the financial status of the residents. Almost invariably, monetary compensation, even including sums that appear quite generous, does not result in sustained financial security for relocatees and their descendants.

(iv) Decrease in Family Support Systems, Increase in Family Problems: The severe stress, demoralization, and sense of defeat experienced by the community would take its toll on family members causing disturbed family life, depression, anxiety, and a breakdown of family support systems. The hardships and pressures brought to bear on the family would result in disorganization within the family structure. The incidence of family problems such as alcohol and drug abuse, family violence, and child neglect is expected to increase.

(v) Extreme Decrease in Informal Support Networks and in Community Cohesiveness: Relocation disrupts social support networks. Normal behavior patterns are disrupted and people become isolated from each other as they attempt to cope with the shock of resettlement.

The disruption of support networks would substantially reduce the cohesiveness of the community. This cohesiveness is, in part, a consequence of residents' shared strong attachments to their land and their belief in their ability to control their lives and sustain the community. Relocation would disrupt their attachment to the land and cause residents to lose confidence in themselves and in their leaders. This would further reduce the cohesiveness of the community.

(vi) Extreme Decline in Satisfaction With Life: Residents of Fort McDowell are currently very satisfied with their lives except for stress caused by threat of relocation. The tribe is making significant progress toward their goal of self-determination. This would cease if residents were forced to relocate. Residents virtually all agree that the vast changes induced by their relocation would be highly undesirable and would alter those things which are presently most satisfying to them.

(vii) Extreme Decrease in Community Viability: Community viability is defined as the ability of a community to sustain itself. It is projected that compulsory relocation would result in an extreme decrease in the viability of the Fort McDowell community, for the following reasons:

Relocation would have deleterious consequences for the economy at Fort McDowell. Unemployment would increase and economic development activities would be abandoned because, following relocation, the Fort McDowell community would not have a reliable economic base.

One of the most commonly reported outcomes of compulsory relocation is the demise of the leadership or local government of the affected population. Besides losing confidence in their leadership, the residents would lose confidence in their system of government, for they would perceive it as inadequate to protect them and meet their most basic needs.

For Fort McDowell residents, the community is their tribe; it constitutes an integral part of their cultural identity. Relocation would disrupt their strong identification with their community because of the interrelatedness of their culture, community and land.

(viii) Extreme Decrease in Potential to Sustain Yavapai Culture: The prehistory and history of the Yavapai demonstrates that culturally and historically they are a people distinct from other groups in the Southwest.

Relocation would likely result in the destruction of the culture and society of the Yavapai. Even if the community would be relocated as a whole, it could take decades for new ties to form. In a cultural sense, fundamental patterns of social interaction, which are public displays of cultural behavior, can no longer be carried out after relocation. Although Yavapai people will survive as will some aspects of the culture, fundamental subsystems would be irreparably damaged, especially those that relate to the tribe as a cultural and legal entity, the community in its relationship to the land, and the people in their social relationships.

(c) Mitigation and Residual Impacts

The conceptual mitigation plan for Fort McDowell residents is outlined in Table IV-30. The impacts at Fort McDowell would be severe, irreversible, long lasting, and would affect every member of the tribe. While some mitigation may be possible, it would not significantly reduce the effects of relocation impacts.

One impact that could be partially mitigated is the breakdown of extended family and social networks. Enough land could be provided for the entire community to duplicate existing spatial housing patterns. Such an arrangement would have less of an impact than dispersing family and neighborhood networks, providing that residents were in good mental and physical health. Clearly, money would not mitigate any of the social impacts described here; money would, however, be paid to the tribe in compensation for land required by the project. Many members of the tribe have expressed concern for the consequences of an influx of large sums of money to people not experienced or trained to invest it.

Since mitigation does little to reduce the impacts of relocation on Fort McDowell residents, residual impacts remain virtually the same as unmitigated impacts. The mitigated effect remains the same, Adverse Flag.

(2) Roosevelt Lake Communities

The impacts and effects of relocation for Roosevelt Lake area residents are summarized in Table IV-31.

