

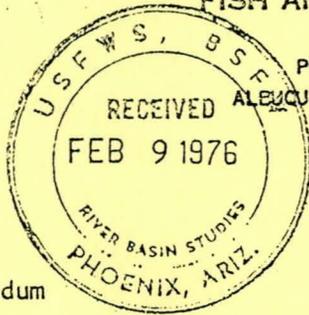


PHOENIX, ARIZ.

REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

ES



POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

REVIEW DRAFT
NOT FOR PUBLIC RELEASE

FEB 5 1976

Memorandum

LIBRARY

To: Regional Director, Bureau of Reclamation, Lower Colorado
Region, Boulder City, Nevada 89005

From: Regional Director

Subject: Central Arizona Project - Fish and Wildlife Coordination
Act Advanced Planning Report

This constitutes our Advance Planning Report on the Central
Arizona Project (CAP), authorized by Public Law 90-537 (82 Stat.
885), approved September 30, 1968. It supersedes previous Fish
and Wildlife Service reports on CAP features.

This report is based on project planning data provided by your
Arizona Planning Office and presents additional information on
fish and wildlife mitigation and enhancement concepts of the proj-
ect. It has been prepared under authority of and in accordance
with provisions of the Fish and Wildlife Coordination Act (48 Stat.
401 as amended; 16 U.S.C. 661 et seq.), and under Contract Number
14-06-300-2545 as consummated with your office on August 2, 1974.

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

LIBRARY



A888.925

Library



PHOENIX, ARIZ.

REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

ES



POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

REVIEW DRAFT
NOT FOR PUBLIC RELEASE

FEB 5 1976

Memorandum

LIBRARY

To: Regional Director, Bureau of Reclamation, Lower Colorado
Region, Boulder City, Nevada 89005

From: Regional Director

Subject: Central Arizona Project - Fish and Wildlife Coordination
Act Advanced Planning Report

This constitutes our Advance Planning Report on the Central
Arizona Project (CAP), authorized by Public Law 90-537 (82 Stat.
885), approved September 30, 1968. It supersedes previous Fish
and Wildlife Service reports on CAP features.

This report is based on project planning data provided by your
Arizona Planning Office and presents additional information on
fish and wildlife mitigation and enhancement concepts of the proj-
ect. It has been prepared under authority of and in accordance
with provisions of the Fish and Wildlife Coordination Act (48 Stat.
401 as amended; 16 U.S.C. 661 et seq.), and under Contract Number
14-06-300-2545 as consummated with your office on August 2, 1974.

LIBRARY



PR
30

Library

Data presented in the report were developed in coordination with the Arizona Game and Fish Department and the New Mexico Department of Game and Fish. These agencies have reviewed and concur in the report as indicated in the attached letters from Director Robert S. Jantzen and from Director William S. Huey, dated _____, respectively.

The Central Arizona Project was authorized without the benefit of fish and wildlife feasibility grade reports on many of the project features. The following reports and letters of comment have provided most recent input concerning fish and wildlife features of the project: Granite Reef Aqueduct, Granite Reef Division, November 21, 1969, initial detailed report; Salt-Gila Aqueduct, Pinal Division, March 31, 1967, detailed report; Tucson Aqueduct (Colorado Source), Tucson Division, September 27, 1966 report; Orme Dam and Reservoir, Maricopa Division, February 23, 1967, initial detailed report; Buttes Dam and Reservoir, Pinal Division, February 20, 1959, preliminary report, and April 18, 1963, supplemental report; Charleston Dam and Reservoir, Tucson Division, May 1947, preliminary report; and Hooker Dam and Reservoir, Upper Gila Division, February 19, 1964, reconnaissance report.

Project purposes are to provide supplemental water to central Arizona and western New Mexico, provide flood control, conserve

and develop fish and wildlife resources, and enhance recreation. The Colorado River will provide the principal source of supplemental water for Arizona.

The average annual Colorado River water diversion will be 1,200,000 acre-feet with an estimated variance of 0.38 million acre-feet to design capacity of 2.2 million acre-feet. Additionally, floodflows from the Salt, Verde, Gila, and San Pedro River systems will be captured and developed for project purposes.

Project features include a pumping facility on Lake Havasu near Parker Dam, four aqueducts, four reservoirs, water distribution systems, and two power generating stations, one off-site of the project.

The conveyance system will carry Colorado River water from Lake Havasu through Granite Reef Aqueduct to the proposed Orme Reservoir and thence to the Salt-Gila Aqueduct. The Salt-Gila Aqueduct will originate at the Granite Reef terminus and continue to the Marana Reservoir, near Marana, Arizona. The Tucson Aqueduct will begin at that point and carry water to a terminal point north of Tucson. The San Pedro Aqueduct, originating at Charleston Reservoir on the San Pedro River, will convey San Pedro River water to Tucson.

Four reservoirs are proposed for construction: Orme Dam and Reservoir, located at the confluence of the Salt and Verde Rivers in Maricopa County, Arizona; Buttes Dam and Reservoir on the Gila River near Florence, in Pinal County, Arizona; Charleston Dam and Reservoir on the San Pedro River in Cochise County, Arizona; and Hooker Dam and Reservoir on the Gila River in Grant County, New Mexico.

Irrigation distribution systems will be constructed to convey project water to existing croplands. Engineering data concerning these distribution systems have not been made available to the Fish and Wildlife Service.

The area of influence on fish and wildlife is generally within the drainage area of the Gila River from above Painted Rock Dam in Arizona to the upper reaches of the Gila River in southern New Mexico. A limited area along the mainstem of the Colorado River also is involved.

The attached substantiating report assesses the effects of the project on fish and wildlife over a 100-year period of analysis. It presents details of project plans as currently known, an evaluation of project effects on fish and wildlife, needs and opportunities for mitigation or enhancement for fish and wildlife, and requirements for additional studies.

Since its inception, there has been a realization that the Central Arizona Project would have significant impacts on fish and wildlife resources. Therefore, the project authorization has included conservation and development of these resources as project purposes. Several specific features have been included in the project by the Bureau of Reclamation to meet fish and wildlife resource needs. Briefly, these include:

A program of research and monitoring to evaluate environmental impacts including project effects on fish and wildlife habitats and resources.

Construction of one warmwater and two coldwater fish hatcheries at sites not yet selected. Presumably the hatcheries would be located at the project reservoirs to take advantage of the dependable water supply available from these facilities.

Development of five 10-acre warmwater fishing lakes with public access and use facilities. These lakes would be unlined unless sites with impervious soil cannot be found. Flow-through water systems connected to the aqueducts would be provided.

Fencing of the rights-of-way for the Granite Reef and Salt-Gila Aqueducts for public safety and livestock and wildlife

protection where needed. Special fencing will be provided in particular problem areas such as migration routes or concentration areas for big game.

Adaptation of bridges, culverts, and overchutes to use as game crossings on big-game migration routes.

Installation of escape facilities in the aqueducts to reduce the incidence of drowning of entrapped wildlife.

Construction of 17 off-aqueduct water catchment basins to draw big-game animals away from the aqueducts.

Installation of 35 small, oasis-type, watering stations along the Granite Reef Aqueduct. These also are intended to provide an alternate source of water for wildlife.

The above project measures will provide some degree of mitigation for fish and wildlife losses and, in some cases, will yield benefits. However, there remain numerous areas of concern where losses still will occur or where fish and wildlife species and their habitats will be adversely affected.

Project lakes, reservoirs, and two segments of the aqueduct system will provide increased opportunities for public fishing. The five 10-acre fishing lakes to be constructed in conjunction with the Granite Reef Aqueduct will become new fishing sites but will require annual stocking to maintain desirable levels of fishing success. Additional fishing water also will become available at the four project reservoirs. The reservoir fisheries will be of the warmwater type except at Hooker Reservoir where a coldwater fishery should be successful. The establishment of a significant level of tailwater fisheries is expected at Orme and Hooker Reservoirs. There is insufficient information on downstream releases from Charleston Dam for a quantitative assessment of the tailwater fishery, while the proposed releases from Buttes Dam appear inadequate for fish survival. Reservoir discharges from Orme and Hooker Dams are expected to be cold enough for maintenance of trout fisheries. A limited amount of fishing also should be possible in the Granite Reef and Salt-Gila Aqueducts. Fish will enter the Granite Reef Aqueduct from the Colorado River and the Salt-Gila Aqueduct from the Granite Reef Aqueduct as well as from water released at Orme Reservoir. These fisheries will not be self-sustaining but will be continually replenished by introductions from the source waters.

The adoption of enhancement measures described in the attached substantiating report would add measurably to project fishing benefits. Such enhancement measures would include fisherman access to the aqueducts and pumping plants (except the Bouse Hill Pumping Plant); additional access to Orme, Buttes, and Charleston Reservoirs; and selective clearing of timber in reservoir areas or the installation of artificial reefs if the reservoirs are completely cleared. Costs associated with these enhancement measures would be subject to the cost-sharing provisions of the Federal Water Project Recreation Act (79 Stat. 213).

The project reservoirs also will have their adverse effects. They will inundate and modify stream reaches, thus reducing a type of natural resource which has become unique in much of Arizona. The streams to be impounded have aesthetic and recreational qualities which are becoming increasingly rare. Even though the reservoirs will offer opportunities for mass public use, they will do so at the expense of an environmental type that is irreplaceable.

Of concern also is the probable impact of the project on endangered fish and wildlife. Four species listed in the "United States List of Endangered Fauna," May 1974, the Gila topminnow, Mexican duck, Yuma clapper rail, and the southern bald eagle, occur within areas

that will be impacted by project construction and could be adversely affected.

Gila topminnows are in the Gila River upstream from the Buttes Reservoir site and in tributaries to the San Pedro River on which Charleston Reservoir is to be constructed. Even though the project works may not directly affect this minnow, it is likely that there will be increased competition from migrating fish produced in the reservoirs.

Mexican ducks occur along the upper Gila River in the vicinity of the Hooker Dam site and along the Babocomari River which will be affected by loss of habitat at the San Pedro Aqueduct crossing. In both areas critical habitat will be reduced or degraded.

Habitat or potential habitat for the Yuma clapper rail exists along the Salt River in the vicinity of the Granite Reef Aqueduct crossing, at the existing Picacho Reservoir which will serve as a retention area for CAP water, and at the Orme Reservoir site. Any destruction of marsh vegetation in these project areas would hamper efforts to preserve and also stimulate the recovery of this species.

Orme Reservoir will directly affect two nest sites of the southern bald eagle. One nest occurs in a tree that will be destroyed by

clearing of the conservation pool. This nest was inactive in 1975. The second nest, successfully used in 1975, is in a tree on the Verde River arm of the reservoir site. It will be within the flood pool. In addition to these direct effects, all eagles in the area will suffer from the loss of riverine environment which is their normal nesting and foraging habitat.

There also are a number of other fish and wildlife species, whose existence may be in jeopardy, occurring within the project area and subject to environmental changes wrought by the project. These include three raptors classified as "peripheral": the zone-tailed hawk, the gray hawk, and the black hawk; and species of fishes, amphibians, reptiles, and birds considered by the States of Arizona and New Mexico to be threatened within their respective states.

It is evident that implementation of the project will result in a conflict with the Endangered Species Act of 1973 (87 Stat. 884). This Act provides that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the Act. Furthermore, all Federal departments and agencies are to take such action as is necessary to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of threatened species. The presence of endangered species or critical habitat for these species within several areas that will be

11

affected by project construction will lead to problems which will require special attention. There is serious question that plans for certain project elements can be legally finalized until conflicts with the endangered species program are resolved.

In view of the severe and irreversible impacts on the environment at Orme, Charleston, and Hooker Reservoirs, consideration should be given to the selection of alternative reservoir locations.

Orme Reservoir would be far less destructive to fish and wildlife if it were relocated to a site or sites on nonperennial streams.

Similarly, all possible alternatives to Charleston and Hooker Reservoirs should be thoroughly examined prior to the finalization of project plans.

In accordance with a provision of the contract under which this Advance Planning Study was conducted, the Fish and Wildlife Service has updated the recommendations contained in previous reports on the Central Arizona Project. These updated recommendations together with certain additional proposals developed during the present study are set forth below. They supersede all prior recommendations and represent the Fish and Wildlife Service's contribution to project planning. To facilitate identification the recommendations are presented in three sections; the first pertaining to the project water conveyance system, the second to the project reservoirs, and the third to recommendations of general scope.

Section I. Conveyance System

1. Studies should be conducted to determine the extent of fish losses resulting from aqueduct pumping operations in order to assess the need for protective fish screening

of project pumps. To allow for assessment of these impacts, O-rings should be installed in the aqueduct walls to permit sampling with a fyke net. To permit sampling at various flow rates a series of three O-rings placed at four-foot intervals downward from the maximum flow line would be needed on each side of the canal. Such structures should be installed near the Buckskin Mountain Tunnel outlet and in the reversible canal near Orme Dam. Each installation should be immediately downstream of an aqueduct bridge crossing for ease of access. Cost of these installations is estimated at \$1,000 and should be assigned as fishery mitigation costs. Sampling should be continued through the first year of operation. This study should be conducted by the Arizona Game and Fish Department using criteria developed cooperatively by that State Department, the Bureau of Reclamation and the Fish and Wildlife Service. The cost of this study is estimated at \$20,000 and is considered a mitigation feature.

2. Provision should be made for screen installation at the pumps should the above study indicate a need for these protective devices. The screens should be of a design agreeable to the Arizona Game and Fish Department and Fish and Wildlife Service.

3. The Tucson and San Pedro Aqueducts, which will be closed pipeline systems, should be screened to prevent fish losses. Screening of these systems would cost an estimated \$19,800 for the Tucson Aqueduct and \$3,300 for the San Pedro Aqueduct. These costs would be fishery mitigation costs.
4. A fish salvage plan should be developed to prevent fish losses during periods of aqueduct dewatering. The plan should be developed cooperatively by the Bureau of Reclamation, Arizona Game and Fish Department, and the Fish and Wildlife Service. Costs of this operation are estimated at \$10,000 per dewatering based on a three-year period of operation between dewatering. These costs should be assigned as fishery mitigation costs.
5. The banks of the protective dike for the intake structure should be modified to provide near-level fishing areas along its perimeter thus improving fishing access. These areas, to be built from materials removed during construction of the Buckskin Mountain Tunnel, should be placed along the dike perimeter at 400-foot intervals. Any costs incurred should be considered as enhancement.

6. Fisherman access should be provided at all pumps except the Bouse Hill Pumping Plant as specified in the attached report. The estimated cost is \$1,000 per access point, or a total of \$5,000. Annual OM&R costs are estimated to be \$500. This access development is an enhancement feature.

7. The five 10-acre lakes included in project plans for fishery enhancement should be built close to the aqueducts so that water delivery and return systems could utilize gravity flow. The lakes should be located near the pumping plants except the Bouse Hill Pumping Plant. Specific locations would be determined through cooperative studies by the Arizona Game and Fish Department, the Fish and Wildlife Service, and the Bureau of Reclamation at the time of detailed project planning for the appropriate aqueduct reach. The lakes should be managed and administered by the Arizona Game and Fish Department for fishery purposes under the terms of a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act. The lakes and peripheral lands should be developed as described in the attached report. The estimated project cost associated with the five lake developments would amount to about \$350,000, based on 1975 prices. Annual OM&R costs would be about \$20,000.

8. The stocking program for these 10-acre lakes should be developed as explained in the attached report. Costs of providing the necessary channel catfish are estimated at \$2,000 for capital construction and \$100 annually for OM&R. The cost of providing bass is estimated at \$2,500. This program is a project enhancement feature.
9. To prevent unnecessary disturbance of the great blue herons on Heron Island during the period of nesting and young rearing, the Bureau of Reclamation should restrict construction of the inlet causeway in Lake Havasu to the months of August through February.
10. Location of the temporary transmission line to be placed through a bighorn sheep lambing area in Buckskin Mountains should be coordinated with the Fish and Wildlife Service and the Arizona Game and Fish Department.
11. The Bureau of Reclamation should cooperate with the Soil Conservation Service in funding the additional study needed to assess the impact of CAP detention dikes and open aqueducts on downslope wildlife habitat. This should be a project responsibility.

12. Should the above studies indicate a significant loss of habitat, these losses should be mitigated through redistribution of runoff downslope of the aqueduct or by inclusion of individual overchutes as originally planned.
13. Wildlife habitat upslope of the protective dikes that is improved by increased water retention should be fenced to exclude cattle and provision made to preclude vegetative clearing. It is estimated that up to 150 miles of fencing would be required for this mitigation feature. The estimated first cost is \$2,600 per mile, with annual OM&R costs being \$150 per mile.
14. Building materials for the protective dikes for the aqueducts should be obtained from excavation of the aqueducts. To minimize habitat destruction, disposal areas other than dike locations should be located in cooperation with the Arizona Game and Fish Department, the Fish and Wildlife Service, and the Bureau of Land Management where lands administered by this agency are involved.
15. Topsoil placement should be required on all aqueduct protective dikes to facilitate establishment of vegetation.

16. Deerproof fencing should be provided along the aqueducts in areas shown in Appendix 1 of the attached report. Fencing should be chain link or an appropriate mesh-type alternative with a minimum height of 84 inches. Fencing would be most effective if placed along the top of the aqueduct embankment at its outer edge. An estimated 360 miles of fence would be needed at a cost of about \$15,800 per mile or a total cost of \$5,688,000. Annual OM&R costs are estimated at \$10,000. These costs should be assigned to wildlife mitigation.
17. Deer crossings to provide for the movement of mule deer, bighorn sheep, and javelina over the aqueducts would be required as a wildlife mitigation measure. The exact locations of these wildlife crossings should be determined by field investigations by personnel from the Arizona Game and Fish Department, the Fish and Wildlife Service, and the Bureau of Reclamation at the time detailed project plans are being formulated. All wildlife crossings should be built with a minimum width of sixteen feet, fenced on both sides with deerproof fencing, and their surfaces covered with a six-inch layer of earth of the same type as that found at either end of the crossings. The cost of the individual crossings, except for

those constructed for multipurpose uses, is estimated to be \$50,000. Annual OM&R costs per crossing are estimated at \$1,000.

18. The proposed 29 wildlife watering catchments should be constructed generally at the locations shown in Appendix I. However, the exact location and size of each facility should be established on the basis of site examinations to ensure that proper terrain is available with adequate drainage areas to fill the catchments. The field investigations should be accomplished by personnel from the Arizona Game and Fish Department, the Fish and Wildlife Service, and the Bureau of Reclamation at the time of detailed project planning. Drawings and specifications for the catchment basins are provided in Appendix II. The catchments should be constructed as specified in the attached report. These structures are estimated to cost \$10,000 per unit for a total cost of \$290,000. OM&R costs would be about \$100 per unit per year for a total annual cost of \$2,900. These costs should be allocated to wildlife mitigation.
19. The proposed 46 oases should be constructed as discussed in the attached report. General locations of these oasis

stations are shown in Appendix I. Final locations should be established by Arizona Game and Fish Department, Fish and Wildlife Service, and Bureau of Reclamation personnel after extensive topographic investigations and soil analyses. The cost would be approximately \$1,500 per oasis if built at time of aqueduct construction. Total costs for the oases would be approximately \$69,000.

Annual OM&R costs are estimated to be \$700. These oasis stations should be managed by the Arizona Game and Fish Department for wildlife mitigation under terms of a General Plan. Elimination of cross-drainage structures combined with the need to keep animals away from the aqueduct to cut down on drowning losses may lead to the need for more oases. Project plans should provide for this contingency.

