In Reply Refer To:
R2/ES-TE

June 29, 2001

Cons. # 2-22-01-F-431

Memorandum

To: Area Manager, Albuquerque Area Office, Bureau of Reclamation

From: Regional Director, Region 2

Subject: Programmatic Biological Opinion on the Effects of Actions Associated with the U.S. Bureau of Reclamation's, U.S. Army Corps of Engineers', and Non-Federal Entities' Discretionary Actions Related to Water Management on the Middle Rio Grande, New Mexico

This document transmits the U.S. Fish and Wildlife Service's (Service) programmatic biological opinion based on our review of the U.S. Bureau of Reclamation's (Reclamation) Discretionary Actions Related to Water Management, U.S. Army Corps of Engineers (Corps) Water Operations Rules, and Non-Federal Actions Related to Ordinary Operations on the Middle Rio Grande, New Mexico, and their effects on the endangered Rio Grande silvery minnow *(Hybognathus amarus)* (silvery minnow), the endangered southwestern willow flycatcher *(Empidonax traillii extimus)* (flycatcher), the threatened bald eagle (*Haliaeetus leucocephalus*), the experimental nonessential population of the whooping crane (*Grus americana*), and the endangered interior least tern (*Sterna antillarum*), in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.). This project period is from June 30, 2001 through December 31, 2003. Any of the proposed actions that will continue after December 31, 2003, will require additional consultation with the Service prior to that date to ensure continued ESA compliance. Your request for formal consultation was received on June 8, 2001.

The June 8, 2001, programmatic biological assessment (assessment) describes conservation measures that Reclamation proposes to avoid potential adverse impacts to the bald eagle, whooping crane, and interior least tern. With implementation of all proposed conservation measures for the bald eagle, whooping crane, and interior least tern, the Service concurs with Reclamation's determination of "may affect, is not likely to adversely affect" for these three species. If the conservation measures in the assessment for the bald eagle, whooping crane, and interior least tern are not carried out as proposed, Reclamation must contact the Service to determine if further consultation is necessary.

This programmatic biological opinion is based on information provided in the June 8, 2001,

assessment for Reclamation's, Corps', and non-Federal activities and other relevant sources of information. A complete administrative record of this consultation is on file at the New Mexico Ecological Services Field Office in Albuquerque.

Consultation History

Reclamation and the Corps, submitted a comprehensive assessment in October 1999 and supplements in April and July 2000. The Service confirmed initiation of formal consultation by letter on July 6, 2000. In a July 20, 2000, faxogram Reclamation requested that the Service not issue opinions on either the comprehensive or supplemental assessments. The Corps requested reinitiation of formal consultation on their water operations, separate from Reclamation's actions on November 16, 2000. However, the Corps did not provide a new assessment at that time. The Service responded on December 19, 2000, asking the Corps to submit an assessment of their actions alone. Reclamation submitted a new biological assessment of discretionary actions related to water management on January 6, 2001. The Service issued a draft jeopardy/adverse modification biological opinion to Reclamation on February 9, 2001 (#2-22-01-F-137). On March 5, 2001, the State of New Mexico (State) submitted a settlement proposal for the *Minnow v. McDonald* litigation. On April 13, 2001, the Corps submitted a biological assessment regarding the effects of their water operations rules (#2-22-01-I-085). Since that time, Reclamation, the Corps, the State, and the Service have been negotiating a settlement agreement that would provide a conservation pool of credit water for the next three years. Because it appeared that the settlement agreement could obviate the need to issue a final biological opinion to the Reclamation and a draft biological opinion to the Corps, the Service halted work on those two opinions to focus our efforts on the proposed settlement agreement. The Corps submitted an environmental assessment with a biological assessment on April 11, 2001, for the storage of water in the conservation pool. On April 12, 2001, the Service concurred with the determination of effects for that action (#2-22-01-I-332). The June 8, 2001, assessment outlining the effects of the combined actions of Reclamation, the Corps, and non-Federal entities constitutes a new request for consultation (#2-22-01-F-431).

BIOLOGICAL OPINION

I. Description of Proposed Action

The State and the United States of America, through the Corps and Reclamation, recently entered into a Memorandum of Understanding (MOU) providing for the storage of native Rio Grande flow in upstream reservoirs. Negotiations are currently underway between Federal parties and the State to develop a Conservation Water Agreement (CWA), which provides for the release of this water for the benefit of endangered species downstream. Federal and non-Federal actions included in this consultation are integral components of this broad water management strategy.