(a) Direct and Indirect Impacts of Plan 8

In the future-without condition for Roosevelt Lake communities, few changes in population numbers and characteristics are expected from the existing condition. This is because little private land remains available in the area, and residents do not want increased development. The proportion of full-time residents, however, will increase as individual lots are developed and housing structures are made more permanent.

(b) Direct and Indirect Impacts of Plans 1, 2, 3, 6, 7, and 9

With all action plans (Plans 1, 2, 3, 6, 7, and 9) Roosevelt Dam would be modified or a new dam built, creating a larger reservoir than currently exists. Land would be acquired by the Bureau of Reclamation for the larger reservoir, and homes and businesses within the take-line would be relocated.

As a result of differences among action plans, the number of people relocated at Roosevelt Lake would vary; however, the general impacts would be the same because of the similarity in the communities that would be affected. In the following sections, these general impacts are first described, and then the differences in the affected communities of Rockhouse Farm, Roosevelt Lake Estates, North Bay Estates, and Roosevelt Gardens East are discussed.

(i) General Impacts at Roosevelt Lake:

Relocation would be stressful for Roosevelt Lake residents and would require considerable adjustment for them. Many residents are older and live on fixed incomes. Since private land is no longer available in the immediate vicinity,

Table IV-31

ROOSEVELT LAKE AREA
AGGREGATED IMPACTS AND EFFECTS OF RELOCATION

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 2	Plans 1, 3, 6, 7 and 9
Social Factors	No Relocations (596 people in affected communities)	247 Relocations (40% of affected population)	347 Relocations (58% of total population)
Individual			
1. Changes in physical and mental health problems	1. Normal incidence of physcial and mental health problems given age distribution of population	1. Slight increase in physical and mental health problems resulting from increased stress	1. Slight increase in physical and mental health problems resulting from increased stress
2. Changes in personal autonomy (the degree to which individuals believe they have freedom and power to control their lives)	2. High levels of personal autonomy	2. Substantial decrease in personal autonomy	2. Substantial decrease in personal autonomy
3. Satisfaction with way of life	3. High satisfaction with way of life	3. Substantial decrease in satisfaction with way of life	3. Substantial decrease in satisfaction with way of life
4. The potential for financial self-sufficiency	4. High potential for financial self-sufficiency	4. Moderate reduction in potential for self-sufficiency	4. Moderate reduction in potential for self-sufficiency
Interpersonal			
1. The nature and extensiveness of family ties and informal support networks	1. Low levels of informal support networks in all communities except Roosevelt Gardens; at Roosevelt Gardens moderately developed informal support networks. Family interaction primarily within nuclear family at all locations	1. Slight decrease in informal support networks among family and friends	1. Moderate decrease in informal support networks. Slight decrease in informal interactions between households
Community			
1. Community Cohesiveness (the extent to which a community is unified with individuals mutually depending on each other for support. A cohesive community is characterized by extensive informal support networks, frequent personal interaction, and by strong personal identification of residents with the community as a whole)	1. Low to moderate community cohesion in all communities except Roosevelt Gardens; high community cohesion at Roosevelt Gardens (formal social organization emerges on temporary basis to meet needs and respond to immediate problems). Low level community organization on day to day basis. (Emphasis on individuality more than community)	1. Slight decrease in community cohesion and social organization	1. Moderate decrease in community cohesion and slight decrease in social organization
2. Community Viability (the ability of a community to sustain itself)	2. Community development likely to remain at present low level which is adequate to sustain viability. Moderate potential for sustained community viability at area level	2. Moderate decrease in potential for sustained community viability	2. Substantial decrease in potential for sustained community viability

Table IV-31 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 2	Plans 1, 3, 6, 7 and 9
Conceptual Mitigation			
	1. NA	1. Relocate only those people who live within the area likely to be inundated more than once in 200 years, but not within the larger IDF area; provide low-cost flood insurance to people residing in the IDF area	1. Relocate only those 50 people who live within the confines of the 200-year flood pool, with no relocation of people in the IDF area 2. Provide low-cost flood insurance to people in the IDF area 3. Provide Forest Service land in the Roosevelt Lake area bordering Roosevelt Lake Estates for relocations, allowing enough space so neighbors may relocate near each other if they wish. 4. Provide monetary compensation for all relocation expenses incurred by residents 5. Provide special services to meet needs that are unique to these communities 6. Provide an accurate and reliable system for disseminating information to residents so that they are constantly informed about relocation proceedings; provide a means by which residents can participate in the relocation planning process