20. A fringe of mesquite, ironwood, and paloverde has become established along the upslope side of the old Florence Casa Grande Canal. This vegetation should not be disturbed by construction activities along the Salt-Gila Aqueduct.
21. Any planned changes in operation of the Picacho Reservoir due to project operation should be coordinated with

the Arizona Game and Fish Department and the Fish and Wildlife Service to insure preservation of this unique wildlife area and its critical habitat for the endangered Yuma clapper rail.

22. Planning for the Salt River Siphon also should be coordinated with the Arizona Game and Fish Department, Fish and Wildlife Service, and the Yuma Clapper Rail Recovery Team to explore impacts and enhancement possibilities.
23. The Tucson Aqueduct should be constructed as originally planned paralleling Interstate Highway No. 10.
24. The San Pedro Aqueduct should be routed outside the riparian vegetation zone along the San Pedro River and to a crossing on the Babocomari River which will not adversely impact gray hawk nesting and foraging areas along the river or areas which the Mexican Duck Recovery Team determines to be important for that species.
25. All disturbed areas along the San Pedro and Tucson Aqueducts should be seeded with native grasses and woody vegetation. Project plans for these aqueducts are not

well defined. Therefore, planting requirements should be determined when routes, design specifications, and methods of construction are known.

Section II. Project Reservoirs

26. Orme Dam and Reservoir not be constructed as proposed and the Bureau of Reclamation use alternative sites(s), located on nonperennial streams.
27. The Bureau of Reclamation should explore alternatives for Charleston and Hooker Dams and Reservoirs which are less destructive to fish and wildlife. These alternatives should be explored in coordination with the Fish and Wildlife Service, the appropriate State fish and game department, and other interested agencies. The examination of possible alternatives should be based on the Principles and Standards guidelines so that an adequate degree of comprehensiveness is obtained.
28. Studies should be conducted one year prior to construction to determine the extent of fishery resources within Buttes Reservoir site, the Charleston Reservoir site, and on the Babocomari River in the vicinity of the proposed

aqueduct crossing. Study costs are estimated at \$40,000 for the the Buttes site; \$15,000 for the Charleston Reservoir site; and \$5,000 for the Babocomari River. The studies should be conducted by the Arizona Game and Fish Department and/or the Fish and Wildlife Service under a study plan developed by these agencies in cooperation with the Bureau of Reclamation and should be considered a project responsibility.

29. Minimum flows of 50 cfs at Ashurst-Hayden Dam should be provided at all times in order to maintain existing fishery resources and immediately adjacent riparian vegetation downstream of Buttes Dam.
30. In the event that one or more reservoirs are deleted from project plans, construction of new warmwater fish hatchery facilities may be unwarranted. In this case, the possibility of expanding existing warmwater hatchery facilities or combining hatchery facilities required by this project with those of the International Salinity Control Project should be considered.
31. In order to establish and maintain sport fisheries in Buttes Reservoir an annual stocking program would be needed. Fish stocking requirements and costs are as follows: 400,000 channel catfish and 400,000 northern

pike at a total capital hatchery cost of \$310,000 and annual OM&R costs of \$15,000. This program should be considered an enhancement feature.

32. In order to obtain optimum use of fishery resources at Buttes Reservoir, an additional small boat-launching facility should be provided. An access site near Cochran is proposed. This access facility should be a minimum-use structure, including a two-lane boat ramp and parking area for about 25 cars. Costs of this structure, an enhancement feature, is estimated at \$21,000. Annual maintenance and replacement costs would be about \$1,100.

33. An investigation should be undertaken at Buttes Reservoir to determine if changes are needed in ongoing fishery management program. Such studies should be undertaken during the first five years of reservoir operation and would be conducted by the Arizona Game and Fish Department and/or by the Fish and Wildlife Service. These studies would be for enhancement purposes and would cost approximately \$100,000.

34. In order to avoid recreational conflicts, promote public safety, and realize full fishery benefits, Buttes Reservoir should be zoned. Zoning may be temporal, i.e., use restricted by certain times, or spatial, where certain uses are allowed in certain areas.

35. Detailed raptor studies should be made on drainages in which Buttes, Charleston, and Hooker Reservoirs would be located. These studies, to be of two years duration, would cost an estimated \$125,000. They are considered a project responsibility.

36. In order to avoid recreational conflicts, promote public safety, and realize full fishery benefits, Buttes Reservoir should be zoned. Zoning may be temporal, i.e., use restricted by certain times, or spatial, where certain uses are allowed in certain areas.

37. Detailed raptor studies should be made on drainages in which Buttes, Charleston, and Hooker Reservoirs would be located. These studies, to be of two years duration, would cost an estimated \$125,000. They are considered a project responsibility.

34. To obtain additional fishing benefits at Buttes Reservoir, trees and shrubs should be retained in the conservation pool area where such vegetation does not interfere with safety or pertinent use facilities. If this is not possible, artificial reefs should be installed to serve this purpose.

35. The minimum pool of 200 surface acres at Buttes Reservoir may not, over time, be sufficient to retain an established fishery resource. A pool of at least 200 surface acres with an average depth of not less than eight feet should be maintained in order to support a fishery resource.

(Rev. 2/17/76)

38. To mitigate the loss of wildlife habitat resulting from construction of Buttes Reservoir, the acquisition of a substitute habitat area will be required. The purchase of _____ acres of streamside land along the San Pedro River could provide comparable replacement. It is envisioned that the proposed area would have the potential for or actually have similar habitat to that lost, be private land, and have a guaranteed water source. The area should be made available for administration by the Arizona Game and Fish Department under terms of a General Plan as specified in Section 3 of the Fish and Wildlife Coordination Act. Acquisition, development, and O&M costs are considered a project responsibility.

Section III. General Recommendations

39. Lands acquired for the Central Arizona Project should be made available for public use except where restrictions are necessary for reasons of public safety, designated Indian use, or fish and wildlife conservation needs. Signs should be posted as necessary to adequately designate public-use areas as well as restricted areas.

40. All capital and OM&R costs associated with project mitigation measures should be treated in the same manner as other project joint costs and allocated among the beneficial purposes of the project.

41. All capital and OM&R costs associated with project enhancement measures should be treated in the manner specified within the Federal Water Project Recreation Act (79 Stat. 213).

CENTRAL ARIZONA PROJECT

Substantiating Report

TABLE OF CONTENTS

Page

Part I. INTRODUCTION

Part II. CONVEYANCE SYSTEM

Havasu Intake Channel, Pumping Plant, and Buckskin Mountains Tunnel

Description of Project Facility

Fish and Wildlife Resources

Fish

Without the Project

With the Project

Wildlife

Without the Project

With the Project

Prior Reports and Recommendations

Granite Reef Aqueduct

Description of Project Facility

Fish and Wildlife Resources

Fish

Without the Project

With the Project

Wildlife

Without the Project

With the Project

Prior Reports and Recommendations

Salt-Gila Aqueduct

Description of Project Facility

Fish and Wildlife Resources

Fish

Without the Project

With the Project

Wildlife

Without the Project

With the Project

Prior Reports and Recommendations

Tucson Aqueduct

Description of Project Facility

Fish and Wildlife Resources

Fish

Without the Project

With the Project

Wildlife

Without the Project

With the Project

Prior Reports and Recommendations

San Pedro Aqueduct
Description of Project Facility
Fish and Wildlife Resources
Fish
 Without the Project
 With the Project
Wildlife
 Without the Project
 With the Project
Prior Reports and Recommendations

Part III. PROJECT RESERVOIRS

Orme Dam and Reservoir
Description of Project Facility
Fish and Wildlife Resources
Fish
 Without the Project
 With the Project
Wildlife
 Without the Project
 With the Project
Prior Reports and Recommendations

Buttes Dam and Reservoir
Description of Project Facility
Fish and Wildlife Resources
Fish
 Without the Project
 With the Project
Wildlife
 Without the Project
 With the Project
Prior Reports and Recommendations

Charleston Dam and Reservoir
Description of Project Facility
Fish and Wildlife Resources
Fish
 Without the Project
 With the Project
Wildlife
 Without the Project
 With the Project
Prior Reports and Recommendations

Hooker Dam and Reservoir
Description of Project Facility
Fish and Wildlife Resources
Fish
 Without the Project
 With the Project
Wildlife
 Without the Project
 With the Project
Prior Reports and Recommendations

Part IV. IRRIGATION DISTRIBUTION SYSTEMS

Part V. DISCUSSION

Conveyance System
Fishery Resources
Wildlife Resources

Project Reservoirs
Fishery Resources
Wildlife Resources

General Considerations

APPENDICES

Part I. INTRODUCTION

The primary purpose of the Central Arizona Project (CAP) is to provide supplemental water to central Arizona and western New Mexico. The project area is generally located within the 50,900 square-mile drainage area of the Gila River and its principal tributaries from upstream of Painted Rock Dam in Arizona to the upper reaches of the Gila River in southwestern New Mexico. However, it also includes an extension to the Colorado River which is a major source of water supply.

The major population areas to be benefited are Phoenix with a 1970 population of 581,562 and Tucson with a population of 262,933.

Within the project area elevations range between 500 and 10,713 feet above mean sea level. The project area is primarily located in Sonoran Desert and the Mexican Highlands sections of the Basin and Range physiographic province. The Sonoran Desert section has characteristics of the southwestern desert of Arizona. It contains most of the presently irrigated land of the project area. The Mexican Highland section occupies the southeast corner of the province and reflects the transition between the desert of southwestern Arizona and semidesert grassland areas extending to the Continental Divide in New Mexico. This section is somewhat higher in elevation than the western valleys and has slightly more rainfall.

The climate is generally characterized by long, hot summers and short, mild winters, low rainfall, low relative humidity, a high rate of evaporation, and a high percentage of sunny days. In the project

area, the mean annual precipitation varies from less than 6 inches along the western boundary to 11 inches at Tucson, 12 inches in the Upper Gila River Basin, and to more than 30 inches in the higher mountain ranges. Temperatures are variable according to season and elevation. Maximum readings of over 100° F. are common in the summer with daily winter maximums in the sixties and low seventies in the low desert.

The watershed has a wide variation in vegetative cover types. As classified in the Comprehensive Framework Study for the lower Colorado River Region, the forest types include the coniferous forest zones of spruce-fir and ponderosa pine, the pinyon-juniper woodlands, and the chaparral types, all of which occur above 4,000 feet elevation. Rangeland communities extend from the forest type through the northern desert shrub, perennial and ephemeral southern desert shrub types, and the northern and southern grasslands. Scattered throughout the area are patches of cultivated land, including irrigated pasture, and urban areas. Riparian areas also are involved.

Project features include a water conveyance system, four reservoirs, and irrigation distribution systems. Due to project complexity, the various features are discussed individually in the following sections of the report.

Part II. CONVEYANCE SYSTEM

Havasu Intake Channel, Pumping Plant, and Buckskin Mountains TunnelDescription of Project Facility

The intake channel will be located in the Bill Williams Arm of Lake Havasu on the Colorado River approximately $2\frac{1}{2}$ miles upstream of Parker Dam within the Bill Williams River portion of the Havasu National Wildlife Refuge. It will be formed between the lake shore and an existing land-formed dike extending into the lake. Materials excavated from the pumping plant site have been used for dike construction. The embankment is non-uniform in cross section and alignment and is designed to approximate the configurations and colorations of the natural peninsulas that finger out from the Buckskin Mountains into Lake Havasu. It has a minimum crest elevation of 456 feet, 8.5 feet above the normal operating water surface elevation of Lake Havasu, a minimum crest width of 30 feet, and a length of 2400 feet from Arizona Highway No. 95 to the pumping site.

A pumping plant, which will raise a maximum flow of 300 cfs of Colorado River water from an average elevation of 447.5 feet to an elevation of 1,250.0 feet, will be built on 20 acres of land east of State Highway No. 95. The plant will house 6 electric motor-driven 500 cfs pumps which will raise the water 800 feet via two 13-foot-diameter

discharge lines to the inlet portal of the Buckskin Mountains tunnel.

The Buckskin Mountains Tunnel will convey project water pumped from Lake Havasu 6.8 miles through the Buckskin Mountains for direct discharge into the Granite Reef Aqueduct. It will be machine-bored to a diameter of 20 feet. About 700,000 cubic yards of material excavated from the tunnel will be spread in gullies to blend with the natural land forms or contours of the existing terrain.

Fish and Wildlife Resources

Fish

Without the Project

Lake Havasu supports populations of largemouth and striped bass, crappie, sunfishes, cat fishes, carp and threadfin shad. Native fish species originally found in the reach of the Colorado River now occupied by Lake Havasu included the Colorado River squawfish, humpbacked sucker, flannelmouth sucker, boneytail chub and woundfin. About 13 species of fishes occur in the vicinity of the intake channel. A 7-pound humpbacked sucker, a species listed as "status undetermined" in the Bureau of Sport Fisheries and Wildlife's Threatened Wildlife of the United States, 1973 Edition, was captured and released in the Bill Williams Arm of Lake Havasu in 1972.

With the Project

As presently designed, fish losses can be anticipated as water is pumped from Lake Havasu. However, many of the fish entering the system will survive and could provide a fishery in the aqueduct. Fish populations in Lake Havasu will be reduced but little impact on the lake fishery is anticipated. Additional study is needed to assess these impacts and determine if fish screens are needed.

The earth dike forming the Havasu Intake Channel will provide increased fisherman access. However, as presently constructed, the banks are too steep for safe fishermen use.

WildlifeWithout the Project

The rock ridges, canyons, and talus slopes leading upward from the Havasu Lake shore to the top of the mesa are dotted sparsely with catclaw, saguaro, barrel, cholla, and hedgehog cacti, creosotebush, ironwood, smoke tree, and mesquite. Small stands of salt cedar and palo verde trees are found along the shore lines and bottoms of the wash areas. Vegetation in the area is extremely sparse.

Desert mule deer and desert bighorn sheep are the only big-game species found within the area. An estimated population of about 50 bighorn sheep inhabit the Buckskin Mountains in and adjacent to the project area. Other mammals include the coyote, badger, skunk, jack-rabbit, fox, and a variety of smaller mammals. Feral burros also are found in the area.

Most of the bird life is to be found in the riparian and marsh habitat in the Bill Williams delta area about three quarters of a mile from the intake channel. Personnel of the Havasu National Wildlife Refuge have observed and identified 264 species of birds. Heron Island, located a short distance from the project area, is used by about 15 pairs of great blue herons as a nesting and rearing area from March through July. This island will not be connected to the mainland, or altered during construction of the intake channel.

The Bill Williams delta area of the Havasu National Wildlife Refuge attracts relatively small numbers of migratory waterfowl during spring and fall migratory periods and is a relatively minor stop-over area. However, the refuge overall receives use from approximately one-quarter million birds per year.

The Yuma clapper rail, listed in the "United States List of Endangered Fauna," May 1974, is the only known endangered species resident to the area, and it is restricted to the marsh habitat of the Bill Williams delta area. The endangered peregrine falcon and the prairie falcon are of seasonal or transient occurrence in the project area, and the bald eagle is a rare winter visitor to the general vicinity.

Herpetofauna has not changed radically due to man's activities. Approximately 25 species of snakes, 21 species of lizards, 4 species of turtle, and 10 species of amphibians are found in the project area. None of the species of reptiles or amphibians are considered endangered by the Fish and Wildlife Service.

With the Project

Survey and core-drilling activities for the Buckskin Mountains Tunnel have resulted in establishment of many roads and trails in and around the Buckskin Mountains. These roads have opened up the mountain range to increased human activity particularly through the use of four-wheel drive vehicles and motorcycles. This increased human activity

is undoubtedly depriving the bighorn sheep of the accustomed use of much of this habitat because of its need for isolation.

Construction of the pumping plant and tunnel will, in itself, greatly increase human activity in the area and can be expected to further reduce the value of this mountain range as bighorn sheep habitat. Project construction is not expected to greatly affect other wildlife in the area. However, some loss of small mammals and reptiles can be anticipated.

Prior Reports and Recommendations

The Fish and Wildlife Service has not reported previously on the Havasu intake channel, pumping plant, and Buckskin Mountains Tunnel.

Granite Reef Aqueduct

Description of Project Facility

Granite Reef Aqueduct will begin at the outlet portal of the Buckskin Mountain tunnel and extend southeasterly through the Sonoran Desert of Arizona to a point on the south side of the Salt River near the existing Granite Reef Dam. The aqueduct will cross through the northern portions of Yuma and Maricopa Counties. It will be approximately 182 miles in length. Three pumping stations along the canal will provide a static lift of 385 feet.

The aqueduct will be a concrete-lined channel having a top width of 80 feet, a bottom width of 24 feet, a sidewall slope of 1.5:1, and a depth of 18.6 feet. At design capacity, the aqueduct will carry a flow of 3,000 second feet at a velocity of 3.75 feet per second (2.5 miles per hour). Approximately $3\frac{1}{2}$ days transit time will be required for water to traverse the length of the aqueduct.

The average annual diversion through the aqueduct will amount to 1,206,000 acre-feet, while annual seepage and evaporation loss will be about 100,000 acre-feet. The regulation of waterflow will be aided by check structures at approximate five-mile intervals along the aqueduct. These structures will help maintain water levels during normal operation and, at less than design flow, will serve to reduce the flow velocity. They also will reduce or stop flows between structures for maintenance purposes and emergencies.

Bridges will be provided at all significant road crossings existing at the time of construction, and, in anticipation of urban development north of Phoenix, at proposed road crossings from the vicinity of Cave Creek east to the terminus of the aqueduct.

A gravel operation and maintenance road closed to public use will parallel the aqueduct. The project right-of-way will be fenced for public safety. An 8-foot-high chain link fence will be used in the Phoenix Metropolitan area and around project control structures.

The remainder of the system will be fenced with a four-strand barbed wire fence, except for 15 miles of sheep proof fence.

Operational plans call for a constant flow eleven months each year with a one-month shutdown for inspection and maintenance. However, it is anticipated that maintenance on an annual basis may not be necessary and that flows could be continuous for periods of up to three years.

Approximately 140 miles of floodwater training dikes and channels will be constructed to collect and direct storm water within contributing watershed areas to cross-drainage structures spanning the aqueduct. These structures will be earth-filled and will be designed to control 50-year frequency floodflows, except in urban or other areas where greater downstream protection is required. In these instances, they will be designed to control the 100-year frequency flood flow. Original project plans included 175 cross-drainage structures. However, current planning has reduced this number and additional reductions are anticipated. In Reach 5, from Centennial Wash to Burnt Mountain Tunnel, a distance of 18 miles, flood control structures will be constructed by the Soil Conservation Service. Floodflows will be diverted to Centennial Wash on the west and to a cross-drainage structure near Burnt Mountain on the east.

Similar structures will be provided for a 12-mile section of Reach 11 in the Paradise Valley area. Storm flows for this section will be released into the aqueduct. Long floodflow detention dikes are being considered for Reaches 10 and 6 with provision for a reduced number

of cross-drainage structures. Materials for construction of the detention dikes will be taken from within the aqueduct alignment and immediately upstream from the dike.

Project plans include fishery enhancement measures such as five 10-acre lakes and wildlife protection measures such as wildlife crossings, fencing, escape facilities, water catchments, and oases.