The MOU and proposed CWA address the storage of up to 100,000 acre-feet (af) of

Conservation Water in Jemez Canyon and Abiquiu Reservoirs over the next three years and release of that water at a rate of up to 30,000 af/year to: 1) reduce the risk that conditions in the Middle Rio Grande for the next three years will jeopardize the continued existence of the silvery minnow and flycatcher, 2) promote the recovery of listed species, 3) contribute to and support the efforts of the Middle Rio Grande ESA Collaborative Program and others to develop and implement a regional plan to address endangered species issues, 4) address and protect the interests, needs, and rights of all stakeholders, including Indian Tribes and Pueblos, and 5) recognize the hydrologic realities that exist in the Middle Rio Grande Basin. The proposed CWA allows the United States to carry over for release in a future year of the CWA any portion of the 30,000 af water that was not released in a particular year. It provides the framework within which the Federal and non-Federal actions described in this assessment will be considered. Both this document and the CWA are controlled by and should be interpreted in compliance with Article XVI of the Rio Grande Compact of 1938 (Compact), which provides: "Nothing in this Compact shall be construed as affecting the obligations of the United States . . . to the Indian tribes, or as impairing the rights of the Indian tribes."

Both the MOU and the proposed CWA refer to the storage of native Rio Grande water "that, if not stored, would otherwise have flowed downstream to Elephant Butte Reservoir and contributed to New Mexico's compact deliveries." The State asserts that it executed the MOU (and will implement the CWA) pursuant to its compact management authority, including its ability to manage and control depletions that result from non-Indian water uses under State law. Since depletions resulting from current non-Indian water uses are related to the MOU and proposed CWA, this biological opinion analyzes the effects of these depletions on the listed species.

Depletions that result from the exercise of Federal Indian water rights are not subject to State law restrictions or administered by the State. In addition, pursuant to Article XVI of the Compact, no Indian water rights may be impaired by the State's compact management activities. Indian Pueblos and Tribes within the action area did not request to have the effects of their actions analyzed in this biological opinion.

However, depletions related to existing Indian uses are included within the depletion figures compiled and provided by the State. Using the information provided for this consultation, the Service is unable to identify the depletions attributable to individual water users, Indian or non-Indian. Thus, this biological opinion analyzes the effects on the listed species from existing depletions that result from both Indian and non-Indian water uses within the action area, and extends incidental take coverage to those uses.[1]

The following section describes proposed actions to be covered in this programmatic biological opinion. The description includes both Federal and non-Federal actions. The intent is that

---

[1] The Service is aware that the Indian Pueblos and Tribes do not concede that the ESA applies to their actions.

coverage be extended to ordinary net depletions in the action area, as they have existed historically and as they will continue through December 31, 2003, so long as these actions do not affect threatened or endangered species or their habitat beyond what is considered in this opinion. Previous assessments filed by Reclamation and the Corps contained descriptions of Federal actions only. Non-Federal actions included within the framework of the Compact were assumed in those biological assessments as part of baseline conditions. The present assessment seeks consultation on future actions as described here without regard to whether they are Federal or non-Federal. Past actions, including depletions and diversions whether Federal or non-Federal, continue to be described as part of the environmental baseline. Also, the CWA, while not yet finalized, is included as a proposed action in this opinion at least in so far as it makes available additional native Rio Grande water for storage. Failure to complete the CWA will require a new consultation.

As outlined below, flows in the Rio Grande are governed in large part by the requirements and the administration of the Compact, and also by the administration of non-Indian water rights through the New Mexico State Engineer. The Compact sets depletion limits, and administration by the State enforces those limits under State law, resulting in a reliable general description of native flows. Further, the Middle Rio Grande Basin is a Declared Ground Water Basin, which means that the New Mexico State Engineer has determined that ground water usage impacts surface flows of the Rio Grande and must be offset, creating further insurance that flow descriptions will be reliable, even if particular actions and actors maintaining those flows change. Thus, with respect to river flows, particular actions that do not affect net depletions of water need not be specifically described. Generally, the actions under consultation are those that cause depletions and diversions of water from the Rio Grande, although some specific actions under consultation are also identified and described, e.g., river maintenance.

With respect to types of actions that might affect listed species or their habitat other than flows in the river, such actions are generally described for non-Federal entities, and programmatically described for Federal entities. Unless specifically stated, this consultation does not address activities which may affect habitat other than river flow as described here--building a road or clearing vegetation, for example. Indian water rights are in no way affected by any statement in this document.

Reclamation, the Corps, and non-Federal entities propose to carry out the following actions from June 30, 2001 through December 31, 2003.

1. Non-Federal Actions

Middle Rio Grande water operations must be conducted in conformance with the Compact (including Article XVI of the Compact), which is administered by the Rio Grande Compact Commission. The Commission is comprised of a Commissioner from Colorado, New Mexico, and Texas, as well as a Federal Commissioner who chairs Commission meetings. Any deviation from the terms of the Compact requires unanimous approval from the three State

Commissioners.

Under the Compact, Colorado is prohibited from accruing a debit, or under-delivery to the Colorado-New Mexico State Line, of more than 100,000 af; while New Mexico's accrued debit to Texas at Elephant Butte reservoir is limited to 200,000 af. These limits may be exceeded if caused by holdover storage in certain reservoirs; but water must be retained in the reservoirs constructed after 1929 to the extent of the accrued debit and cannot be released except upon demand of the respective downstream State Commissioner. Neither New Mexico nor Colorado can increase the amount of water in storage in reservoirs constructed after 1929 whenever there is less than 400,000 af of usable water in project storage in Elephant Butte and Caballo Reservoirs.