Table IV-31 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 2	Plans 1, 3, 6, 7 and 9
Residual Impacts			
1. Residual impacts are those that cannot be eliminated by mitigation measures	1. NA	1. None. If mitigation measures are implemented no people will be relocated	1. 50 individuals reside below elevation 2,173 feet at Roosevelt Lake Estates and would require relocation with mitigation. These individuals would experience slight levels of stress and inconvenience if relocated within the community and awarded equitable compensation
Unmitigated/Mitigated Effects			
	1. NA	SA/No Effect	SA/I

relocation could force many to leave the area. If residents could no longer maintain the same lifestyle elsewhere, the change in their lives would be both significant and disruptive.

Stress levels would be limited, to some extent, because there is not a high degree of consensus among residents regarding their expectations about relocation. None of the residents want to be relocated, but some feel they could adjust quite easily to relocation. Some residents believe that relocation would undermine their ability to live as they desire, while other think relocation would not change much in their lives.

If forced to move, residents would be very upset and disappointed; however, they would not construe their relocation as a personal defeat and would not be likely to internalize feelings of helplessness or failure which would reduce their ability to cope with the stress.

Since community cohesiveness, formal organization, and community viability are generally at low or moderate levels, relocation would not significantly reduce these factors even if it results in the dissolution of the community, as with Rockhouse Farm or North Bay Estates.

The aggregate impact to Roosevelt Lake residents is displayed in Table IV-31. The unmitigated effect has been evaluated as Significant Adverse. The severity of the impact stems from residents' strong desire to remain in the area, the problems associated with moving and re-establishing a home, financial considerations, and relocating large proportions of, or in some cases, entire communities. Differences among the effected communities are described below.

(ii) Rockhouse Farm: All of the 47 residents of Rockhouse Farm would be required to relocate with all action plans. The residents (except the owners of the mobile home park) rent their trailer lots; most rent their mobile homes or trailers as well. The degree of change caused by relocation of this community would not be great.

(iii) Roosevelt Lake Estates: Approximately 125 people would be relocated from Roosevelt Lake Estates with Plan 2; 175 people would be relocated with Plans 1, 3, 6, 7, and 9. A total of 359 people live in the Estates. The Estates residents own their own property. Since no private property remains available near the lake, those who are relocated would have to leave the area. This would disperse the community, disrupt interpersonal relationships, and substantially reduce individuals' feelings of satisfaction and autonomy.

(iv) North Bay Estates: All of the 60 residents of North Bay Estates would be relocated with all the action plans. About two-thirds of North Bay Estates residents live there only part-time. As a result, the community is not highly cohesive or well developed and community level impacts are minimal. However, individual level impacts would result in significant change for people who would be relocated.

(v) Roosevelt Gardens East: Fifteen people would be relocated as a result of Plan 2. Most of these are part-time residents, so impacts on all levels would not be great. Since private land near the lake is no longer available, residents would have to leave the area. With Plans 1, 3, 6, and 7, about one-third of the residents would have to relcoate, and impacts would be more adverse.

(vi) Impacts to Roosevelt Lake Area Business: The Lakeview Marina on the east side of the lake would be relocated with all action plans. The marina is the only boat launching ramp of its kind at Roosevelt lake and includes a small store equipped with supplies. The Rockhouse Farm store and trailer park, also on the east side of the lake, would require relocation with all action plans. One ranch, located on the west of the lake in Roosevelt Gardens East, would be relocated with all action plans. Other lands used by ranches for grazing cattle on both sides of the lake would be inundated with any increase in the lake's elevation.