Fish and Wildlife Resources

Fish

Without the Project

Fishery resource areas near the aqueduct route include Lake Havasu near the intake structure and the Salt River in the vicinity of Granite Reef Dam. The aqueduct will not impact these areas.

With the Project

The quality and quantity of water in the Granite Reef Aqueduct will have the potential of providing a warmwater fishery. Approximate water temperatures at the western terminus will range from a January low of about 50° F. to an August high of about 75° F. Water temperatures are not expected to increase over ten degrees throughout the length of the aqueduct. Excessive water velocity in the canal coupled with the lack of fish resting areas, suitable spawning habitat, and annual dewatering of the canal will preclude the development of a self-supporting fishery. However, fish are expected to enter the aqueduct from the Colorado River system and some fishing will be possible.

Project plans provide for fishery enhancement in relation to Granite Reef Aqueduct by inclusion of five 10-acre, unlined fishing lakes. The lakes will provide good quality warmwater fish habitat with the most suitable fish species being threadfin shad, largemouth bass, and channel catfish. An annual stocking program will be necessary to maintain these fisheries.

Wildlife

Without the Project

The aqueduct route will traverse rocky, almost barren, mountain ranges, areas of typical desert shrub, and dense stands of mesquite, paloverde, ironwood and salt cedar along the less dry desert washes. Little agricultural activity occurs adjacent to the aqueduct route. The area traversed provides habitat important to a wide variety of wildlife. Habitat varies from stands of mesquite, paloverde, ironwood, and salt cedar, to areas of barren desert and creosotebush flats.

The mule deer, javelina, and desert bighorn sheep are the important big game species found in the project vicinity. Other mammals, including the bobcat, coyote, gray fox, kit fox, badger, and cottontail, inhabit the area as well as a large variety of smaller mammals.

The Gambel's quail, mourning dove, and white-winged dove inhabit the area along with a large variety of song birds. Waterfowl are found in the route vicinity. However, no water areas important to waterfowl occur within the right-of-way proper. The Yuma clapper rail, an endangered species, has been found to inhabit and probably nest in a marshy area below Granite Reef Dam near the Salt River siphon right-of-way. A variety of reptiles and amphibians also can be found along the aqueduct route.

Wildlife populations vary widely depending upon habitat variances, range conditions, and water. This is particularly true for the smaller animals having small home ranges. Population densities and species composition are not expected to change over the period of analysis except for the possible reintroduction of the Sonoran pronghorn antelope. Plans are presently underway by the Arizona Game and Fish Department to reintroduce this species in the vicinity of the Red Sand Dunes, an area to be crossed by the aqueduct.

With the Project

About 11,000 acres of wildlife habitat will be required for the canal right-of-way and project facilities. Of this amount 5,000 acres will be permanently destroyed and 6,000 temporarily lost due to aqueduct construction. Areas temporarily disrupted are expected to require considerable time to revegetate particularly along the

downslope side of the canal and its protective dike system. Observations of existing detention dikes show an additional loss of habitat due to reduced runoff in the downslope washes and to reduced sheet runoff. This habitat loss is first reflected by reduced vigor and finally terminates in the total loss of vegetation. Losses vary with detention structures but generally occur for a distance of one-fourth to one mile downslope of the dikes. The degree of loss is dependent in part upon soil structure.

Wildlife habitat upslope of the detention dikes is expected to improve due to water retention by the dikes. Existing structures reveal narrow strips of woody vegetation where such vegetation is not cleared as part of project maintenance operations.

Studies are underway which should more clearly define beneficial and adverse impacts of such structures on wildlife habitat.

The Soil Conservation Service is constructing some of the flood detention dikes upstream of Granite Reef Aqueduct. If material for these or Bureau of Reclamation dikes is not obtained primarily from aqueduct excavation, additional habitat loss will be experienced. It is expected that the protective dikes will remain unvegetated for a number of years if not planted with vegetation or surfaced with topsoil.

Construction of the aqueduct will have a significant effect on desert mule deer and bighorn sheep populations existing along the aqueduct route. In some locations the canal will block the normal movement between various feeding and watering areas. With its abundant water supply the canal also will serve as an attraction to these animals.

and losses will be incurred when they attempt to drink from or cross the canal. Additional losses may occur from entanglement in the project's four-strand barbed-wire fence.

Losses of small game and nongame mammals and birds as well as reptiles and amphibians will be more closely related to habitat destruction and construction activities. While many of these animals will be initially displaced to the surrounding habitat, the ultimate impact will be a reduction in overall numbers since the carrying capacity of the total habitat will be reduced. Yuma clapper rail habitat could be adversely impacted by project construction. However, the extent of these impacts cannot be assessed until siphon construction plans are known.

To reduce project impacts on wildlife habitat and populations, project plans, as shown in the environmental statement for the aqueduct, include provision for 15 miles of sheep proof fence, 142.5 miles of 4-strand barbed-wire fence, 24 miles of safety fence, and deer escape facilities at each curve, siphon, check structure and tunnel. There will be 140 overchutes adaptable for animal crossings, 17 off-aqueduct watering holes and 35 oasis-type watering stations.

Project fences will reduce bighorn sheep losses but will not preclude deer movement within or through the canal area. Animal escape

devices to be provided by the project have proven relatively unsuccessful elsewhere in preventing big-game losses due to drowning in canals. This inadequacy, coupled with the lack of deer proof fences, will result in significant deer losses in the canal.

The provision of overchutes to pass water over the canal at the intersection of major washes will greatly reduce anticipated habitat losses. Losses still will occur on smaller washes and flat areas from flow reductions. Overchutes also will permit continued movement of deer and bighorn sheep through the area. Recent changes in project design indicate that many of the planned overchutes may be eliminated to reduce interference with aqueduct operation and maintenance. As a result, habitat loss and restrictions on big-game movement within the area will be more pronounced.

Watering holes will be located some distance from the canal and thus will serve to draw wildlife away from the canal. The 35 oasis-type structures will improve wildlife distribution and will enhance upland-game populations. These structures will be fenced to prevent grazing by domestic stock and to maintain small areas of natural vegetation.

Prior Reports and Recommendations

A Fish and Wildlife Service report on the Granite Reef Aqueduct was released on November 21, 1969. This report contained the following recommendations:

1. The Osborne Wash Reservoir Area be administered for fish and wildlife purposes by the Bureau of Land Management with the help of the Arizona Game and Fish Department and to facilitate fishing, fisherman access to be provided with a minimum of two unpaved access areas with boat-launching ramps, parking areas, and sanitary facilities at a total cost of \$30,000.
2. To increase fishing and promote safety, the Arizona Game and Fish Department, the Bureau of Reclamation, and the Bureau of Land Management cooperatively formulate regulations to prohibit speedboating and waterskiing on Osborne Wash Reservoir.
3. To enhance fishing, five 10-acre lakes to be administered by the Bureau of Land Management be constructed on public lands at a cost of \$222,000 in accordance with specifications previously outlined in this report.
4. To enhance fish and provide fish resting and spawning areas, approximately 8,800 concrete blocks be constructed and placed in the aqueduct at an estimated cost of \$15,000 to be cost-shared by the Arizona Game and Fish Department, the design, number, and location of the blocks to be determined cooperatively by that Department, the Bureau of Reclamation, and the Bureau of Sport Fisheries and Wildlife.
5. To insure that fishing in Granite Reef Aqueduct from U. S. Highway Nos. 60-70 east to the terminus of the aqueduct be available to the public, the Bureau of Reclamation provide an access point to the aqueduct at least every mile; provide access across the aqueduct; and assure fishing downstream from project structures by designing flow checks, siphons, and tunnels with walkways.
6. To mitigate big-game losses in the project area, 17 wildlife watering catchment basins to be administered by the Bureau of Land Management be constructed at a project cost of \$71,400 concurrently with construction of the Granite Reef Aqueduct, the exact locations to be determined cooperatively by the Arizona Game and Fish Department, the Bureau of Reclamation, and the Bureau of Sport Fisheries and Wildlife.
7. To mitigate big-game losses, project fencing of most of the aqueduct route from Osborne Wash Reservoir to U. S. Highway Nos. 60-70 be modified to consist of at least seven strands of barbed wire, spaced not more than 8 inches apart, with a minimum height of 56 inches for an additional project cost of \$7,000.

8. To mitigate big-game losses and to minimize the occurrence of big-game becoming entangled in the barbed-wire fencing provided by the project, 50 miles of substitute fencing be provided in areas of high animal use at an estimated project cost of \$50,000 more than the project-provided fencing, with the Arizona Game and Fish Department, the Bureau of Reclamation, and the Bureau of Land Management determining the type and extent of such fencing during construction.
9. To alleviate wildlife drowning losses and promote safety in the aqueduct, project-installed operation and maintenance bridges, overshoots, and culverts be accessible to wildlife and that safety devices be constructed in conjunction with these structures to facilitate escape of animals from the canal and project right-of-way, the location of these structures and type of safety devices should be planned cooperatively by the Arizona Game and Fish Department, the Bureau of Reclamation, and the Bureau of Sport Fisheries and Wildlife.
10. To enhance wildlife, 30 oasis-type watering stations to be administered by the Bureau of Land Management to be constructed on public lands concurrently with the Granite Reef Aqueduct at a project cost of \$72,000, the locations of the stations to be determined cooperatively by the Arizona Game and Fish Department, the Bureau of Land Management, the Bureau of Reclamation, and the Bureau of Sport Fisheries and Wildlife.
11. To enhance wildlife, low, damp, vegetated areas on public lands adjacent to the aqueduct be administered by the Bureau of Land Management and be included as part of the right-of-way by modifying the project fence alignment as determined by the Arizona Game and Fish Department, the Bureau of Land Management, the Bureau of Reclamation, and the Bureau of Sport Fisheries and Wildlife, with approximately two miles of additional fencing needed at a total project cost of \$3,600.
12. To prevent unnecessary disturbance of the great blue herons that nest and rear their young on Heron Island during the months of March through July, the Bureau of Reclamation restrict construction of the inlet causeway in Lake Havasu to the months of August through February.

Recommendation Nos. 1 and 2 are no longer pertinent because of project modification, and No. 4 appears infeasible because it would make maintenance of the aqueduct difficult.

NO PAGE 18

Salt-Gila AqueductDescription of Project Facility

The Salt-Gila Aqueduct will provide water for supplemental irrigation and municipal and industrial uses in the vicinity of Tucson. It will begin at the bifurcation structure near the terminus of the Granite Reef Aqueduct and end at Marana Reservoir near Marana, Arizona, a distance of approximately 97 miles.

The first 63 miles of this open, concrete-lined canal will be 15 feet deep, have a top width of approximately 64 feet, a side slope of 1.5:1 and a design capacity of 1,800 cfs. The remainder will be nearly 10 feet in depth, have a top width of over 40 feet, with a design capacity of 750 cfs.

Three pumping plants and several siphons are incorporated in the project plans. Aqueduct turnouts will be provided at certain locations to furnish water to agricultural and urban areas. To protect the aqueduct and existing flood control structures, 60 miles of low dikes, and seven miles of channel will divert flood flows into cross-drainage structures. Overchutes and culverts will then disperse waters downstream. Culverts and overchutes may be deleted in final project plans for some reaches of the aqueduct. A total of 61 bridges

will be constructed over the aqueduct. Urban exclusion fencing will be provided in areas of high human population.

The aqueduct will tie into the main conveyance system for the San Carlos Project at the Gila River Siphon. At this point, water to replace that used in the Upper Gila River basin will be delivered to the San Carlos Project under an exchange agreement.

Project plans include measures for conservation and development of wildlife resources such as wildlife crossings, escape facilities, and fencing.

Construction and/or operation of the Salt-Gila Aqueduct may influence Picacho Reservoir. P. L. 90-537 specified that ". . . canals and distribution systems through which water is conveyed after its delivery by the United States to the contractors shall be provided and maintained with linings adequate in his judgment to prevent excessive conveyance losses." In accordance with this provision, the Bureau of Reclamation has given consideration to requiring modification of Picacho Reservoir since it would act as a retention area for CAP waters delivered to the San Carlos Project.

Fish and Wildlife ResourcesFishWithout the Project

Within the vicinity of the aqueduct, some fishing is presently available in the Salt and Verde Rivers and Picacho Reservoir. The aqueduct will not pass through any fishing waters.

With the Project

A potential exists for establishment of a fishery in the canal. Fish are expected to be introduced into Salt-Gila Aqueduct from Granite Reef Aqueduct and water released from Orme Dam. Periodic dewatering of the aqueduct for maintenance purposes will eliminate chances for a self-sustaining fishery. However, the fish will be replenished from the water source and a utilizeable fishery will exist.

WildlifeWithout the Project

A varied landscape will be traversed by the aqueduct. It will cross basin and range country with saguaro, barrel, hedgehog, and cholla cactus; creosotebush, bursage, mesquite, paloverde, and ironwood; washes with stands of mesquite and paloverde; and urban and agricultural areas.

Big-game animals found along the aqueduct route include the desert mule deer, white-tailed deer, and javelina. Mule deer are in the vicinity of Utery Mountains, Florence Military Reservation, Picacho Mountains, and generally along Reach 4. White-tailed deer are not abundant in the area. Javelina have been observed on the Florence Military Reservation, northeast of the Picacho Mountains, and south of Park Link Road to Marana.

Other recorded wildlife species include the coyote, badger, kit fox, burro, mountain lion, bobcat, three species of rabbit, and 13 species of small rodents.

No waterfowl habitat exists within the project right-of-way. However, Picacho Reservoir, west of the project alignment, provides important waterfowl habitat. It may be affected by project

construction or operation. Picacho Reservoir is a marsh environment surrounded by mesquite. The marsh community may support nesting populations of the cinnamon teal, ruddy duck, pied-billed grebe, least bittern, great blue heron, green heron, marsh wren, and black-necked stilt. The endangered Yuma clapper rail has been found in the area and is expected to nest there. The pintail, roseate spoonbill, glossy ibis, and black-crowned night heron have been seen in and around the reservoir. The area is one of the most outstanding water-dependent bird areas in Arizona.

Raptor species observed along the aqueduct alignment include the sharp-shinned hawk, Cooper's hawk, red-tailed hawk, marsh hawk, American kestrel, rough-legged hawk, ferruginous hawk, Harris' hawk, golden eagle, caracara, and great horned owl.

Waterfowl species sighted along the alignment include the Canada goose, mallard, cinnamon teal, green-winged teal, pintail, coot, and redhead duck. Gambel's quail, mourning dove and numerous other species of birds were sighted.

Wildlife species within the project area are listed in Appendixes V and VI.

With the Project

The first 8 miles of aqueduct alignment (Reach 1) extends through "lush" Sonoran desert vegetation consisting of the saguaro, cholla, ocotillo, barrel cactus, mesquite, paloverde, and ironwood. Some small, scattered, vegetated washes are crossed. The Utery Mountains are north of this section of the aqueduct. Close to Apache Junction the vegetation has been disturbed although some creosotebush areas are still intact.

In Reach 2, the aqueduct alignment runs downslope of the existing Soil Conservation Service's Powerline, Vineyard, and Rittenhouse flood detention dikes. Vegetation immediately upslope of the dikes has been cleared and no vegetation has reestablished. The dikes remain unvegetated. Along this reach, vegetation upslope and downslope of the proposed alignment varies from creosotebush flat to washes vegetated with mesquite and paloverde.

The first part of Reach 3 traverses agricultural areas but includes some scattered washes and upland areas where native vegetation remains. Where the aqueduct will cross the Florence Military Reservation to the Gila River, it will pass through creosotebush, paloverde, saguaro, cholla, and hedgehog vegetation, dissecting large washes that empty into the Gila River channel.

Reach 4 extends through saguaro, paloverde, cholla, and creosote-bush areas and some agricultural areas. A portion of the reach is south of the unvegetated Florence flood water retarding structure built by the Soil Conservation Service and north of the Old Florence Casa Grande Canal. A fringe of mesquite, paloverde, and ironwood trees is found along the upstream edge of the old canal.

Reach 5 extends from Picacho Reservoir and passes through areas of creosotebush flats, then through lush paloverde, mesquite, and cactus vegetation around Picacho Mountains. The area to Park Link Road has stretches of creosotebush flat and small mesquite flats and combinations thereof. Below Park Link Road there is a creosotebush flat with many mesquite/paloverde vegetated washes.

Salt-Gila Aqueduct construction will involve 5,800 acres of wildlife habitat. Destruction of vegetation in washes and other small-game habitat in some reaches would reduce habitat beyond that being lost through urbanization and agriculture in the area. It is expected, however, that vegetation will become established upslope of the protective dikes where storm runoff will accumulate. However, if clearing is undertaken upstream of the dikes or grazing is allowed, benefits will be obviated, and the initial destruction of vegetation will be more critical.

The Soil Conservation Service will be constructing the protection dikes along some reaches of this aqueduct. If dike building material is obtained from adjacent desert habitat, additional wildlife habitat loss will be realized. The protective dikes are expected to remain unvegetated for several years if not covered with topsoil.

As presently proposed, storm water drainage will not be passed down natural drainage systems along a major portion of Salt-Gila Aqueduct. Areas involved include, possibly, about one-half the length of Reach 1, all of Reach 2, three-fourths of Reach 3 and all of Reach 4. Apparently Reach 5 drainage water will be distributed down the natural washes. From our observations, we are convinced that wildlife habitat has been lost due to existing dike-obstructions to water flow.

Big-game losses and disruption of migrational patterns can be anticipated due to aqueduct construction. However, project plans include certain wildlife protective measures to lessen these impacts.

Bridges, culverts, and overchutes will be made available for wildlife crossings near known migration routes. In the event that culverts and overchutes are deleted from project plans, then other provisions must be made for wildlife movements across the aqueduct. Fencing of the right-of-way for wildlife protection will be constructed at migration routes and areas of high incidence of mule deer and bighorn sheep. Project plans also include provision for wildlife escape devices in the canal.

Prior Reports and Recommendations

A Fish and Wildlife Service report on the Salt-Gila Aqueduct, dated March 31, 1967, contained the following recommendations:

1. The conservation and development of fish and wildlife resources be included among the project purposes.
2. Structural measures such as ramps, steps, or sidewall slope changes be provided at intervals in the aqueduct and at the entrance to siphons to provide entrapped big-game animals as well as humans a means of escape.
3. The location of project-installed operation and maintenance bridges over the aqueduct be planned cooperatively by the Bureau of Reclamation, the Arizona Game and Fish Department, and the Bureau of Sport Fisheries and Wildlife to provide safe crossing for big game.
4. Five watering facilities for wildlife be constructed as project features in conjunction with the aqueduct at a total estimated cost of \$31,000 to be cost-shared by the Arizona Game and Fish Department in accordance with provisions of the Federal Water Project Recreation Act, P. L. 89-72.

Tucson AqueductDescription of Project Facility

The Tucson Aqueduct will originate at the Marana Pumping Plant two miles northwest of Marana, Arizona, and extend about 20 miles to its terminus north of Tucson. The terminus will tie into an existing Tucson distribution system through future extensions. A 1,000 acre-foot, 50-acre, regulating reservoir is planned at the Marana pumping plant site. A regulating tank will be constructed on the aqueduct approximately 4 miles northeast of the plant.

According to preliminary plans, the aqueduct may be routed through the Tucson Mountain Park. This pipeline would then terminate at a reservoir on Cat Mountain. Three pumping plants would be required. We understand that this route may be the preferred alternative.

As presently planned the aqueduct will be a buried pipeline about six feet in diameter with a capacity of 150 cfs. The right-of-way width will be approximately 99 feet. The original plan entailed use of about 290 acres for the aqueduct. Existing roads will be used for access during construction. A service road will be constructed along the aqueduct, but we understand it will not be maintained. Borrow areas will not be necessary. Disturbed areas will be revegetated.

Fish and Wildlife ResourcesFishWithout the Project

Neither the aqueduct's original nor alternate route will cross an existing fishery resource. The alternate will cross the Santa Cruz River which flows intermittently.

With the Project

Fish from the Salt-Gila Aqueduct can be expected to enter Tucson Aqueduct and will be lost as a usable fishery resource. Provisions should be made to assess this impact and determine if fish screening is necessary. A regulating reservoir on Cat Mountain might have fishery potential, depending upon its operation.

WildlifeWithout the Project

Along the aqueduct's alignment as originally planned, vegetation consists of paloverde, mesquite, creosotebush, saguaro, and cactus mixtures. Near its southern end, the aqueduct enters a heavily developed area with many houses and business establishments. The route passes through good wildlife habitat along its northern reach but crosses more creosotebush areas and areas of increased human development as it nears Tucson.

Big-game species found in the area include the mule deer and javelina. Populations within the area are low. Other mammals found in the area include the coyote, fox, rabbits, and a large variety of smaller animals.

Gambel's quail and mourning doves are the upland-game birds found in the area along with a variety of raptors and other nongame species. Little waterfowl use occurs along the aqueduct route. A large variety of reptiles and amphibians are found throughout the vicinity .

The possible alternative route would pass through the Tucson Mountain Park and State Game Refuge. This refuge sustains good populations of mule deer as well as the white-tailed deer and javelina. Hunting by bow and arrow only is allowed. Cat Mountain is a historic bighorn sheep area. Large numbers of nongame mammals also are found in this mountainous area. These include the coyote, fox, bobcat, rabbit, skunk, badger, and many smaller animals.

With the Project

The original route basically parallels Interstate Highway 1-10. Along this route no significant long term adverse impact on wildlife is anticipated. The vegetation within the right-of-way will be destroyed but revegetation, preferably with native species, is planned for some areas. Wildlife species are not expected to be significantly impacted by construction along this route.

The alternative route will permanently scar fragile ridge and mountainous areas. These areas, once scarred, will be subjected to erosion and continuing destruction by vehicle use and are not expected to revegetate. Wildlife is expected to be adversely impacted from construction activities and a subsequent increase in human activities.

Prior Reports and Recommendations

A Fish and Wildlife Service report on the Tucson Aqueduct was released on September 27, 1966. No recommendations were made in that report.

San Pedro AqueductDescription of Project Facility

The San Pedro Aqueduct will be a buried pipeline system originating at Charleston Reservoir on the San Pedro River and terminating south of Tucson in the Davis-Monthan Air Base. Water will be released from a controlled outlet through the dam into the system and pumped to Tucson. The pipeline will have a diameter ranging from 21 to 33 inches and will be designed to carry flows of 18 cfs for an annual average of 12,000 acre-feet of water. Length of the pipeline will be approximately 64 miles. The right-of-way will be 99 feet in width and consist of 750 acres.

We understand that the San Pedro pipeline may be modified to supply water to different consumers.

Fish and Wildlife ResourcesFishWithout the Project

Fish resources along the aqueduct route are to be found in the Babocomari and San Pedro Rivers. Documentation of the fish resources in the Babocomari River is not available at this time. However, native fish species which could inhabit this stream system include the endangered Gila topminnow, the loach minnow, and the spikedace. All of these species are included in Arizona's proposed list of threatened wildlife.

Fish resources of the San Pedro River also are generally unknown at this time. Species composition known from the reservoir site include the longfin dace and Gila Mountain sucker. The Gila topminnow historically inhabited the area and is presently found in various tributaries of the river system.

Information relating to these resources is inadequate and additional studies are needed.

With the Project

The aqueduct route generally moves away from the San Pedro River and should have little impact on this river downstream of the dam.

Since the aqueduct will be a closed pipe system, fish entering it from the reservoir will be lost as a usable resource.

Placement of the pipeline under the Babocomari River could result in temporary fishery habitat degradation through turbidity from excavation and resultant siltation of the adjacent stream bottom.

Wildlife

Without the Project

The project area of influence covers a variety of wildlife habitats. Seep willow and mature cottonwoods line the river bottoms while extensive stands of mesquite occur on the alluvial terraces. The terrain immediately adjacent to the riparian habitat is dominated by Chihuahuan desert vegetation with acacia, tarbush, and creosote-bush, being the most common species. The Babocomari River runs through steep canyon terrain in some of its reaches. Along the rest of the aqueduct route, vegetation consists of desert grasslands and riparian-vegetated washes.

Big-game animals found in the project vicinity include the mule deer, white-tailed deer, and javelina. Other animals common to the area are the coyote, gray and kit foxes, bobcat, badger, skunk, and a large number of smaller mammals.

The area provides important habitat for a large variety of bird life including the Gambel's quail and mourning dove, which are the major upland-game birds of importance. An estimated 160 species have been reported as using the project vicinity. The area is particularly important as raptor habitat and supports nesting populations of gray hawks. Other raptors found in the vicinity include the redtailed hawk, golden eagle, prairie falcon, and Mississippi kite.

Waterfowl using the area include the green-winged teal, blue-winged teal, pintail, mallard, gadwall, and the endangered Mexican duck which may nest along the Babocomari River.

Reptiles and amphibians are common in the area with a large number of species being reported. Of those known to inhabit the area, the Gila monster, desert tortoise, narrow-mouthed toad, hood-nosed snake and Western massausauga are included on Arizona's proposed list of threatened wildlife.

Overall, wildlife habitat conditions are expected to degrade only slightly during the period of analysis. Thus, wildlife populations should remain relatively stable.

A list of probable wildlife species along the aqueduct route is contained in Appendixes V and VI.

With the Project

From its origin at the dam site, the aqueduct will extend through about 3 miles of riparian vegetation and cross the Babocomari River through mesquite and cottonwood-willow growth. From the Babocomari River it will pass through desert grasslands with variable amounts of mesquite, yucca, and other associated vegetation. It will dissect several well-vegetated washes. The pipeline will terminate in a regulating reservoir in a wash on Davis-Monthan Air Force Base.

Construction of the aqueduct along the San Pedro River could destroy gray hawk nesting and foraging habitat. Construction along the Babocomari River could degrade the area for Mexican duck use and may destroy a nest tree or permanently discourage use of the only known gray hawk nestsite on this river system.

In other areas aqueduct construction will cause destruction of vegetation but is not expected to be of long-term significance. We understand pipeline construction may affect the entire width of the right-of-way. However, a maintenance road will not be maintained and the disturbed areas would be revegetated. As long as no roads except for those within the aqueduct right-of-way are created during pipeline construction, adverse impact on vegetation is expected to be minimal in areas other than those noted above.

Prior Reports and Recommendations

The Fish and Wildlife Service has not reported previously on the San Pedro Aqueduct.

Part II. Project ReservoirsOrme Dam and ReservoirDescription of Project Facility

Orme Dam and Reservoir will be located in Maricopa County about 25 miles northeast of Phoenix, Arizona at the confluence of the Salt and Verde Rivers and about 3 miles upstream from Granite Reef Diversion Dam at which Salt River flows are now diverted. The reservoir will provide terminal regulatory storage for Granite Reef Aqueduct, flood protection for Phoenix, conservation of flood water, sediment control, recreation, and public use of fish and wildlife resources.

The dam will rise 195 feet above the riverbed to an elevation of 1,520.0 feet. A 2,600-foot saddle dam will be constructed southeast of the dam's left abutment. The reservoir pool characteristics will be as follows:

	Elevation (feet)	Capacity (acre-feet)	Inundated (acres)
Sediment pool	1,340.0	2,000	
Minimum pool	1,374.0	41,000	2,300
Conservation pool	1,437.0	367,000	9,700
Flood pool	1,500.0	950,000	
Surcharge pool	1,513.5	290,000	24,000
TOTAL		1,650,000	

The pool is expected to be above elevation 1,437.0 feet 5.8 percent of the time during the period of analysis. The reservoir will inundate portions of the Salt River Indian Reservation, Fort McDowell Indian Reservation, and Tonto National Forest (Bureau of Reclamation withdrawn land).

A reversible flow canal will connect the aqueducts to Orme Reservoir. Power generating units, with a combined capacity of about 34 megawatts, are being incorporated into the project plan. The major generating unit probably will be located somewhere near the dam's left abutment, with a pumping plant/generator unit on the reversible flow canal. Water will be released into the channel through a power-generating turbine at approximately elevation 1,370. Releases from the dam will be made directly into the natural Salt River channel for diversion at the existing Granite Reef Diversion Dam or for pumping into the Salt-Gila Aqueduct. Stream flows will approximate those occurring under present conditions.

The Corps of Engineers is reevaluating reservoir flood benefits and establishing flood release criteria. As presently planned, flood flow releases will be made as waters exceed the top of the conservation pool. Flood releases will equal inflow, up to 50,000 cfs. When maximum flood storage is reached, emergency flood routing will go into effect with releases of about 103,000 cfs being made. A design flood of approximately 2,100,000 acre-feet in magnitude will take approximately 2½ weeks to cycle, i.e., flood waters received and evacuated.

The Corps is considering release of flood flows at a slower rate when certain meteorological parameters are known. Under these conditions flood storage or portions thereof could be retained over a longer period of time.

Fish and wildlife measures included in this project feature include fish hatchery facilities, fisherman access, and reservoir zoning.

Fish and Wildlife Resources

Fish

Without the Project

Stream reaches in the project area of influence include approximately 25 river miles of Salt River. Stream flows of the Salt and Verde Rivers are mainly dependent upon controlled releases from upstream storage impoundments. On the Salt River, the Salt River Project controls Theodore Roosevelt, Apache, Canyon, and Sahuaro Reservoirs. Impoundments on the Verde River are Horseshoe and Bartlett Reservoirs. Controlled flows on the Salt River below Stewart Mountain Dam ranged from 7.3 to 14,800 cfs in water year 1973. Flows on the Verde River below Bartlett Dam ranged from zero to 11,200 cfs during the same period of time; however, flows were reduced to zero during only three days in October.

Ongoing studies show that the following fish species inhabit the Verde River: threadfin shad, red shiner, mosquitofish, sailfin molly, longfin dace, rainbow trout, carp, roundtail chub, desert and sonora suckers, yellow bullhead, channel catfish, flathead catfish, green sunfish, bluegill, and largemouth bass. Except for the flathead catfish, all species found in the Verde also occur in the Salt River. Yellow bass are found in the Salt River system but not in the Verde. Red shiners, mosquitofish, and suckers, are the most prevalent fishes in the Verde River. The two species of sucker and the carp are the most prevalent fishes in the Salt River. Fish species within the project area are listed in Appendix IV.

No endangered fish species have been found in the project area; however, studies are continuing to ensure that all possible habitats are sampled. The Arizona Game and Fish Department stocked 350 endangered woundfin fingerlings off Bluepoint in the Salt River in 1972. No return has been recorded from this release.

Through a cooperative agreement, the Fish and Wildlife Service plants fish in Indian Reservation waters and provides technical assistance in the management and development of the fishery resources. Approximately 6,000 catchable rainbow trout are presently stocked annually in the Verde River on the Fort McDowell Reservation and 6,000 catchable trout in the Salt River on the Salt River Reservation.

The Arizona Game and Fish Department developed a summer fishery by stocking 15,000 catchable rainbow trout and 18,000 fingerlings in the Salt River between Stewart Mountain Dam and Bluepoint in 1974, and another 15,000 catchables in 1975.

Picnic and general recreation sites are numerous adjacent to the Salt River. Within the Tonto National Forest, the Forest Service administers the Phon D. Sutton Recreation Area and the Coon Bluff Picnic Area. The Salt River Pima-Maricopa Indian Community has established picnic facilities on the reservation adjacent to the Salt and Verde Rivers. The Fort McDowell Yavapai-Mohave Community allows use of undeveloped picnic sites on their land. Both communities experience heavy recreational use of portions of their lands and waters. Inner-tubers and picnickers utilize the reservation lands intensively during the summer months. Use of the lower Salt and Verde Rivers has been estimated by the National Park Service at 335,000 recreation-days in 1975. No plans have been made to restrict public access in these areas and such recreational pursuits probably will continue to grow in popularity. This high use recreation limits fisherman use of the rivers mainly to early mornings and weekdays. Both stream reaches are open for fishing, but by permit only on the Fort McDowell Indian Reservation.

Fish habitat without the project is expected to remain similar to that presently existing. With silt content presently controlled

to some extent by upstream dams, the quality of the water and amount of habitat are expected to remain constant.

The streams in the project area provide fishing and recreational opportunities rare to central Arizona. These are the only flowing streams near the Phoenix Metropolitan area, and both are accessible and attractive to local residents.

With the Project

Construction and operation of Orme Dam and Reservoir will affect 17 river miles of the Verde River, three miles of which are in Tonto National Forest, 12 miles in the Fort McDowell Reservation, and two miles in the Salt River Indian Reservation. Also affected will be 14 miles of the Salt River, four miles of which constitute the Salt River Indian Reservation/Tonto National Forest boundary. The remaining 10 miles are totally within the Tonto National Forest.

Approximately five river miles of the Verde River and six miles of the Salt River will be permanently inundated. The permanently inundated areas will be changed from stream to lake habitat. Reservoir fluctuation also would adversely affect stream habitat temporarily inundated as such areas silt in during inundation.

A minimum reservoir pool of about 2,300 surface acres would ensure habitat suitable for development of a warmwater reservoir fishery.

This type of fishery is already plentiful in Central Arizona since six reservoir fisheries presently exist on the Salt and Verde Rivers. Orme Reservoir will reduce spawning habitat of some native fishes and may increase spawning areas for introduced species. However, Orme Reservoir fluctuations could reduce spawning success of even the introduced species. Therefore, a stocking program will be needed in order to establish and maintain a reservoir sport fishery. Channel catfish, walleye, and largemouth bass should be stocked in the reservoir during its initial year of operation. The stocking of largemouth bass prior to nongame fish population increases should permit this species to become established on a self-sustaining basis. However, an annual stocking program will be needed to maintain populations of channel catfish and walleye. Other fish species found in the drainage system also are expected to establish self-sustaining populations which will contribute to the fishery.

Fisherman access to the reservoir should be provided in order to permit optimum use of fish resources. The National Park Service, in a draft Reservoir Use Plan for this project feature, has suggested that boat launching facilities be located near the dam. This would limit boat fisherman use of the upstream reservoir area.

The potential exists for establishment of a carp or sucker commercial fishery in Orme Reservoir.

It is anticipated that a fishery for catchable rainbow trout could be maintained in the 3-mile stream reach between Orme and Granite Reef Dams. This could be a year around fishery provided water temperatures do not exceed 65° F.

If Orme Reservoir is constructed, recreational opportunities will shift in the reservoir site to lake-oriented pursuits, such as boating and swimming. Stream-type opportunities will be limited to stream segments above the conservation or flood pool and to the river downstream of the dam. Recreational-use conflicts can be expected as the demand for water-oriented recreation increases.

The proposed power-generating unit at Orme Reservoir may have impact on the aquatic resources of the reservoir. Waters released through the turbine probably will result in the death of some fish, the extent of which cannot be determined at this time. More data will be required before comments and recommendations can be made concerning this project structure.

Wildlife

Without the Project

Wildlife habitat in the project area of influence varies from a dense cover of bottomland vegetation to a sparse cover of desert vegetation. Adjacent to the rivers, wildlife cover is comprised largely of perennials such as salt cedar, mesquite, arrowweed,

cottonwood, and seep willow. Above the floodplains, wildlife cover changes to scattered paloverde, creosotebush, bursage, cat-claw, graythorn, mesquite, and cacti. The reservoir site is unique in Central Arizona for its assemblage of mixed habitats of cottonwood, mesquite bosques, and emergent vegetation. Because of this diversity, it is utilized by a large variety of wildlife species.

There is some riparian vegetation immediately downstream of Granite Reef Diversion Dam. Where the Salt River channel winds through Phoenix, vegetation is sparse, however, some clumps of mesquite and paloverde remain along the river channel. There is more extensive vegetation along the Salt River several miles downstream of Granite Reef Diversion Dam.

The reservoir area includes approximately 24,000 acres of wildlife habitat below surcharge elevation 1,513.4 feet. Of this, approximately 14,000 acres belong to the Fort McDowell Community, 1,300 acres to the Salt River Community, and 7,900 acres lie within the Tonto National Forest.

Big-game species utilizing the reservoir site include the mule deer and the javelina. Recent surveys show the following mammals inhabiting the project area: coyote, raccoon, bobcat, fox, skunk, beaver, badger, muskrat, cottontail, jackrabbit, mule deer, javelina, and 13 species of small rodents. Historic sightings of mammals include 13 species of bats, 1 species of shrew, 2 species of

rabbit, 16 species of small rodents, muskrat, beaver, porcupine, 4 species of skunk, ringtail, coati, mountain lion, raccoon, feral horse, bobcat, javelina, mule deer, coyote, gray fox, badger, kit fox, ocelot, jaguar, and gray wolf. There is no evidence of recent sightings of the ocelot, jaguar, or gray wolf in the reservoir area. If they do occur, they probably represent transient individuals.

The area is very productive as shown by its diversity of birdlife. Historically, 205 bird species have been reported as using the site. Of these, 25 species have been recorded only once or twice and therefore are considered "accidental." Of the birds recorded, 72 are considered nesting species.

Recent surveys list 10 species of raptors as having been sighted in the area. Included are the peregrine falcon, gray hawk, and the Mississippi kite, all unusual visitors. A great blue heron rookery exists within the flood pool. Game birds such as the quail, mourning dove, and the white-winged dove nest in the project area. In 1975, the density of dove nests in mesquite within the reservoir site ranged from 3 to 8 nests per acre. Quail surveys, in 1975, in the reservoir area revealed 1.3 and 1.4 nesting pairs per station, down about 50 percent from the previous year.

Two endangered species, the southern bald eagle and Yuma clapper rail, are known to inhabit the project vicinity. The Yuma clapper rail was found using the marsh habitat in the vicinity of Granite Reef Dam. The Salt and Verde River systems in the project area provide an additional small amount of habitat potentially suited for habitation by this species. Of the seven known active nesting pairs of southern bald eagles in Arizona, two pairs nested successfully along the Verde River downstream of Bartlett Dam in the spring of 1975. They hatched a total of 3 fledglings, which is more than 50 percent of Arizona's 1975 fledgling southern bald eagle production. A third pair was spotted in early spring on a nest along the Salt River but did not rear young in that nest. An immature southern bald eagle also was seen cruising the Verde River prior to nesting time.

The black hawk has one known nest in the project area, perhaps within the conservation pool area. The black hawk status in Arizona is not well-known at this time. However, bird students within Arizona are concerned over the ultimate survival of this species due to its riparian dependency and the cumulative loss of apparently suitable riparian areas within the State.

Ongoing surveys indicate 13 species of waterfowl utilize the area with the green-winged teal, mallard, lesser scaup, American wigeon, and coot being the most common. Whistling swans also have been

observed in the reservoir area. Waterfowl use is only moderate during the winter season, and there is little use in the summer months.