Area businesses would experience a decrease in sales and profits if nearby communities are relocated. Recreational facilities would experience a temporary loss in income, with long-term prospects of profitability increasing because of greater recreational use of the lake. The Punkin Center School would have a decrease in enrollment if residents are relocated out of the area.

(c) Mitigation and Residual Impacts

The conceptual mitigation plan for Roosevelt Lake relocations focuses on not relocating people from ares where the probability of reservoir inundation is very low; in all plans, mitigation would consist of not relocating people from the IDF area. Other provisions of the conceptual mitigation plan are presented in Table IV-30.

With mitigation, the severity of the impacts would be greatly reduced in Plans 1, 3, 6, 7, and 9 resulting in an insignificant effect. The 90 families still requiring relcoation with mitigation (those who live at elevations below 2,173 feet) live near the northern boundary of Roosevelt Lake Estates, close to the lake. About half of these are part-time residents, many of whom are planning to retire in the community. Since it is possible to compensate for financial losses, to provide land in the area so that residents can retain the same lifestyle, and to provide moving services, the impacts of relocation for these 90 families can be significantly reduced. If these individuals can be relocated to higher Forest Service land adjacent to the community and compensated for all expenses incurred as a result of their move, all impacts would be virtually eliminated.

Mitigation for Plan 2 would eliminate all impacts because there would be no relocations.

(3) KA Ranch (Cliff Dam)

Relocation would occur at the Cliff site under all action plans except Plan 9. The impacts and effects of relocation at the KA Ranch within the Cliff site area are summarized in Table IV-32. The

Table IV-32

CLIFF SITE (KA RANCH)
IMPACTS AND EFFECTS OF RELOCATION

Impacts and Effects	Plan 8 and Plan 9 CAWCS No Action Future Without Project	Plans 1, 2, 3, 6, and 7
Social Factors		
	No Relocations (16 people reside at the ranch)	16 Relocations (100% of total population)
Individual		
1. Changes in physical and mental health problems	1. Normal incidence of physical and mental health problems	1. No change in incidence of physical and mental health problems
2. Changes in personal autonomy (the degree to which individuals believe they have freedom and power to control their lives)	2. High levels of personal autonomy	2. Slight decrease in personal autonomy
3. Satisfaction with way of life	3. High satisfaction with way of life	3. Slight decrease in satisfaction with way of life
4. The potential for financial self-sufficiency	4. High potential for financial self-sufficiency	4. Moderate reduction in potential for self-sufficiency
Interpersonal		
1. The nature and extensiveness of family ties and informal support networks	1. High levels of informal support networks among familial households	1. No impact
Conceptual Mitigation		
	1. NA	1. Monetary compensation should cover all expenditures and new expenses incurred by the residents as a result of relocation
		2. Attempt to replace patented land owned by residents with equivalent acreage in region with potential for adjacent grazing lease land and sufficient water rights to grow feed for cattle operation
		3. Provide an accurate, reliable system for disseminating information to relocatees so that they are constantly informed about the relocation proceedings

Table IV-32 Continued)

Impacts and Effects	Plan 8 and Plan 9 CAWCS No Action Future Without Project	Plans 1, 2, 3, 6, and 7
Residual Impacts		
1. Residual Impacts are those that cannot be eliminated by mitigation measures	1. NA	1. Mitigation procedures would lessen the stress and financial problems associated with relocation, althoug residents would experience minor stress and inconvenience while relocations take place.
Unmitigated/Mitigated Effects		
	1. NA	I/I

unmitigated impacts at the KA Ranch stem mostly from financial considerations and from the residents' desire to live in the area. Mitigation, based on monetary compensation and providing equivalent alternate land, could reduce the impacts. The impacts are described as slight because of the small number of people involved (16 people) and steps the family has taken to remain together in the area. The current owners of the ranch have recently pruchased another ranching operation in the area and plan to relocate together.

e. Flood Damage Reduction

This section described the social impacts and effects of flood damage reduction. Impacts and effects of alternative plans, including no action, are described in Tables IV-33, IV-34, and IV-35. Alternative plans are associated with three floodflow levels. Plan 8 (no action) does not provide flood control. Plan 2 provides control of the 200-year flood (275,000 cfs) to 157,000 cfs at Sky Harbor Airport. Plans 1, 3, 6, and 7 control the 200-year flood to between 70,000 and 92,000 cfs at the airport. Plan 9 controls the 200 year flood to 215,000 cfs.