Herpetofauna within the reservoir site is estimated to include 59 species. Of these, the Gila monster and desert tortoise are presumed to be in the area and are on Arizona's proposed list of threatened wildlife.

The Fish and Wildlife Service, in cooperation with the U. S. Forest Service and the Arizona Game and Fish Department, is in the process of evaluating critical habitat for the endangered southern bald eagle. This evaluation is an essential prerequisite to project planning in view of the provision in Section 7 of the Endangered Species Act of 1973 that Federal departments and agencies shall take

" . . . such action necessary to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered species and threatened species or result in the destruction or modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with the affected States to be critical."

In furtherance of the purposes of this Act the Fish and Wildlife Service will attempt to preserve critical areas from alteration

through cooperative agreements or leases. Through such action it is anticipated that, without the project, a large portion of the necessary habitat can be preserved, and the southern bald eagle nest on the Fort McDowell Reservation can remain viable.

The Fort McDowell Indian Community apparently has no development plans endorsed by the Community or Tribal Council which would interfere with the critical habitat of endangered species. However, the Tribal Council has received a grant to conduct a study to assist them in planning for utilization of their lands and for general community development. No urban-development leases have been made by the Community.

The 7,900 acres of Tonto National Forest Service lands along the Verde and Salt Rivers to be affected by the project are expected to remain basically as at present. No plans have been made by the Forest Service for future construction of recreational facilities in the area. However, increased recreational use will reduce wildlife use of the area, particularly during the summer high-use period unless controls are instituted.

Without the project, the Salt River Pima-Maricopa Indian Community would develop the area downstream from Granite Reef Dam for industrial and commercial purposes. The riverine area between Granite

Reef Dam and the Orme Dam site has been zoned as a recreational area. Funds to assist the Community in the recreational development of this area are being requested from the Bureau of Outdoor Recreation. Habitat along the river within the Indian reservation will become degraded as recreational facilities replace existing habitat and recreational pressures increase. However, total riparian habitat is not expected to be destroyed and some will continue to be available to various species of wildlife. Annual equivalent wildlife values, estimated at ____ units annually, will be determined in subsequent studies.

With the Project

Initiation of construction on Orme Dam and Reservoir is proposed for 1978. It has been estimated that in the reservoir site below elevation 1,513.5 feet (flood pool), there is a total of 2,688 acres of heavy mesquite, 3,706 acres of light mesquite, 324 acres of salt cedar/arrowweed, 406 acres of cottonwood/willow, 15,754 acres of desert scrub, and 1,121 acres of riverbed. With construction of the reservoir, all vegetation will be cleared up to elevation 1,437.0, the top of the conservation pool, an area of 9,700 acres. This amounts to all of the riparian acreage on the Salt River downstream from Stewart Mountain Dam and about 62 percent of that along the Verde River downstream from Bartlett Dam. Within the flood pool, flooding and siltation would adversely affect the riverine vegetation between elevations 1,437.0 and 1513.5 feet. No

studies have been undertaken to ascertain the effects of flooding on the existing vegetation. However, it seems likely that portions or all of the affected riverine area will be lost or change in vegetative type, especially if flood waters are retained for lengthy periods. In flood and/or conservation pool areas, salt cedar may invade or only annual grasses may survive. Other riparian vegetation is not expected to become established adjacent to the lake.

Orme Dam will reduce flood flows into the area downstream of Granite Reef Dam. The vegetation immediately downstream is expected to be maintained by flood spillage and seepage from Granite Reef Dam. Vegetation farther downstream is not expected to be substantially affected by reduced floodflows. The greatest adverse impact could arise from additional clearing of vegetation and utilization of riparian areas as floods are reduced by the flood control structures. This project effect should be explored further by the Bureau of Reclamation for incorporation into the Orme environmental impact statement.

Orme Reservoir will reduce habitat for mammal populations in the area. The mule deer, javelina, bobcat, gray fox, and coyote will decrease as habitat diminishes and recreational uses and development occur. Of 54 species of mammals historically occurring in the Orme Reservoir site, six species are predicted to increase in numbers

with impoundment, five species are expected to be unaffected (three of which are the ocelot, jaguar, and gray wolf), and 38 are expected to be adversely affected. There are no predicted effects for five other species.

With the reservoir in operation bird species nesting within the reservoir site would be affected adversely. Out of 72 nesting species, 12 would increase and/or not be affected, while 60 would be affected adversely. Of these, the Gambel's quail and the white-winged and mourning doves, important game species, will decrease.

The reservoir will destroy the small amount of marsh that constitutes potential Yuma clapper rail habitat along the river. Some potential does exist, however, for creation of marsh habitat within the project area at some future date. Limited marsh development may occur if the pool stabilizes after a period of 20-25 years of operation. This possibility is based on information relative to the year 2030 level of development, Summary of Average Monthly Water-Surface Elevations. However, according to information relative to the 1980 level of development, the pool will fluctuate enough to preclude development of marshes. At Lake Roosevelt, which Orme Reservoir may emulate, no suitable marsh development has taken place.

Increased flood control may afford some protection to the rail habitat presently being utilized near Granite Reef Dam, particularly in cases of extremely high floods.

The black hawk nest within the site will be affected by project construction. The tree in which the nest is located either will be cut down or periodically flooded. Southern bald eagles using the area also will be adversely affected. The unused nest site (but potentially usable) on the Salt River will be destroyed by clearing of the conservation pool. One of the most successful nests on the Verde River is within the flood pool. The other known nest on the Verde River is not expected to be directly affected by reservoir construction. All eagles in the area will be affected by the reduction of stream feeding habitat. The southern bald eagles observed in the project area appear to depend upon a riverine, not a lake, system for food. A reduction in the length of streams and intensification of recreation on the remaining areas will further jeopardize their existence. Destruction by clearing or flooding of large cottonwood trees also will reduce potential nesting and perching sites. It is our opinion that project conditions will result in the loss of one viable nest and contribute to conditions which are serving to depress the population of this endangered species.

The expanded water surface resulting from construction of the reservoir will not benefit waterfowl materially. It will provide additional resting area, but numbers of birds using the vicinity are not expected to greatly increase.

With the exception of two species of introduced turtles, no reptiles or amphibians are expected to be enhanced by impoundment of Orme Reservoir. The other species are expected to be eliminated from the reservoir site.

Habitat losses will occur with development and intensified use of Forest Service lands and Indian Community properties surrounding the reservoir. Under Public Law 90-537, the Colorado River Basin Projects Act, each Indian community has the right to develop and operate recreational facilities along a reservoir shoreline in accordance with a master recreation plan approved by the Secretary of the Interior. The National Park Service has been assigned responsibility for the recreational master plan and has prepared a draft plan for Orme Reservoir. It indicates that recreational facilities would be concentrated on the Verde arm of the reservoir about two miles upstream of the dam and four miles upstream and three miles downstream on the Salt River. This concentration of facilities will concentrate public use and will result in uneven distribution of recreational uses, particularly fishing.

Areas further upstream in the flood pool area were indicated as having use as shoreline camping sites, grazing areas, golf courses, and other less permanent structural developments.

The Act also provides that the Indian communities may retain certain rights in the flood pool area. The former owner may lease the land and use it for purposes not inconsistent with the project purposes, i.e., grazing, recreation, farming, or mineral extraction. Unlike most other federal water development projects it would seem that the flood pool lands will not be available for wildlife management purposes under a General Plan.

The Salt River Indian Community recreational plans for the flowing stream, downstream of the dam, will be similar with or without the project. Residential and commercial developments may be constructed along the edge of the reservoir. Whether the Fort McDowell Indian Community has development plans is not known at this time.

Provisions of the Act call for the Fort McDowell Indian Community to receive 2,500 acres of Forest Service lands in compensation for lands inundated by the project. Exchange lands have not yet been delineated. However, the Fort McDowell Indian Community has indicated its desire to obtain Forest Service lands northwest and southeast of the reservation boundary as exchange lands and to lease several miles along both sides of the Verde River and most

Areas further upstream in the flood pool area were indicated as having use as shoreline camping sites, grazing areas, golf courses, and other less permanent structural developments.

The Act also provides that the Indian communities may retain certain rights in the flood pool area. The former owner may lease the land and use it for purposes not inconsistent with the project purposes, i.e., grazing, recreation, farming, or mineral extraction. Unlike most other federal water development projects it would seem that the flood pool lands will not be available for wildlife management purposes under a General Plan.

The Salt River Indian Community recreational plans for the flowing stream, downstream of the dam, will be similar with or without the project. Residential and commercial developments may be constructed along the edge of the reservoir. Whether the Fort McDowell Indian Community has development plans is not known at this time.

Provisions of the Act call for the Fort McDowell Indian Community to receive 2,500 acres of Forest Service lands in compensation for lands inundated by the project. Exchange lands have not yet been delineated. However, the Fort McDowell Indian Community has indicated its desire to obtain Forest Service lands northwest and southeast of the reservation boundary as exchange lands and to lease several miles along both sides of the Verde River and most

of the lands along the north side of the flood pool on the Salt River. The Salt River Indian Community, although not specifically authorized to receive exchange lands, has requested about 23 square miles of Forest Service land along the south side of the Salt River.

Exchange lands involved constitute areas of riparian or upland wildlife habitat that without-the-project would remain in the public trust without major alteration of vegetation. If exchanges are granted, these lands no longer will be public, and wildlife habitat may be modified or lost due to residential and recreational pressures. Units of habitat lost as a result of the project will be determined in upcoming studies.

Prior Reports and Recommendations

This project site was discussed in two Fish and Wildlife Service reports on the CAP and the Maxwell site, dated October 1947 and November 30, 1961, respectively. A report on the Orme Unit, issued February 23, 1967, contained the following recommendations:

1. Conservation and development of fish and wildlife resources be recognized as a project purpose.

2. Prior to impoundment of Orme Reservoir, \$10,000 be provided for toxicant to be used in a nongame fish eradication program.
3. Over a 5-year period, \$100,000 be made available to provide for fishery management investigations on Orme Reservoir.
4. The project plan provide fisherman access to the reservoir with a minimum of eight public access parking areas, launching ramps for small boats, and sanitary facilities at a total cost of \$120,000.
5. To benefit commercial fishing as well as the management of reservoir fish populations, two properly cleared and permanently marked seining areas, with general locations as shown on Plate 1, be provided at an estimated cost of \$10,000.
6. To promote safety and to increase fishing, a zoning plan and regulations to control boat operations be developed cooperatively by the Bureau of Reclamation, Arizona Game and Fish Department, Arizona State Parks Board, Fort McDowell Indian Community, Salt River Indian Tribe,

Bureau of Indian Affairs, Forest Service, and other agencies having responsibility for the administration of the reservoir so that adequate areas of the reservoir are reserved for fishing.

7. To facilitate fishing and to promote maintenance of suitable fish habitat in reservoir waters, clearing plans for Orme Reservoir specify the retention of trees and brush within the reservoir area except where clearing is necessary for reasons of safety, public health, project operation, and seining areas for fishery management purposes.
8. Subject to project land acquisition conditions, the Bureau of Reclamation, in cooperation with the Bureau of Sport Fisheries and Wildlife and the Arizona Game and Fish Department, investigate the feasibility of including a wildlife management area as a project feature.
9. The exterior boundary of project lands be marked adequately immediately after acquisition so as to identify areas available to the public for hunting and fishing.

Recommendation 2 is no longer applicable since it is no longer an essential part of the fisheries management proposal.

Recommendation 9 is no longer needed because public use areas for Orme Reservoir will be defined by the recreational use plan.

Also a broader recommendation is being made for delineation and public use of CAP project lands.

Buttes Dam and Reservoir

Description of Project Facility

Buttes Dam and Reservoir will be located on the Gila River about 14 miles east of Florence, Arizona, and 4 river miles upstream of the Ashurst-Hayden Dam at which Gila River flows are presently diverted. The reservoir will provide water conservation, flood control, sediment control, and opportunities for recreation, and fish and wildlife. The U. S. Army Corps of Engineers is reevaluating flood benefits for the dam and is compiling a flood release schedule.

The dam will be an earthfill structure rising about 210 feet above the stream bed to elevation 1,796.0 feet. As presently proposed, the release structure will be located at elevation 1,625.0 and as sediment accrues, the outlet will be raised by stop logs.

Releases from the dam may be partially or entirely diverted into a cement-lined canal for use in irrigation. It is anticipated that either CAP waters or CAP and San Carlos Project waters will be released into the canal.

The Bureau of Reclamation and the San Carlos Irrigation District have a water exchange agreement which will affect the operation of Buttes Reservoir. Under the agreement, at certain times, CAP waters from the Salt-Gila Aqueduct will be provided the San Carlos Project and an equivalent amount of San Carlos' Gila River water will be stored as CAP water behind Buttes Dam. At times, the entire historic water rights will be exchanged in this fashion. Under this operation, in some years there will be periods of several months when no San Carlos water could be released downstream, even if the natural channel were to be used.

The reservoir will have a conservation pool of 4,000 surface acres at elevation 1,750.0 and a surcharge pool of 6,200 surface acres at elevation 1,787.5. A minimum pool of 200 surface acres will be maintained at all times.

Fish production facilities are included as part of the project plans.

Fish and Wildlife ResourcesFishWithout the Project

Waters flowing through the proposed Buttes Reservoir site have had a recent history of extreme minewaste pollution. Previous sampling in the river has netted only a few fish, reportedly in poor physical condition. Recent water quality improvement has led to some fish reestablishment as there have been reports of catfish at Ashurst-Hayden Dam. Fish habitat is expected to improve as mine-waste degradation lessens and the river system recovers. Gila River waters are somewhat silty and are expected to continue so unless watershed practices improve.

It is expected that the bullhead, mosquitofish, crappie, threadfin shad, bluegill, longfin dace, Gila mountain sucker and other species found in the drainage system will become established as water quality improves. There is a native population of the Gila topminnow, classified as an endangered species, upstream of the proposed Buttes Reservoir site. It is possible this species may become established within the reservoir area. A fishery survey is required to adequately ascertain the status of the Gila topminnow.

Probable fish species in the area are listed in Appendix IV.

With the Project

Buttes Reservoir will affect 25 river miles of fish habitat. Approximately 15 miles will be constantly flooded, 6 miles will be intermittently flooded, and 4 miles will experience altered flows and occasionally may be dewatered.

The inundated area will be changed from stream to lake habitat. Stream habitat intermittently inundated will be adversely affected as the stream bottom silts in during periods of flood storage.

Fishery habitat downstream of Buttes Dam could be destroyed by operating procedures as planned. With the exchange agreement, even if San Carlos waters were put into the natural river channel for delivery, there would be several months of zero or reduced flow from Buttes Dam. Leakage from the dam is not expected to sustain a fishery. If constant flows were maintained, fish from the proposed reservoir and other species existing in the river system could be expected to establish self-sustaining populations.

The reservoir will provide habitat suited to development of a warmwater fishery. The planned minimum pool of 200 surface acres should be adequate to sustain fish populations during low water

periods. However, the accumulation of sediment in this area will reduce both quantity and quality of the fishing.

To establish and maintain a sport fishery in the reservoir, channel catfish and northern pike should be stocked annually. Several other fish species found in the drainage system are expected to establish self-sustaining populations which will contribute to the fishery. Fisherman access should be provided in order to permit optimum utilization of fish resources. Recreational-use conflicts can be expected as the demand for water-oriented recreation increases.

Wildlife

Without the Project

Wildlife habitat within the project area of influence consists of dense stands of salt cedar along the river's edge; mesquite communities intermingled with arrowweed, creosotebush and catclaw; and desert scrub. Vegetation downstream of the dam site consists of an intermingling of willow, salt cedar, mesquite and scattered stands of cottonwoods. About 500 yards of this vegetation have been recently cleared along the south river bank in conjunction with dredging operations at Ashurst-Hayden Dam.

Mule deer and javelina are the two important big-game species found in the project vicinity. Other large mammals include the bobcat, badger, striped skunk, gray fox, raccoon, and coyote. The deer population density is estimated at about four per section. Historically, 51 species of mammals are known to have occurred in the area, including the bighorn sheep.

Upland-game birds including the white-winged dove and Gambel's quail are abundant. White-winged doves nest in the project area and were reported at high densities during a recent nesting season. Historically, 100 bird species have been recorded of which 51 are nesting species. Five species of raptors are reported to nest in the area but limited field studies now being conducted may not accurately determine their status.

Waterfowl species common to southern Arizona such as the mallard, teal, and pintail can be expected to use this river segment particularly as improving water quality permits increased aquatic production. A male Mexican duck, classified as an endangered species, was reported to have been using the area in the summer of 1975.

A total of 54 species of reptiles and amphibians are expected to be within the area. Of these, seven were found in recent surveys. Two of the reptiles, the Gila monster and the desert tortoise are on Arizona's proposed list of threatened wildlife.

Wildlife species within the project area are listed in Appendixes V and VI.

Existing mining claims within the area, if developed, could reduce wildlife habitat values.

The riverine area from Ashurst-Hayden Dam to the upstream limit of the conservation pool is predominantly state and federal land. This land and associated habitat are not expected to change drastically over the project life. Access to the area is limited and access points demonstrate little habitat degradation. Habitat located on private lands is expected to show some decrease in wildlife value due to increased human activity. Annual equivalent wildlife values estimated at ____ units annually will be determined in subsequent studies.

With the Project

As presently planned, Buttes Reservoir will result in the loss of about 4,000 acres of wildlife habitat within the conservation pool. Included is riparian vegetation found along about 15 miles of river. Habitat quality also is expected to decrease within the flood pool area if vegetation remains flooded over extended periods of time. Salt cedar may invade the conservation pool area if frequency and depth of flooding does not inhibit it. Relocation of roads and

railroads from the reservoir site, borrow areas, and recreational developments will result in additional habitat reductions.

An additional four miles of riparian vegetation between Buttes and Ashurst-Hayden Dams would be degraded or destroyed if all but the very infrequent spills are diverted from the natural river channel at Buttes Dam. The release of San Carlos Project waters into the channel, even though there will be some months of no release, may be adequate to maintain the downstream vegetation. Buttes Dam will virtually cut off flood flows to the Ashurst-Hayden Dam throughout most of the project life. This could reduce the vigor of vegetation downstream of Ashurst-Hayden Dam. However, agricultural irrigation along the river bank may keep the water table at a level sufficient to maintain this growth. An additional impact on vegetation downstream of Ashurst-Hayden Dam will be induced by the clearing of lands within the flood plain due to increased protection from flooding.

Significant reductions in wildlife populations will accompany habitat losses within the reservoir site. Of the 51 mammal species historically known to occur at the site, it is expected that nine will be unaffected or show an increase, and 38 will be adversely affected. The effects on four are not known. Species to be adversely affected include the mountain lion, bobcat, javelina, and mule deer.

Populations of Gambel's quail, white-winged and mourning doves, the important game bird species found in the reservoir area, will be adversely impacted by the project. The loss of high density nesting habitat will be felt throughout the surrounding area. Of the 51 species of birds nesting in the area, 49 will be adversely affected while two are expected to increase in population numbers.

Waterfowl are expected to use the reservoir as a resting area. However, the numbers of birds should not greatly exceed that which otherwise could be anticipated to use the river as water quality improves and aquatic production increases.

Out of the 54 historically documented species of herpetofauna found at the Buttes site, only one amphibian, the introduced soft-shelled turtle, will be enhanced by project construction. Other species will be eliminated.

Conservation pool clearing, periodic flooding, recreational facility development, borrow area excavation, railroad and road relocation, channel construction, and downstream dewatering will degrade or destroy irreplaceable fish and wildlife habitat. Units of annual equivalent habitat lost as a result of the project will be determined in studies presently being initiated.

Prior Reports and Recommendations

The Butte's Dam and Reservoir was discussed in the November 30, 1961 Fish and Wildlife Service report on the CAP. In addition, the Fish and Wildlife Service issued a report dated February 30, 1959, entitled, "Middle Gila River Project, Buttes Dam and Reservoir, Arizona," also, a supplemental report on the project dated April 18, 1963.

The following recommendations were made in the 1959 report:

- (1) That fish and wildlife conservation be made a project purpose.
- (2) That a minimum pool of not less than 200 surface acres with an average depth of not less than 8 feet be maintained at all times in Buttes Reservoir.
- (3) That reservoir clearing along the Gila River not extend above contour 1650.

Recommendation 3 from the above report has not been adopted by the Bureau of Reclamation. As presently proposed, all lands below elevation 1,750.0 will be cleared.

Charleston Dam and ReservoirDescription of Project Facility

Charleston Dam and Reservoir will be constructed on the San Pedro River near Charleston in Cochise County, Arizona. It will provide water conservation and flood control of the San Pedro River.

Flood benefits are being reevaluated by the U. S. Army Corps of Engineers, and the flood pool may be reduced or deleted from the project plan.

The proposed dam will rise about 160 feet above streambed to a crest elevation of 4,090.0. A second earthfill dike will be built in the saddle west of the river. The release structure will be located at elevation 4,000.0 feet and, as sediment accrues, the outlet will be raised via stop logs.

The reservoir will inundate 5,600 acres at flood control elevation 4,070.0 feet. Storage capacity at this elevation will be 238,000 acre-feet. The conservation pool will cover 4,000 acres at elevation 4,055.0 and provide 125,000 acre-feet of storage capacity.

A minimum pool of 700 surface acres will be maintained in the reservoir.

Releases from the dam, as proposed, will enter the San Pedro Aqueduct. Present reservoir operation data indicate that historic downstream water rights may not be maintained. It has not been determined by what method or in what volume releases will be made. Also the San Pedro Aqueduct may be modified or deleted from the project with some other delivery system being substituted.

Project plans include the purchase of 1,150 acres of upland area for recreational purposes, as recommended by the Bureau of Outdoor Recreation.

Fish production facilities included in the overall project will provide fish for stocking in the reservoir.

Fish and Wildlife ResourcesFishWithout the Project

The San Pedro River originates in Mexico and extends approximately 112 miles into Arizona, flowing north to its confluence with the Gila River. The river is unusual in that it is as yet unencumbered by dams. Stream flows in 1973 at Charleston ranged from 1.3 cfs to 689 cfs with a mean of 28.4 cfs. Stream flow is intermittent throughout much of the river course.

Many native fish species including the endangered Gila topminnow historically have been known to occur within the project site. Various tributaries to the river support populations of this endangered species. Recent data indicate the longfin dace and Gila Mountain Sucker continue to inhabit the project site. Fishery data relating to this river system are not sufficiently detailed to permit total assessment of project impacts on the resource. Fish species which may occur in the project area are listed in Appendix IV.

Fisheries habitat and resource utilization by man probably would remain similar to present. As the San Pedro Valley develops, use of the river resource would be expected to increase.

The presently undammed river provides recreational opportunities rare in southern Arizona.

With the Project

Construction and operation of Charleston Reservoir will affect 11 river miles of stream within the reservoir site plus the downstream segment. Downstream effects are difficult to assess because of the present intermittent nature of the stream.

Approximately nine miles of river will be inundated by the conservation pool. An additional two miles will be intermittently flooded during the periods of flood storage. The inundated area will be changed from stream to lake habitat. Stream habitat periodically inundated will silt in during flood periods reducing its quality. Stream habitat downstream of the dam could be enhanced or degraded depending on continuity and volume of releases from the dam and the extent to which the existing stream channel will be used for delivery of project water. Present plans call for a diversion of releases into the San Pedro Aqueduct. However, this proposal is still under investigation, and it is anticipated that an alternate method will be used. Further study will be required to show how much of a release is needed to sustain a downstream fishery and the length of stream which will carry a surface flow.

Reservoir conditions would be such that a fair sport fishery can be established. The reservoir minimum pool of 700 surface acres will be adequate to maintain fish during reservoir drawdown. The reservoir will fluctuate widely which will reduce spawning success of some fish species.

To help establish and maintain a sport fishery in the reservoir, a fish stocking program will be needed. Northern pike and channel catfish should be produced in the project planned hatchery facility for annual stocking of the reservoir. The carp, mosquitofish, bullhead, green sunfish, bluegill, and other species within the river system also will contribute to the reservoir fishery.

Sufficient fisherman access should be provided to permit proper utilization of fish resources. The Bureau of Outdoor Recreation in a draft report dated April 15, 1970, has recommended boat launching facilities near the dam only. This would handicap boat fisherman use of the upstream reservoir area. Recreational-use conflicts can be anticipated as reservoir use increases.

Wildlife

Without the Project

The project area of influence provides varied wildlife habitat. Seep willow occurs on gravel beds along the stream bank and in

washes. Mature cottonwoods line both sides of the river. Extensive mesquite stands occur on the alluvial terraces. Sacaton is found in scattered areas along the river. The terrain adjacent to the riparian habitat is dominated by Chihuahuan desert-type vegetation with acacia, tarbush, and creosotebush dominating. The riverine area within the reservoir site and at least as far downstream as Winkleman consists of mesquite, willow, bands of cottonwood trees, salt cedar, and perennial grasses.

This habitat supports a wide variety of mammals. Historically, 65 species of mammals have been found in the project area. Big-game species include the javelina, desert mule deer, and white-tailed deer. Other mammals include the coyote, gray wolf, kit and gray foxes, bobcat, mountain lion, ocelot, jaguar, badger, coati, ring-tail, skunk, and a large number of smaller animals.

Waterfowl such as the American wigeon, ring-necked duck, pintail, gadwall, and mallard, utilize the river area. Populations are relatively low and are expected to remain so.

The importance of the area for wildlife is indicated by its diversity of birdlife. Over 140 species have been reported of which 60 are nesting species. Several raptors are known to inhabit the vicinity including the prairie falcon, golden eagle, redtailed hawk, gray hawk, and the Mississippi kite.

Arizona is the only state in which the gray hawk is known to nest. The San Pedro River is one of the last remaining strongholds of this species. Ten nest sites are located along the San Pedro River drainage between Hereford and Mammoth; four nest sites may be within the reservoir area; three are immediately downstream of the damsite; and one is close to or at the proposed San Pedro Aqueduct crossing on the Babocomari River. The gray hawk is on Arizona's proposed list of threatened wildlife.

An uncommon raptor in Arizona, the Mississippi kite, has two nesting colonies downstream of the proposed damsite on the San Pedro River. This species also is on the state's proposed list of threatened wildlife.

Reptiles and amphibians are common in the area with 66 species recorded as occurring or presumed to occur at the Charleston Reservoir site. The Gila monster, desert tortoise, narrow-mouthed toad, hood-nosed snake, and desert massasauga are on the proposed state list of threatened wildlife.

Wildlife species probably occurring within the project area are listed in Appendixes V and VI.

Most of the impact area within the flood pool and immediately downstream is in private ownership. About one-half of the project-affected

riverine area lies within the San Raphael del Valle Spanish land grant. The dam site and several miles of downstream areas are within another Spanish land grant, San Juan de las Boquillas Y Nogales. Both land grants and some parcels in between are now owned by TENNECO.

Wildlife conditions are expected to remain essentially the same for an indefinite period. No plans have been made for present or immediate future development of the TENNECO lands. TENNECO is presently developing 6,100 acres of other lands near Sierra Vista. It can be expected that development will occur in the future along the San Pedro River. Due to flood hazards, development may not occur within the bottomlands; thus the riparian vegetation may remain. However, it would become degraded through increased human use of the area.

With the Project

Construction of Charleston Reservoir is proposed to begin _____. With construction, all vegetation in the conservation pool area (4,000 acres) will be cleared. Included are nine river miles of streamside habitat. Of the 4,000 acres an estimated 670 acres are riparian growth. In the flood pool, additional vegetation may be destroyed by prolonged flooding. Salt cedar may invade the flood and conservation pool areas during extensive

dewatering periods or only annual grasses may survive. Riparian habitat is not expected to become established adjacent to the lake.

Adverse impact is expected on downstream vegetation for approximately ___ miles. With construction of Charles Dam, the vegetation downstream will be subject to altered river flows. The volume and temporal aspects of flows will be modified, and flood flows will be virtually eliminated. Salt cedar is becoming increasingly established on permanently exposed and stabilized sand bars along the river channel. Charleston Dam will further control flow in the river and permit extensive stands of salt cedar to become established. Salt cedar can and has eliminated large areas of native riparian vegetation such as cottonwood and seep willow.

Of the 65 species of mammals historically known to occur in the project area, 11 are expected to increase in numbers or not be affected, 49 will be adversely affected, and effects on five species are unknown. Mule deer, javelina, and white-tailed deer numbers are expected to be adversely affected by the project.

Upland-game bird populations within the area will decrease in conjunction with nesting habitat losses. Many other bird species also will be adversely impacted. Of the 60 nesting species using

the reservoir site population decreases are expected for 56 while four will be benefited. Adversely impacted species include the gray hawk and possibly the Mississippi kite. Four known gray hawk nest sites probably will be destroyed.

Waterfowl use will increase with increased resting area. However, use will remain relatively light. The period of highest use will be from late November through March.

The population of all but one of the reptiles and amphibians inhabiting the reservoir area will be lost. The introduced Texas soft-shell turtle is expected to increase in numbers with increased water area.

Prior Reports and Recommendations

"A Preliminary Evaluation Report on Fish and Wildlife Resources in Relation to the Water Development Plan for the Proposed Charleston Dam and Reservoir Project, San Pedro River, Colorado River Basin in Arizona" was prepared in May 1947 by the Fish and Wildlife Service. The following recommendations were made in that report:

- (a) No vegetation be removed from the reservoir basin except for such trees as would be a hazard to public use of the reservoir.

- (b) Title be secured in fee simple to all lands in the reservoir area and to a buffer strip bordering the perimeter of the reservoir sufficient to permit free and ready public use and access to the reservoir.
- (c) The Fish and Wildlife Service be advised at such time as the project may become authorized by the Congress and a definite project report prepared thereon in order that a detailed Service report for the project can be prepared and furnished the sponsor.

These recommendations are no longer considered valid because of subsequent changes in project plans.

Hooker Dam and Reservoir

Description of Project Facility

The proposed Hooker Dam site is located on the Gila River within the Gila National Forest about 10 miles upstream from the communities of Cliff and Gila, Grant County, New Mexico. Hooker Reservoir water will back up into the Gila Wilderness area.

The dam will be an earth-fill embankment rising about 235 feet above the stream bed to elevation 4,895.0 feet. Crest length will

be about 1,500 feet. It will provide storage capacity for flood and sediment control, water conservation, recreation, and fish and wildlife .

The reservoir will inundate approximately 1,340 acres at the surcharge elevation of 4,890.0 feet. The conservation pool capacity of 70,000 acre-feet will inundate 1,120 acres at elevation 4,863.0 and will be maintained approximately 50 percent of the time. Inactive storage, 20,000 acre-feet, will inundate approximately 580 acres at elevation 4,780.0.

This project feature will allow water users in New Mexico to increase their consumptive use of the Gila River and its tributaries through water exchange agreements with downstream water users in Arizona. Downstream water users affected will obtain water from the CAP aqueduct system. Increased annual consumptive use in New Mexico will not exceed an average of about 18,000 acre-feet per year in any period of ten consecutive years. Downstream releases from Hooker Reservoir are expected to average about 65,000 acre-feet per year for an average flow of approximately 90 cfs.

The project plans include provision for a coldwater hatchery facility.

Fish and Wildlife ResourcesFishWithout the Project

The Gila River within the project area exhibits wide seasonal ranges in stream flow, varying from as low as one cfs to several thousand cfs. During periods of high volume flow from snowmelt and intensive summer rains the river becomes silt laden. The average flow in the river is between 100 and 200 cfs. Most of the time the river flows clear and cool.

The Gila River in the vicinity of the reservoir site provides good quality fish habitat. Fishes found in the vicinity include the following native species: chub, loach minnow, spokedace, longfin dace, desert sucker, Sonoran sucker and speckled dace. The first three of these are listed in the New Mexico State Game Commission's Regulation No. 563, dated January 24, 1975, as likely to be in jeopardy within the foreseeable future. Introduced fish species within the area include the smallmouth bass, rainbow trout, brown trout, channel catfish, yellow bullhead, black bullhead, flathead catfish, green sunfish, and mosquitofish.

The channel catfish, smallmouth bass, and rainbow trout, are the primary species appearing in the fisherman's creel. The New Mexico

Department of Game and Fish stocks about 2,500 9-inch rainbow trout annually in the reservoir vicinity. Good access to the stream is available downstream of the dam site. Vehicular access to the stream is available at only one point upstream from the dam site due in part to road restrictions within the Gila primitive and wilderness areas. However, many fishermen hike into this area.

With the Project

Hooker Reservoir will be long and narrow with a width not exceeding one fourth mile. Approximately 10 miles of the Gila River will be inundated thus eliminating the stream fishery from this reach. Reservoir releases are expected to be cooler than present stream flows during the summer months. This will provide better habitat conditions for establishment of a trout fishery but is expected to be detrimental to some native species including the spikedace, considered as endangered in New Mexico. Furthermore, native species upstream of the reservoir also could be detrimentally affected by the introduction of competitors through use of bait fishes in the reservoir or upstream movement of nonnative fishes enhanced by lake conditions.

The reservoir will provide habitat suitable for establishment of a reservoir fishery. Minimum pool depth and surface area should be adequate to sustain fish populations during periods of extreme drawdown.

Several fish species native to the river system can be expected to increase in numbers and establish self-sustaining populations in the reservoir. Anticipated reservoir temperatures will permit development of a trout fishery. Present plans are based on an annual stocking of rainbow trout and channel catfish; however, consideration is being given to an alternate program in which native trout would be stocked exclusively.

Information presently available on the timing and volume of releases from Hooker Reservoir indicates that the downstream fishery will be maintained. A concentration of fish below the dam, resulting from fish moving upstream in the Gila River and from reservoir fish passing through the outlet structure, should provide increased fishing opportunities in this area.

Fisherman access to the reservoir will be restricted to the general vicinity of the dam. The reservoir will be attractive to other forms of recreation-boating activity and use conflicts could arise.

Wildlife

Without the Project

Wildlife habitat within the project area consists of a very diverse canyon-type ecosystem. Riparian woodland comprised of sycamore, cottonwood, and willow, characterize this system. The riparian habitat along the Gila River in the project area is unique in New

Mexico. It is the Fremont Cottonwood-Arizona Sycamore Association which is representative of the subtropical Sonoran biotope, quite rare north of the Mexican border. Further back from the stream, the woodland becomes a complex vegetational type including hackberry, Arizona walnut, and velvet ash. On the hillsides bordering the riparian woodland the vegetation includes one-seeded juniper, alligator bark juniper, ebony oak, gray oak, pinyon pine, and mesquite. However, the canyon slopes vary in vegetative composition depending on exposure. The south-facing slopes are very rocky and are dominated by catclaw acacia, one-seeded juniper, bear grass, and scattered mesquites and cacti, both cholla and prickly pear. Where the slopes are less exposed, such as the east- and west-facing slopes, the vegetation becomes shrublike, almost chaparral in appearance. Here, pinyon pine and juniper increase in number. Dense stands of shrub oak, buckhorn, and other chaparral species occur. The more mesic locations on the slopes become denser forest. On the north slopes in the deeper drainage, the pinyon-juniper forest becomes quite dense including pinyon pine, alligator bark juniper, ebony oak and wavy-leafed oak.

Impounded project waters would influence approximately 1,340 acres of wildlife habitat below elevation 4,890.0. Project lands are within the Gila National Forest. However, some patented lands lie within the reservoir area. It can be expected that the reservoir

level will be at the top of the conservation pool, elevation 4,863.0 approximately 65 percent of the time.

Big-game animals found within the project area include the mountain lion, bobcat, javelina, elk, white-tailed deer, mule deer, and bighorn sheep.

Fur animals including the raccoon, foxes, badger, muskrat, and beaver, are common in the vicinity.

Literature review indicates that about 226 species of birds may be found in the reservoir area of which 111 are nesting birds. The Mexican duck, black hawk, and Gila woodpecker may nest within the reservoir site. All three species are on the New Mexico endangered species and subspecies list, and the Mexican duck is on the United States list of endangered fauna.

Waterfowl such as the gadwall, pintail, green-winged teal, blue-winged teal, and many others use this area.

Raptors including the goshawk, sharp-shinned hawk, ferruginous hawk, bald eagle, osprey, prairie falcon, and peregrine falcon, are reported to use the area. The Cooper's hawk, redtailed hawk, Swainson's hawk, zonetailed hawk, black hawk, golden eagle, barn

owl, screech owl, great horned owl, and elf owl, may nest in the reservoir area and downstream. Detailed raptor nest surveys will be needed to accurately ascertain this. The peregrine falcon is classified as endangered. Potential nest sites within the Gila River system are presently being identified by the Peregrine Falcon Recovery Team.

Approximately 62 species of amphibians and reptiles are found in or adjacent to the area. Two of these, the narrow-headed garter snake and the Arizona coral snake, are on New Mexico's endangered species and subspecies list.

A list of wildlife in the project area is found in Appendixes V and VI.

Without the project, the National Forest lands within the project area are expected to remain basically in their present condition. Apparently no plans have been made by the U. S. Forest Service for future construction of recreational facilities within the project area.

With the Project

Construction of the Hooker Dam and Reservoir is scheduled to begin in _____. With the construction of the reservoir, 134 acres of riparian habitat along eight river miles of the Gila River will be lost due to clearing for the conservation pool. Of this total two miles are within the Gila Wilderness area. The flood pool will back up an additional two miles within the Wilderness. In addition, an unknown acreage will be altered for borrow and also for accelerated recreational use.

Downstream riparian vegetation is expected to be maintained by the flows released from Hooker Dam.

Riparian vegetation would not be expected to revegetate around the reservoir shoreline because of wide fluctuations in reservoir level. Some salt cedar might take hold along the outer fringes.

Hooker Reservoir will eliminate or degrade habitat for mammal populations in the area. The mule deer, white-tailed deer, javelina, bighorn sheep, bobcat, gray fox, and coyote will decrease as habitat decreases and human recreational use of the pool and encroachment occurs. Of the 68 species of mammals historically occurring in the Hooker Reservoir site, six have been predicted to increase in numbers with impoundment and four probably would be unaffected. Fifty-eight are expected to be adversely affected by the impoundment.

The expanded water surface resulting from the construction of Hooker Reservoir will not benefit waterfowl materially. The reservoir will provide waterfowl with resting and limited feeding areas during the spring and fall migration periods, but few are expected to remain or nest within the area.