(1) Types of Flood Damage Reduction Impacts

Each of the alternative flood control plans are analyzed according to two levels of measurement: individual and area. The individual level of analysis describes the direct effects of flooding while the area level described the indirect effects.

The direct impacts of flood control are the reduction or elimination of conditions experienced by individuals as a result of property inundation during and following a flood. These conditions include changes in physical and mental health, financial capacity, and life satisfication. Indirect impacts are the reduction or elimination of threats to area-wide public safety and welfare during and following a flood. These threats are contingent upon the degree of breakdown experienced by a particular area's physical infrastructure and public safety organizations. Area level impacts are assessed according to organizational characteristics peculiar to the CAWCS study area. These include disruptions in automobile, air, and rail transportation; public utilities; telecommunication; public safety response organizations; business operations; tourism; and communities inundated as they relate to public safety and welfare. One added impact of flood control is the additional land available for development as a result of reduced flood flows.

The degree of individual and area wide disruption in a flooding disaster varies; it depends largely upon the suddenness, duration and intensity of a particular flood event. Historic flooding events are used to characterize the type of impacts caused by floods in central Arizona.

(2) Direct and Indirect Impacts of Plan 8

Future social conditions without flood control are assumed to be conditions in the event of a 200-year flood by the year 2000. In the CAWCS study area, the 200-year flood is defined as a flow of 275,000 cfs as measured at Sky Harbor International Airport. Projection of the year 2000 population for the Salt-Gila flood inundation area 46,560. This number is slightly less than 2 percent of the projected Maricopa County population of

TABLE IV-33

FLOOD DAMAGE REDUCTION IMPACTS OF PLANS 1, 3, 6 and 7
CONTROL OF 200-YEAR FLOOD TO FLOW OF 70,000 TO 92,000 cfs

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level Between 70,000 and 92,000 cfs (Plans 1,3,6,7)	Impact
Individual Level Factors			
(1) Physical and Mental Health	Potential for inundation area impacting of 46,560 individuals in year 2000. High probability for large number of flood-related deaths. Widespread potential for physical injury, illness, and severe stress for flood victims. High levels of disorganized (panic) activity.	Potential for inundation area impacting less than 100 individuals in year 2000. No flood-related deaths anticipated. Potential for physical injury and illness for less than 100 individuals. Low levels of disorganized (panic) activity.	Elimination of potential for inundation area impacte >46,460 individuals. Elimination of high probability of large number of flood-related deaths. Potential for physical injury and illness and severe stress eliminated for >46,460 individuals. Substantial reduction of potential for disorganized (panic) activity.
(2) Net Disaster Losses	Projected $87,292,000 in residential property damages in year 2000; majority of 46,560 individuals directly affected in low-to-moderate income brackets. Majority	Projected $602,000 in residential property damage in year 2000. Majority of <100 individuals affected low-to-moderate income sequential flooding disaster	Reduction of $86,690,000 in residential property damage by year 2000; majority of directly affected individuals in low-to-moderate income

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level Between 70,000 and 92,000 cfs (Plans 1,3,6,7)	Impact
Individual Level Factors (Continued)			
	of flood victims required to obtain loans or use personal savings to make repairs to property.	victims. Majority of <100 individuals inundated required to obtain loans or use personal savings to make repairs to property.	brackets. Extreme reduction of potential for loans and depletion of personal savings for property repairs by majority of >46,460 individuals.
(3) Lifestyle Disruption	Temporary lifestyle disruption for 46,560 individuals subject to inundation by floodwaters. Long and debilitating cleanup for many months; lost work and school time. Permanent changes in lifestyle for majority of 525 sequential disaster victims in Holly Acres subdivision.	Temporary lifestyle disruption for <100 individuals subject to inundation; permanent lifestyle disruption for majority of <100 sequential disaster victims in Holly Acres.	Extreme reduction of lifestyle disruption. Elimination of disruptions for >46,460 individuals. Elimination of lost work and school time for >46,460 individuals.

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level Between 70,000 and 92,000 cfs (Plans 1,3,6,7)	Impact
Area Level Factors			
(1) Transportation Disruptions			
- Automobile	Damages to roads and bridges projected to be $15,800,000 by year 2000. 0-1 river crossings operable. Transportation delay costs projected to be $39,694,000 by year 2000. High levels of stress experienced by area motorists due to traffic delays and hazardous driving conditions. Many unable to cross floodplain area.	15 bridge crossings remain operable. Closure of dip crossings. Damages to roads and bridges totalling <$5,000,000. No significant delays in transportation by the year 2000.	14-15 bridge crossings maintained. Substantial reduction of costs of damages to bridges and roads (>$10,800,000). Elimination of significant transportation disruptions.
- Air and Rail	Damages to airport facilities and railroad tracks and yard projected to be $7,021,000 by year 2000. Major delays in air service for 2 days beyond peak flow. Repairs would require 3 months to complete. >$500,000 in damages to airport channel clearing project.	No damage to air and rail transportation facilities. Minor damage may occur to airport channel clearing project.	Elimination of $7,021,000 in damage costs and reduction of damages to airport channel clearing project by year 2000.

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level Between 70,000 and 92,000 cfs (Plans 1,3,6,7)	Impact
Area Level Factors (Continued)			
(2) Public Utilities	Damages totalling $6,400,000 to electrical transmission towers and power lines: repairs would take 2 months to complete. No blackout expected. >$275,000 in damages to sewage and wastewater treatment plants. Damages to active landfills cannot be quantified at the present time.	Damages to electrical transmission towers and power lines would be well below $1 million. Insignificant damages to sewage and wastewater treatment plants. Damages to active landfills cannot be quantified at the present time.	Substantial reduction of damages to electrical transmission towers and power lines (>$5,400,000). Substantial reduction of damages to sewage and wastewater treatment plants and active landfills.
(3) Communication	Temporary delays in telephone service. Major delays in delivery schedules of newspapers, mail, and other subscription services.	Possibility of delays in telephone service for some. No delays in delivery schedules of newspapers, mail and other subscription services.	Elimination of disruption in delivery service of published material (mail, newspapers, etc.). Substantial reduction in disruption of phone service.
(4) Business Community	Damages totalling $68,713,000; combined both short and long term revenue losses costs could be in excess of $150 million	Damages totalling $6,194,000; Majority of damages occurring to sand and gravel operations.	Reduction of $62,519,000 in damages. Elimination of lost revenues due to transportation disruptions

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level Between 70,000 and 92,000 cfs (Plans 1,3,6,7)	Impact
Area Level Factors (Continued)			
(5) Tourism	Short- and long-term losses due to forced cancellations of trips and adverse publicity.	No significant disruption in tourist trade.	Substantial reduction of short- and long-term losses due to cancellations of trips and adverse publicity.
(6) Public Safety	Civil defense warning system fully activated. Emergency aid required from outside of metropolitan area. Emergency costs of $1,109,000. Lack of emergency personnel to carry out all door-to-door warnings.	Although no accurate estimate exists for emergency costs in a flood of this level, it is estimated that costs would be below $60,000.	Reduction of <$1,049,000 in emergency costs. Elimination of needed aid from outside of the Phoenix metropolitan area.
(7) Communities Subject to Inundation	Mesa, Tempe, Phoenix, SRPMIC, GRIC, Buckeye, Holly Acres. Breakdowns in established informal support networks and community cohesion for 7 communities.	Less than 100 individuals residing in the subdivision of Holly Acres could be inundated by floods below 100,000 cfs. Major breakdowns in informal support networks and community cohesion would not be anticipated.	Elimination of residential property damage and breakdowns in informal support networks and community cohesion for >46,460 individuals in 7 communities (Mesa, Tempe, Phoenix, SRPMIC, GRIC, Buckeye, Holly Acres).