With the construction and operation of Hooker Dam and Reservoir many of the bird species presently nesting in the reservoir site will be adversely affected. Of the 111 nesting species, 13 will increase or not be affected and 88 will be adversely affected with the project. The destruction of the riparian woody vegetation along the river could well spell the destruction of the bird populations that it supports. Nesting birds that could be especially adversely affected include: Abert's towhee, black hawk, elf owl, Wied's crested flycatcher, white-winged dove, mourning dove, yellow-bellied cuckoo, Gila woodpecker, and Lucy's warbler. Many other species, especially other nesting birds, conceivably could have their numbers considerably reduced by the inundation or removal of trees. Of those species that will be adversely affected, the Gambel's quail, white-winged dove, and mourning dove, are important game species.

The destruction of at least eight miles of sycamore and cottonwood vegetation on the upper Gila River in New Mexico will eliminate nesting sites for zone-tailed and black hawks. The black hawk is dependent upon nesting close to the water because of its diet of frogs, small fishes, and aquatic animals. The zone-tailed hawk has a more varied diet including mammals, birds, and reptiles, but also is dependent upon streamside vegetation for nesting cover. These hawks are peripheral species with only a few birds nesting in

the United States. Most nesting takes place in Mexico south of the International Border. There is, however, reason for concern about the south-of-the-border future of the black and zone-tailed hawks.

It can be expected that most species of reptiles and amphibians inhabiting the reservoir area will decrease in numbers as they are displaced to compete for remaining habitat with other animals.

Prior Reports and Recommendations

The Fish and Wildlife Service reported on the Central Arizona Project on November 30, 1961. Another report, "Upper Gila River Project, Arizona and New Mexico," including the Hooker site, was issued on February 19, 1964.

The following recommendations were made in the 1964 report:

1. That the project provide at each reservoir boat-launching access areas equipped with ramps or other suitable boat-launching facilities with adjacent parking areas and sanitary facilities and served by all-weather roads. A minimum of one such area should be established at Natural Corral Reservoir, two at Reserve Reservoir, and three each at Camelsback, Hooker, Quail Springs, and Alma Reservoirs.
2. That the project provide one access-parking area with sanitary facilities and served by all-weather roads at the tail water below Hooker, Alma, Quail Springs, and Reserve Dams and that public access be provided to at least 1,000 feet of stream below said dams; and that the stilling basins of Hooker, Alma, Quail Springs, and Reserve Reservoirs be equipped with berm or other type fishing platforms for fisherman access and safety.

3. That project reservoirs be zoned to control speedboating and waterskiing. Zoning plans should prohibit speedboating and waterskiing at all times on Natural Corral and Reserve Reservoirs, and on Camelsback, Quail Springs, and Alma Reservoirs whenever water levels are at minimum pool elevations. Zoning plans should be developed cooperatively by the respective State game and fish departments and the agency or agencies expected to administer the reservoirs.
4. That cleared and charted seining areas be established at project reservoirs for investigation and control of fish populations. One area should be established at Natural Corral Reservoir, two each at Camelsback and Reserve Reservoirs, and three each at Quail Springs, Alma, and Hooker Reservoirs. Locations and specifications will be determined during detailed planning stage of project development.
5. That a State trout hatchery be established at project cost of about \$500,000 in conjunction with either the Hooker Reservoir or the Alma Reservoir to assure realization of assigned coldwater fishing benefits in New Mexico. Location, size, and exact cost of the facilities required will be determined during detailed planning stage of project development.

Part IV. IRRIGATION DISTRIBUTION SYSTEMS

Engineering data concerning the irrigation distribution systems have not been provided to the Fish and Wildlife Service. The impacts of these systems will be analyzed when appropriate information is made available.

Part V. DISCUSSION

Since its inception, there has been a realization that the Central Arizona Project would have significant impacts on fish and wildlife resources. Therefore, the project authorization has included conservation and development of these resources as project purposes.

Several specific features have been included in the project to meet these needs. Additional measures necessary to reduce project impacts and to provide for fish and wildlife mitigation are discussed in this report section. Where opportunities for enhancement are available, these also are described.

Conveyance System

Fishery Resources

Fishery losses are anticipated as water is pumped from the Colorado River and along the aqueduct systems into Orme Reservoir. Losses also can be anticipated as the result of power generation at Orme Dam and as water is diverted into pipeline aqueducts from the Salt-Gila Aqueduct and Charleston Reservoir. The probable extent of losses due to pumping and power generation is unknown at this time. Studies should be undertaken to determine this loss in order to assess the need for protective fish screening of project pumps. To allow for assessment of these impacts 0-rings should be installed in the aqueduct walls to permit sampling with a fyke net. In order to sample at various flow rates, a series of three 0-rings, placed at four-foot intervals downward from the maximum flow line, will be needed on each side of the canal.

Such structures should be installed near the Buckskin Mountain Tunnel outlet and in the reversible canal near Orme Dam. Installation

should be immediately downstream of an aqueduct bridge crossing for ease of operations. Cost of installation is estimated at \$1,000 and should be assigned as a fishery mitigation cost.

Sampling of the aqueduct should be conducted over the first year of operation and during various flow rates. This study should be conducted by the Arizona Game and Fish Department in a manner developed cooperatively by the Arizona Department, the Bureau of Reclamation, and the Fish and Wildlife Service. The cost of this study is estimated at \$20,000 and is to be considered as a mitigation feature. Should this study indicate the need for fish screens, provision should be made in the project design for modifications necessary to permit fish screen installation.

The Tucson and San Pedro Aqueducts, closed pipeline systems, should be screened to prevent fish losses. Screening of these systems would cost an estimated \$19,800 for the Tucson Aqueduct and \$3,300 for the San Pedro Aqueduct. Annual OM&R costs are estimated to be \$1,100. These costs would be fishery mitigation costs.

A fish salvage plan should be developed to provide for the salvage of fish stranded in the aqueduct during periods of dewatering. The plan should be developed cooperatively by the Bureau of Reclamation, the Arizona Game and Fish Department and the Fish and

Wildlife Service. Costs of this operation are estimated at \$10,000 per dewatering based on three-year periods of operation between dewatering. These costs should be assigned as fishery mitigation costs.

Project aqueducts will increase fishing opportunities. As presently constructed, the banks of the protective dike for the intake structure are too steep for safe fisherman access. This structure could be modified to provide near-level fishing areas along its perimeter, thus improving fishing access. These areas could be built from materials removed during construction of the Buckskin Mountain Tunnel and should be placed along the dike perimeter at 400-foot intervals. Any costs incurred should be considered as enhancement.

Fish introduced into the aqueducts from the Colorado and Salt River systems will concentrate around flow control structures and pumping stations where reduced water velocities or eddies occur.

Fisherman access should be provided to such areas. Access should consist of a small parking facility and a turnstile entranceway through the aqueduct fence. Access also should be provided at all pumps except the Bouse Hill Pumping Plant. These would be enhancement features and would cost an estimated \$1,000 per access point, for a total of \$5,000. ✓

Project plans include construction of five 10-acre fishing lakes along the aqueduct systems as a fishery enhancement measure. As recommended in our November 29, 1969, report on Granite Reef Aqueduct, the lakes should be unlined and built near the aqueducts so that the water delivery and return systems could utilize gravity flow. The annual water requirement for the five lakes is estimated at 7,200 acre-feet of which 375 acre-feet would be annual consumptive use. For each lake, inlet and outlet control structures in the aqueduct sidewall with connecting culverts would be needed. These structures should be capable of handling flows up to five second feet and should be provided with removable self-cleaning fish screens of 1" size mesh.

The lakes should be constructed to a water depth of 12 feet over 70 per cent of their surface area and a depth of six feet or less over the remaining 30 per cent. They must be capable of retaining sufficient water to sustain fishlife during periods of low flow or aqueduct closure. Construction of these unlined lakes is dependent upon the availability and location of sites with nonporous substrata. It is proposed that the lakes be located near the pumping plants along the aqueducts except the Bouse Hill Pumping Plant. Specific locations would be determined through cooperative studies by the Arizona Game and Fish Department, the Fish and wildlife

Service, and the Bureau of Reclamation, at the time of detailed project planning for the appropriate aqueduct reach.

An additional 30 acres of peripheral lands would be necessary at each lake for development of access, parking, and sanitary facilities. Fencing of each site also would be necessary. The lakes should be managed and administered for fishery purposes by the Arizona Game and Fish Department under the terms of a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act (43 Stat. 401, as amended; 16 U.S.C., 660 et seq.).

Estimated project costs for the five lakes would be about \$350,000, based on 1975 prices. Annual operation, maintenance, and replacement costs would be about \$20,000.

A stocking program would be needed in order to establish and maintain a sport fishery in the lakes. Channel catfish and largemouth bass should be stocked in the lakes during their initial year of operation. The stocking of largemouth bass could be accomplished by introducing about 25 gravid bass per lake; these bass could be taken from nearby lakes where good bass populations now exist. The bass population should be self-sustaining after this initial introduction. Costs associated with providing the necessary bass are estimated at \$1,500. The channel catfish should be stocked at the rate of 1,000 fish per lake and maintained by annual stocking. Catfish would be provided from the project-associated

warmwater hatchery. Costs of providing these catfish are estimated at \$2,000 for capital construction and \$100 for operation, maintenance and replacement. The lakes should be made available to the Arizona Game and Fish Department for fish and wildlife management under the terms of a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act.

Wildlife Resources

Project construction will result in losses of wildlife and habitat through the loss of land area required for project facilities, the modification of local drainage patterns, and disturbance from human activities.

Heron Island near the south shore of Lake Havasu in the area of the intake channel is used from March through July each year by about 15 pairs of great blue herons for nesting and rearing. Excessive disturbance of the island from March through July by project construction could result in its abandonment by the great blue herons.

Survey and core drilling activity for the Buckskin Mountain Tunnel and construction of the pumping plant and tunnel has and is expected

to further reduce the value of the mountain range for bighorn sheep habitat. We understand that a temporary project-related transmission line will extend through a bighorn sheep lambing area.

Project aqueducts will result in the direct loss of valuable wildlife habitat. Additional losses are anticipated as storm runoff is diverted by the open aqueducts and their protective dikes from terrain on the downslope sides of the aqueducts. The extent of downslope loss will be dependent upon the number of project-planned overchutes which may be eliminated from the open-aqueduct design. Habitat conditions are expected to improve on the upslope sides of the aqueducts or their protective dikes because of increased water retention.

The impact on wildlife habitat from decreased storm water runoff is unknown as are the benefits to be derived from upslope water retention. A study to determine these impacts was conducted by the Soil Conservation Service and Arizona Water Commission. However, the initial study findings were inconclusive and additional work is needed. Also, total impacts cannot be assessed until a firm decision is made regarding the number of overchutes to be installed for passage of water over the aqueducts. In this regard the Bureau of Reclamation should cooperate with the Soil

Conservation Service in funding the additional study needed to assess these project impacts.

Should this study indicate a significant loss of habitat, this loss should be mitigated by redistributing runoff downslope of the aqueducts or the inclusion of individual overchutes as originally planned.

Wildlife values associated with improved habitat conditions upslope of the protective dikes would be reduced if these areas are grazed or cleared as a part of the project operation. These areas should be fenced to exclude cattle and native vegetation should not be cleared. The fencing would be a mitigation feature and would cost an estimated \$2,600 per mile, with annual O&M costs of \$150 per mile. Areas to be fenced should be defined on the basis of improving habitat conditions. It is estimated that up to 150 miles of fencing may be required.

Materials for building the protective dikes should be obtained from excavation of the aqueduct in order to avoid excessive land disturbance. There will be an estimated 1,000,000 cubic yards of excess material after excavation of Reach 1 of the Salt-Gila Aqueduct, and this should be used for dike construction wherever

necessary. Disposal areas for unused spoil other than dike locations should be located in cooperation with the Arizona Game and Fish Department and the Fish and Wildlife Service to minimize habitat destruction.

The protective dikes could remain unvegetated for a number of years if no vegetation or topsoil placement is done. The need for topsoil has been demonstrated along a portion of the Paradise Valley Detention Dike, where placement of topsoil resulted in the establishment of annual and some perennial vegetation in less than one year. Topsoil placement should be required on all aqueduct protective dikes.

To prevent deer from drowning in the aqueducts, deerproof fencing should be provided along the aqueduct routes in areas shown in Appendix 1. Fencing used should be chain link or an appropriate mesh-type alternative with a minimum height of 84 inches. Fencing would be most effective if placed along the top of the aqueduct embankment at its outer edge. An estimated 360 miles of fence would be needed at a cost of about \$15,800 per mile or a total

cost of \$5,688,000. Annual maintenance and replacement costs are estimated at \$10,000. These costs should be assigned to wildlife mitigation.

An estimated 157 game crossings will be needed to provide for the movement of mule deer, bighorn sheep and javelina over the aqueducts. Proposed locations of these crossings are listed in Appendix 1. Multipurpose structures which could have served this function were included in the original project plan. However, some of these structures are being eliminated; therefore, the list of sites is provided to insure adequate consideration of crossing needs. The indicated crossings may be structures installed specifically for this use or may be planned overchutes or bridges modified to serve the purpose. A review of project maps, dated February 1968, indicates that 56 of the bridges spanning the aqueducts will be suitably located to serve as game crossings.

The exact number and location of these wildlife crossings should be determined by field investigation by personnel from the Arizona Game and Fish Department, the Fish and Wildlife Service, and the Bureau of Reclamation, at the time detailed project plans are being formulated. All wildlife crossings should be built with a minimum width of sixteen feet (fenced on both sides with deer-proof fencing) and their surface covered with a six-inch layer of

earth of the same type found at either end of the crossing. The crossings should be considered a project wildlife mitigation feature, and those constructed for this single-purpose use are expected to cost an estimated \$50,000 each. Annual OM&R costs per crossing are estimated at \$1,000.

Project plans include construction of big-game watering catchments. These structures would provide sources of additional water away from the aqueduct and would reduce big-game use of the aqueduct as a water source thus reducing losses from drowning. Further, a more desirable distribution of deer and bighorn sheep would result. Twenty nine catchments are now proposed. These would be of the basin type and should be constructed concurrently with or before the aqueducts. They would not require water from the aqueduct except during periods of drought. During these periods, the water could be transported by truck from the aqueduct to fill the catchment basins which would have a capacity of not less than 10,000 gallons each. Filling of the basins along Granite Reef Aqueduct would require less than one-half acre-foot of water per year.

To ensure a water supply to the catchment basins during drought periods provision should be made for an efficient method of obtaining water from the aqueduct by tank trucks. The trucks could reach the aqueduct through a gate in the project fence or could be

supplied by a water pipe extending outside of the project right-of-way. The general location of the catchments is shown in Appendix I. However, the exact location of these facilities should be established upon a close field examination to ensure that proper terrain is available with sufficient drainage area to provide adequate runoff. This field investigation should be accomplished by personnel from the Arizona Game and Fish Department, the Fish and Wildlife Service, and the Bureau of Reclamation. Exact locations should be established at the time of detailed project planning. Drawings and specifications for the catchment basins are provided in Appendix II. These structures are estimated to cost \$10,000 per unit for a total cost of \$290,000. Operation, maintenance, and replacement cost would be about \$100 per unit per year for a total annual cost of \$2,900. These costs should be allocated to wildlife mitigation.

As another means for reducing wildlife drownings and providing partial replacement of habitat loss due to the construction of the aqueduct, a provision for fenced, oasis-type stations along the aqueduct route was included in project plans. These stations would provide for better distribution of wildlife by providing water necessary for drinking and for the establishment of vegetation. Each oasis would consist of a fenced area of at least 60

square feet situated approximately 1,000 feet from the aqueduct. Each area should be fenced to a height of approximately 42 inches. The fence should consist of at least 5 strands of wire with the middle three being four-barbed, 12.5 gauge wire. The bottom and top wires should be 12.5 gauge smooth wire. Each station would be connected to the aqueduct by a 1½-inch plastic, gravity fed, pipe. Two types of stations should be constructed. One type would have a 3-foot square, slightly depressed, concrete slab located at the outlet within the fenced area. Overflow from the slab would disperse into the surrounding land creating a small vegetated area which would be attractive to wildlife. The second type of oasis would be similar but also would contain an array of porous pipe. Seepage from this porous pipe would supply water for the establishment of vegetation. Doves, quail, rabbit and deer could be expected to make extensive use of these small oases.

General locations of 46 oases are shown in Appendix I; however, finalized locations should be established by Arizona Game and Fish Department, Fish and Wildlife Service, and the Bureau of Reclamation, after extensive topographic investigations and soil analyses. Costs would be approximately \$1,500 per oasis if built at time of aqueduct construction. Total cost for the oases would be approximately \$69,000. Annual OM&R costs are estimated to be \$700. The 46 oases should be managed by the Arizona Game and Fish

Department for wildlife purposes. The annual water requirement for the stations would be approximately one acrefoot per oasis per year for a total of 46 acre-feet per year.

The elimination of cross-drainage structures, both overchutes and culverts on some reaches of the aqueduct could result in the loss of desert wash habitat on the downslope side of the aqueduct. Unless this habitat loss can be prevented, there will be a need for additional oases. This need should be examined when project plans are finalized and the number of oases expanded as necessary.

The Salt-Gila Aqueduct parallels the old Florence Casa Grande Canal for a portion of its alignment. A fringe of mesquite, ironwood, and palo verde has become established along the upslope side of the canal. This vegetation provides habitat for small upland mammals and birds and should be retained in its natural state.

Project plans include the use of temporary earthen plugs as escape facilities in those portions of the aqueduct which are to be concrete-lined. These plugs will reduce wildlife losses due to entrapment in the aqueduct prior to its becoming operational.

The project may influence the operation of Picacho Reservoir. Any changes in operation of this reservoir should be planned in cooperation with the Arizona Game and Fish Department and the Fish and Wildlife Service to insure preservation of this unique wildlife area and its endangered Yuma clapper rail habitat. The Salt River siphon construction also may impact Yuma clapper rail habitat. Planning should be coordinated with the Arizona Game and Fish Department, the Fish and Wildlife Service, and the Yuma Clapper Rail Recovery Team, to explore impacts and enhancement possibilities.

Construction of the Tucson Aqueduct as originally planned would have minimal impact on wildlife resources. However, construction of the aqueduct on its alternate route through the Tucson Mountains Park and State Game Refuge would result in a long-term loss of habitat dedicated to wildlife preservation. Construction roads located in this area and subsequent use by off-road vehicles would preclude reestablishment of permanent habitat, increase erosion problems, and expose wildlife to increased human harassment. These impacts make this alternative highly undesirable.

The San Pedro Aqueduct should be routed outside the riparian vegetation zone along the San Pedro River and to a crossing on the

Babocomari River which will not adversely impact gray hawk nests or foraging areas along the river or areas the Mexican Duck Recovery Team determine are critical for that species.

To reduce the time lag required for reestablishment of vegetation along the aqueducts all disturbed areas should be seeded with native grasses and woody vegetation. Project plans for the aqueducts are not well-defined. Therefore, planting requirements should be determined when routes, design specifications, and methods of construction are known.

Project Reservoirs

Fishery Resources

Recent water quality improvements in the Gila River in the vicinity of Buttes Reservoir site are expected to result in reestablishment of fish populations in this river reach. Further studies should be conducted to determine the extent of fishery resources at the time of dam construction. Additional studies also should be conducted on the San Pedro River, both within the reservoir site and downstream, and on the Babocomari River in the vicinity of the proposed aqueduct crossing. All studies should be conducted one year prior to construction of the involved project feature. Study costs are estimated at \$40,000 for the Buttes site, \$15,000 for

the San Pedro River, and \$5,000 for the Babocomari River. The studies should be conducted by the Arizona Game and Fish Department and/or the Fish and Wildlife Service under a study plan developed by these agencies in cooperation with the Bureau of Reclamation and should be considered a project responsibility.

Downstream flows will be greatly altered by construction of Buttes, Charleston and Hooker dams. Minimum flows of 50 cfs at the Ashurst-Hayden Diversion Dam and 50 cfs, or reservoir inflow when less than 50 cfs, at Hooker Dam should be provided at all times to maintain existing fishery resources and immediately adjacent riparian vegetation. Hydrological studies should be conducted on the San Pedro River to determine the minimum flow needed downstream of Charleston Dam.

In order to avoid temperature changes in downstream releases from Hooker Reservoir, a multigated outlet should be included in the project design. The cost of this structure should be determined by the Bureau of Reclamation and allocated to mitigation purposes.

Water temperatures for the Gila River should be monitored for a three-year period prior to dam construction. This could be done at the existing gaging station located northeast of Gila, New Mexico.

Costs of this program are estimated at \$4,200 and should be a project responsibility.

As mitigation for the stream fishery to be inundated by Orme Reservoir, a trout fishery could be established downstream of the dam provided water temperatures do not exceed 65° F. An estimated 50,000 10-inch catchable trout would be needed on an annual basis to sustain this high-use fishery. Fish presently being stocked by the Fish and Wildlife Service would continue to be provided. Thus, costs for an additional 38,000 fish are estimated to be \$730,000 for initial construction, with an annual operation, maintenance, and replacement cost of \$27,000. These costs should be assigned as mitigation costs. Screens should be installed at diversions in order to block the escape of the planted fish into the canals associated with the Salt River Project. Costs to the project of screening the diversions are estimated at \$200,000 initially, with annual OM&R costs being about \$10,000.

The project plan includes one warmwater and two coldwater fish hatcheries to provide fish for project reservoirs. If all project reservoirs are built, construction of one new warmwater hatchery and expansion of possibly two coldwater hatcheries would be sufficient to supply fish stocking requirements. In the event that one or more reservoirs are deleted from project plans, construction of new warmwater facilities may be unwarranted. In this

case, the possibility of expanding existing warmwater facilities or combining hatchery facilities required by this project with those of the International Salinity Control Project should be considered. Management responsibilities for the warmwater hatchery have not yet been determined. We are investigating the possibility of Federal management due to stocking needs for Orme Reservoir (if constructed) and associated Indian Reservation waters.

Annual fish stocking programs for project reservoirs should be considered enhancement measures. Fish stocking requirements and costs for the various reservoirs based on conservation pool storage are shown in Table 1. The table illustrates costs for 3-inch fingerlings of the species listed, except for the largemouth bass stocking in Orme. An initial stocking of 500-600 gravid largemouth bass in the reservoir should result in establishment of good bass populations. These fish could be obtained from a nearby lake at an estimated cost of \$2,500.

Table 1. Estimated Annual Project Reservoir Fish Stocking Requirements

Fish Species	Number of Fish				Totals
	Orme Reservoir	Buttes Reservoir	Charleston Reservoir	Hooker Reservoir	
Channel catfish	970,000	400,000	400,000	112,000	1,882,000
Walleye	970,000				970,000
Northern pike		400,000	400,000		800,000
Largemouth bass	500-600				500-600
Rainbow trout				1,112,000	1,112,000
<u>Capital Hatchery</u>					
Cost	\$750,000 ^{1/}	\$310,000	\$310,000	\$223,000 ^{2/}	\$1,593,000
Annual OM&R	\$ 37,000	\$ 15,000	\$ 15,000	\$ 24,200	\$ 91,200

^{1/} Does not include \$2,500 for one-time bass transplant

^{2/} Includes \$180,000 for expansion of existing trout hatchery

In order to fully utilize reservoir fishery resources, small boat-launching facilities should be provided. Present recreational plans do not include access facilities to upstream reservoir reaches. Such access could be provided for Orme Reservoir on the Verde River at or near Fort McDowell and about two miles downstream of Stewart Mountain Dam on the Salt River. These access points should be designed to provide access to the reservoir pool at elevation 1,380.0 thus being usable about 50 percent of the time.

Access for Buttes Reservoir should include a site near Cochran designed to provide access to the reservoir pool at elevation 1,690.0. At Charleston Reservoir, one access site should be made available to approximate elevation 4,030 at Lewis Springs. In order to maintain the wilderness character at Hooker Reservoir, access should be limited to the general vicinity of the dam.

Each access facility should be a minimum-use structure including a two-lane boat ramp and parking for about 25 cars. Costs of these facilities are estimated at \$21,000 per facility and should be considered as enhancement. Annual maintenance and replacement costs are estimated to be \$1,100.

Additional fishing benefits could be obtained at the reservoirs by retaining trees and brush in the reservoir areas where such vegetation would not interfere with safety or pertinent use facilities. Timbered areas in a reservoir serve as concentration points for fish; consequently, they are utilized heavily for fishing. If retention of timber is infeasible, artificial reefs would serve the same purpose.

The depth of the planned minimum pool of 200 surface acres at Buttes Reservoir will decrease with sediment deposition and may not be

sufficient to maintain an established fishery resource over an extended period of time. A pool of at least 200 surface acres with an average depth of not less than 8 feet should be maintained in order to support fishery resources.

In order to optimize the reservoir fishery potential, an investigation should be initiated at all CAP reservoirs to determine if changes are needed in the fishery management program. Such studies should be undertaken during the first five years of reservoir operation and would be conducted by the agency responsible for management. These studies would be considered enhancement and would cost approximately as follows: Orme Reservoir, \$150,000; Buttes Reservoir, \$100,000; Charleston Reservoir, \$100,000; and Hooker Reservoir, \$100,000.

In order to avoid recreational conflicts, to promote safety, and to realize full fishery benefits, all reservoirs should be zoned. Zoning could be temporal; i.e., uses restricted by certain times, or spatial, certain uses allowed in certain areas.

Wildlife Resources

With reservoir clearing, periodic flooding of uncleared flood pool areas, recreational facility development, borrow area excavation,

rerouting of roads and railroads, and possible downslope vegetation die-off, irreplaceable wildlife habitat will be degraded or destroyed.

If Buttes, Charleston, and Hooker Reservoirs are to be built, detailed raptor studies should be made. These reservoir sites provide nesting habitat for raptors included on Arizona's proposed list of threatened wildlife and on New Mexico's list of endangered species and subspecies. The raptor study should be conducted for a period of at least two years. It should cover all drainages (American side) within which the Buttes, Charleston, and Hooker Reservoir sites are located. These drainages include, but are not limited to, the Gila River, San Francisco River, and the San Pedro River. Studies involving the entire drainage are particularly important for systems like the San Pedro River whose flow regimen will be drastically altered by proposed dam construction.

The actual study should provide at least the following data:

- a. Number of nests by species and locations;
- b. Description of raptor nests, nest site, number of years occupied;
- c. Fledgling success; and
- d. Spatial, foraging, territorial, or behavioral requirements associated with the raptor's use of the particular area.

It is estimated that a raptor study as described would cost approximately \$125,000 for two years, using two full-time and two part-time biologists, two vehicles and 40 hours of helicopter time; purchasing two spotting scopes and miscellaneous equipment; and preparing a final report.

The Fish and Wildlife Service has investigated possible protection measures for the endangered southern bald eagle population existing within the Orme Reservoir site and has found no evidence that any project-associated measures can guarantee preservation of the existing population or that any project-related measure will improve the status of this species. It would appear that the present riverine area represents "critical habitat" for the southern bald eagle.

The Verde/Salt River system also is unique in its assemblage and diversity of wildlife habitat and species, and is irreplaceable.

If Orme Reservoir is built, some habitat replacement for wildlife other than the southern bald eagles would be possible through purchase in fee of mitigation lands. Any such areas would have to have potential for or actually provide similar habitat to that being lost, preferably be private land, and have a guaranteed water

source. Land tracts as large and as high in wildlife values as the Orme Reservoir area are no longer available for purchase in Central Arizona. Purchase of ___ acres of land along Tonto Creek, a tributary of the Salt River, would replace ___ units of habitat lost; ___ acres along the upper Verde River, ___ units; and ___ acres in the Greenbelt along the Gila River, ___ units. These areas could be purchased for wildlife mitigation at project expense, or withdrawn for wildlife purposes.

If the reservoir is built, the heron rookery in the Orme Reservoir flood pool should be protected from human disturbance associated with the reservoir.

In the Buttes Reservoir site, ___ units of wildlife habitat will be lost. In order to mitigate this loss of wildlife habitat, the acquisition of replacement habitat would be necessary. Purchase of ___ acres of streamside land along the San Pedro River would replace ___ units of habitat lost.

The four miles of habitat downstream of Buttes Dam would not be maintained if all flows are diverted at Buttes. A minimum flow of 50 cfs should be scheduled to maintain this vegetation.

Construction and operation of the Charleston Reservoir on the San Pedro River will have adverse impacts on wildlife, particularly on the gray hawk which is on the state's proposed list of threatened wildlife. The reservoir will destroy nest trees and foraging areas and damage may occur in downstream reaches. If this reservoir is constructed, wildlife habitat losses should be mitigated by purchase of substitute habitat. A total of _____ acres of streamside lands along the San Pedro immediately downstream of the dam site should be purchased to offset this loss.

One effect of the flood control function of Charleston Reservoir will be an accelerated encroachment of salt cedar along downstream reaches of the San Pedro River. To prevent this encroachment and consequent competition with the indigenous cottonwoods and willows which are important to numerous wildlife species, including the gray hawk, the stands of cottonwoods and willows should be augmented by new plantings and the salt cedar should at least be prevented from spreading until the new plantings are established. Planted trees would require irrigation for a period of about two years to assure success. At least 75 percent survival of the planted trees should be maintained over the life of the project. The estimated cost of this program, to be spread over a period of two to three years, would be about \$ _____. This cost is assignable to mitigation.

A major loss of wildlife habitat also will occur if Hooker Reservoir is built on the Gila River in New Mexico. The acquisition of a comparable acreage of riparian habitat downstream from the damsite, including private lands within the National Forest boundary and additional lands downstream of this boundary, would help offset this loss. Acquired lands within the National Forest boundary would be incorporated into the National Forest and would be administered by the U. S. Forest Service in accordance with Section 3 (f) of the Fish and Wildlife Coordination Act. Lands acquired downstream of the National Forest boundary should be turned over to the New Mexico Department of Game and Fish for wildlife management purposes.

Downstream Gila River habitat, both aquatic and bottomland habitat, should be maintained by flows released to meet downstream water rights with releases scheduled to prevent the occurrence of prolonged periods of abnormally low or zero flows.

Wildlife lands acquired by either purchase or withdrawal for mitigation of wildlife losses at the four reservoirs, other than lands within National Forest boundaries, should be made available to the respective State departments of game and fish for administration and management under terms of General Plans as provided in Section 3 of the Fish and Wildlife Coordination Act.

Mineral leasing and extraction on withdrawn lands could interfere with the successful achievement of mitigation; therefore, all mineral rights should be acquired in order to permit the control or prohibition of such activities.

General Considerations

From an overall view of the proposed Central Arizona Project reservoirs, it is evident that there will be irreversible adverse effects on fish and wildlife resources. The Orme Reservoir area is habitat for the endangered southern bald eagle, which will be adversely impacted by reservoir construction. The reservoir area is presently a flowing stream system whose adjacent habitat supports unusual and extremely diverse wildlife populations. It is a unique area in central Arizona. Charleston Reservoir will be located on the San Pedro River which is presently an undammed watercourse. There may be fish species within the reservoir site which are on the proposed state list of threatened species or on the United States list of endangered species. It also supports nesting gray hawks, a species whose existence in Arizona is threatened. Significant downstream vegetational changes and resultant habitat losses will be attributable to this project. The Hooker Reservoir area will result in clearing of about two miles of riparian vegetation within a designated wilderness area and will

periodically flood an additional two miles of this wilderness. The reservoir will inundate habitat presently used by fishes and birds considered as endangered by the State of New Mexico.

Continuing fish and wildlife studies of the Central Arizona Project will include special studies undertaken in accordance with the Principles and Standards guidelines established by the Water Resources Council in October 1973. Specific studies involving these procedures are presently scheduled for the Orme and Butte's Reservoir sites. At a later date studies of this scope should be undertaken at other project units. Because of the major impacts on fish and wildlife resources anticipated at Charleston and Hooker Reservoirs, there is a definite need for similar indepth evaluations at these reservoir areas. Consideration should be given to the selection of possible alternatives for Orme, Charleston, and Hooker Reservoirs which would be less destructive to fish and wildlife resources.

Lands acquired for the Central Arizona Project will be public lands and should be available for public use except where restrictions are necessary for reasons of public safety, designated Indian use, or fish and wildlife conservation needs. Signs should be posted as necessary to adequately designate public use areas as well as restricted areas.

APPENDIX I

GENERAL LOCATIONS OF PROPOSED AQUEDUCT-RELATED WILDLIFE STRUCTURES

STRUCTURES

<u>Aqueduct</u>	<u>Game Crossing</u>	<u>Deer Fencing</u>	<u>Oasis</u>	<u>Water Catchment</u>	
Granite Reef Reach 1	T10N, R17W, NE1/4	Fenced on both sides for entire length	T9N, R17W, Mile 17		
	SE1/4		T8N, R16W, 21-1/2		
	T9N, R17W, SW1/4		4	24-1/2	
	NW1/4		9		
	SE1/4		9		
	NW1/4		15		
	NE1/4		24		
	SE1/4		24		
	*Mile		16		
			17		
	T8N, R16W,		18-1/4		
			20		
			21		
			22		
			22-1/2		
			23-1/4		
			24		
	T7N, R16W		25		
			26		
Total crossings	19				
Reach 2	T7N, R16W Mile	Fenced on both sides for entire length	T7N, R16W, Mile 28	T7N, R16W, NW1/4 2	
			27-1/2	T6N, R15W, NE1/4 5	T6N, R14W, NW1/4 6
			28		T6N, R14W SW1/4 30
			28-1/2		
			29		
	T7N, R15W, SE1/4		28		

*Granite Reef Aqueduct Maps numbers 344-314-681 thru 709.

GENERAL LOCATIONS OF PROPOSED AQUEDUCT-RELATED WILDLIFE STRUCTURES

STRUCTURES

<u>Aqueduct</u>	<u>Game Crossing</u>	<u>Deer Fencing</u>	<u>Oasis</u>	<u>Water Catchment</u>
<u>Granite Reef</u>				
Reach 5		Fenced on both sides for entire length	T3N, R11W, NE1/4 25 T3N, R10W, NW1/4 26 T3N, R9W, NE1/4 26 T3N, R8W, NW1/4 31	T3N, R9W, NE1/4 13 T3N, R8W, NE1/4 19 T3N, R8W, NE1/4 18
	1 farm bridge			
	2 livestock crossings			
	Eagle Eye Road "			
	Salome Road "			
	Aguila Road "			
	T3N, R9W, on the line between sections 25 & 26			
	T3N, R8W, on the line between sections 30 & 31			
	T3N, R8W, SW1/4SE1/4 section 32			
	Total crossings			9
Reach 6		Fenced on both sides for entire length	T2N, R7W, NW1/4 6 T3N, R7W, NE1/4 32 T3N, R6W, NE1/4 19 T3N, R6W, SE1/4 13	T3N, R6W, NE1/4 12 T3N, R6W, SE1/4 10* NW1/4 12
	T2N, R8W, NE1/4 9 NW1/4 10 NW1/4 1 NE1/4 1			
	T3N, R7W, NE1/4 31 NW1/4 32 SW1/4 27 NE1/4 26 SE1/4 24			

*Replacement for an existing catchment which will be eliminated by aqueduct construction.

GENERAL LOCATIONS OF PROPOSED AQUEDUCT-RELATED WILDLIFE STRUCTURES

STRUCTURES

<u>Aqueduct</u>	<u>Game Crossing</u>	<u>Deer Fencing</u>	<u>Oasis</u>	<u>Water Catchment</u>
Reach 6 Cont.	T3N, R6W, NE1/4 19 NE1/4 20 SE1/4 16 SW1/4 15 SE1/4 15 SE1/4 14 SW1/4 13 SE1/4 13 Total crossings 17			
Reach 7	T3N, R5W, NE1/4 18 SW1/4 8 NE1/4 9 SW1/4 3 NE1/4 2 T4N, R4W, SE1/4 30 Total crossings 6	Fenced on both sides entire length		T4N, R6W, SE1/4 28
Reach 8	T4N, R4W, SE1/4 20 SE1/4 21 Center 22 NW1/4 23 T4N, R4W, SW1/4 13 T4N, R3W, NW1/4 17 NW1/4 16 SE1/4 3 Total crossings 8	Fenced on both sides to Mile 131	T4N, R4W, SE1/4 13 T4N, R3W, SW1/4 10	T4N, R4W, SW1/4 11 (if T4N, R4W, NW1/4 36 diked) T3N, R3W, NW1/4 8 NE1/4 3

GENERAL LOCATIONS OF PROPOSED AQUEDUCT-RELATED WILDLIFE STRUCTURES

STRUCTURES

<u>Aqueduct</u>	<u>Game Crossing</u>	<u>Deer Fencing</u>	<u>Oasis</u>	<u>Water Catchment</u>
<u>Granite Reef</u>				
Reach 9	Mile 138 139-1/4 T5N, R1W, NW1/4 21 SW1/4 15 NW1/4 14 Total crossings 5		Mile 141 T5N, R1W, SW1/4 14 SE1/4 13 T5N, R1E, NW1/4 15	
<u>Salt-Gila</u>				
Reach 1	All bridges indicated on Salt-Gila Aqueduct Maps (February 1968)* Total crossings 20	Beginning of Reach 1 to 1-60/70/80/89 (both sides of aqueduct)		
Reach 2	All bridges indicated on Salt-Gila Aqueduct Maps (February 1968) Total crossings 7		T1S, R8E, SW1/4 34 T1S, R8E, NE1/4 10	

*Map numbers 344-314 - 950 thru 956.

APPENDIX I

GENERAL LOCATIONS OF PROPOSED AQUEDUCT-RELATED WILDLIFE STRUCTURES

STRUCTURES

<u>Aqueduct</u>	<u>Game Crossing</u>	<u>Deer Fencing</u>	<u>Oasis</u>	<u>Water Catchment</u>
<u>Salt-Gila</u>				
Reach 3	14 bridges indicated on Salt-Gila Aqueduct Maps (February 1968)	Highway 80 to end of Reach 3 (both sides of aqueduct)	T4S, R9E, SE1/4 15	T4S, R10E, SE1/4 8 T4S, R10E, SW1/4 10
	T4S, R9E, NW1/4 9 T4S, R10E, SW1/4 18 T4S, R10E, NW1/4 17 T4S, R10E, NW1/4 16 Total crossings <u>18</u>			
Reach 4	8 bridges indicated on Salt-Gila Aqueduct Maps (February 1968)	Entire reach (both sides of aqueduct)	T4S, R10E, NW1/4 27	T5S, R9E, SE1/4 36 T6S, R9E, NE1/4 3 T6S, R9E, SE1/4 10 T6S, R9E, NW1/4 16 T6S, R9E, NW1/4 21
	T4S, R10E, SE1/4 <u>21</u> Total crossings <u>9</u>			