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level Between 70,000 and 92,000 cfs (Plans 1,3,6,7)	Impact
Area Level Factors (Continued)			
(8) Additional Land Use	No additional land available.	Approximately 3,563 additional acres available for higher urban uses. Valued at $107,311,000 by year 2000.	Additional 3,563 acres available for higher urban uses. Valued at $107,311,000 by year 2000.

TABLE IV-34

FLOOD DAMAGE REDUCTION IMPACTS OF PLAN 2
CONTROL OF 200-YEAR FLOOD TO FLOW OF 157,000 CFS

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Individual Level Factors			
(1) Physical and Mental Health	Potential for inundation for 46,560 individuals in year 2000. High probability for large numbers of flood-related deaths. Widespread potential for physical injuries and illness and severe stress for inundated flood victims. High levels of disorganized (panic) activity.	Potential for inundation for approximately 525 individuals by the year 2000. Low probability for large numbers of flood-related deaths. Potential for physical injury and illness and severe stress for 525 individuals. Low levels of disorganized (panic) activity.	Elimination of potential for inundation for approximately 46,035 individuals in year 2000. Moderate decrease in probability for large number of flood-related deaths. Elimination of potential for physical injury and illness and severe stress for 46,035 individuals. Substantia reduction in potential for disorganized (panic) activity.
(2) Net Disaster Losses	Projected $87,292,000 in residential property damage in year 2000; majority of 46,560 people directly affected are in low-to-moderate income brackets.	Projected $5,684,000 in residential property damage in year 2000. Majority of 525 individuals affected are low-to-moderate income sequential flooding disaster	Reductions of projected $81,608,000 in residential property damage by year 2000; majority of directly affect individuals are in low-to-

TABLE IV-34 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Individual Level Factors (Continued)			
	majority of inundated flood victims required to obtain loans or use personal savings to make repairs to property.	victims; majority of 525 inundated individuals required to obtain loans or use personal savings to make repairs to property.	moderate income brackets. Elimination of potential for loans and depletion of personal saving for property repairs for 46,035 individuals.
(3) Lifestyle Disruption	Temporary lifestyle disruption for 46,560 individuals subject to inundation by floodwaters. Long and debilitating cleanup for many months. Lost work and school time. Permanent changes in lifestyle for majority of 525 sequential disaster victims in Holly Acres.	Temporary lifestyle disruptions for 525 individuals inundated; permanent lifestyle disruption for many of 525 sequential disaster victims in Holly Acres. Lost work and school time for inundated individuals.	Substantial reduction of lifestyle disruption. Elimination of disruption for 46,035 individuals. Elimination of lost work and school time for 46,035 individuals.

TABLE IV-34 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Area Level Factors			
(1) Transportation Disruptions			
- Automobile	Damages to roads and bridges projected to be $15,800,000 by year 2000. 0-1 river crossings operable. Transportation delay costs projected to be $39,694,000 by year 2000. High levels of stress experienced by area motorists due to traffic delays and hazardous driving conditions. Many unable to cross floodplain area.	15 river crossings operable. Damages to roads and bridge crossings totalling >$5,000,000. Closure of all dip crossings. Transportation delay costs considered to be insignificant with new bridge crossings in place. Low levels of stress experienced by area motorists due to minor transportation delays (i.e. added driving distances to cross floodplain).	Substantial reduction of damages to bridges and roads as a result of flooding (<$10,800,000). Substantial reduction of transportation delay costs. Elimination of stress associated with long waits to cross floodplain area.
- Air and Rail	Damages to airport facilities and railroad tracks and yard projected to be $7,021,000 by year 2000. Major delays in air service for 2 days beyond peak flow. Repairs would require 3 months to complete. >$500,000 damage to airport channel clearing project.	No damage to air and rail transportation facilities in year 2000. No delays in service. Approximately $500,000 in damage to airport channel clearing project.	Elimination of $7,021,000 in damages to airport facilities and railroad tracks and yards by year 2000. Elimination of service disruptions.