In order to meet delivery obligations under the Compact, non-Indian depletions within New Mexico are controlled. Allowable depletions above Otowi gage (located outside of Santa Fe, near the Pueblo of San Ildefonso) are confined to levels described in the Compact. Allowable depletions below Otowi gage and above the headwaters of Elephant Butte Reservoir are calculated based on the flows passing through the Otowi gage. New Mexico's annual allowable depletion below Otowi gage reaches a maximum of 405,000 af of the native flow of the Rio Grande at the gage plus all tributary inflows to the Rio Grande between the Otowi gage and Elephant Butte dam. In an average year, when approximately 1,100,000 af of water passes the gage, 393,000 af of the water is allowed to be depleted below Otowi gage, plus tributary inflows minus evaporation off of Elephant Butte Reservoir. The remaining 707,000 af must be delivered to Elephant Butte Reservoir. In a less than average year, New Mexico is allowed to deplete less water. In the dry year of 1977, for example, when native flow past Otowi gage was 296,500 af, allowable depletions were 127,500 af, plus tributary inflows. As stated above, Article XVI of the Compact explicitly provides that the Trust obligations of the United States to the Indian Tribes, and the rights of the Indian Tribes, are not affected or impaired by the Compact. Neither are these obligations or rights affected or impaired by this document.

General Description of Withdrawals and Depletions Under the Compact

The following description of withdrawals and depletions was initially prepared for the Middle Rio Grande Endangered Species Act Work Group, based, in part, on information from Wilson and Lucero 1997. It focused primarily on irrigation, reservoir evaporation above Elephant Butte Reservoir, and public water supply uses in counties immediately adjacent to the Rio Grande and Rio Chama during the early 1990's. The areas described include all or portions of Bernalillo, Rio Arriba, Sandoval, Santa Fe, Socorro, Taos, and Valencia counties. The description was modified to incorporate recent information from the 2000 Middle Rio Grande water budget, regarding riparian and open water depletions along the Rio Grande from Cochiti Dam to Elephant Butte Reservoir. Therefore, the following description represents approximate average withdrawal and depletion conditions for the basin; primarily, but not exclusively, along the mainstem of the Rio Grande and Rio Chama during a general wet climate period.

Withdrawals in the basin, excluding riparian and open water evaporation, averaged

approximately 950,000 af annually. Surface water accounted for about 73 percent of these basin withdrawals, while ground water accounted for 27 percent. Depletions in the basin from irrigated agriculture, public water supply, self-supplied domestics, and reservoirs above Elephant Butte Reservoir averaged approximately 400,000 af annually with surface water accounting for 65 percent of that number and ground water the remaining 35 percent.

Included within these descriptions of depletions and withdrawals are the depletions and withdrawals from the exercise of valid and existing water rights of 18 Pueblos (Acoma, Cochiti, Isleta, Jemez, Laguna, Nambé, Picuris, Pojoaque, San Felipe, San Ildefonso, San Juan, Sandia, Santa Ana, Santa Clara, Santo Domingo, Tesuque, Taos, Zia), the Navajo Nation and certain Navajo allottees, and the Jicarilla Apache Nation. Federal Indian water rights are not: (1) impaired by the Compact, (2) subject to State law restrictions, and/or (3) administered by the State of New Mexico. Nonetheless, depletions resulting from the exercise of Indian water rights are included within the general descriptions in this section, for the reasons discussed above.

Generally, Federal and non-Federal water uses are not described and analyzed in terms of depletions. The analysis in this biological opinion does not attribute depletions to particular water users. This biological opinion and the incidental take statement cover all Federal and non-Federal water uses within the action area, so long as no new net depletions occur within the action area.

Pursuant to Federal law and the prior appropriation doctrine, the Service recognizes that who depletes and the amount they deplete may vary from year to year. Consequently, the action agencies and non-Federal water users assume the risk that the future development of senior water rights, including Indian Pueblo and Tribal water rights, may result in shortages of water to junior users. Nothing in this biological opinion precludes any new depletions that result from the exercise of senior Indian water rights within the action area. Based on this understanding, the Service believes that nothing in this biological opinion affects or impairs Indian Pueblo and Tribal trust resources within the action area.

Irrigated Agriculture

Irrigated agriculture accounted for almost 700,000 af of the 950,000 af of withdrawals discussed above. Surface water accounted for 92 percent of the irrigation withdrawals in the basin while ground water accounted for the remaining 8 percent. Irrigation accounted for approximately 235,000 af of annual basin depletions. Surface water accounted for 87 percent of the irrigation depletions while ground water accounted for 13 percent.

Riparian and Open Water (excluding reservoirs)

Riparian and open water depletions along the floodplain from Cochiti Dam to the headwaters of Elephant Butte Reservoir accounted for approximately 205,000 af annually of basin depletions.

Public Water Supply and Self-Supplied Domestic

Water use by public water supply and self-supplied domestic entities accounted for approximately 190,000 af, or 20 percent of the withdrawals in the basin, excluding riparian and open water evaporation. The vast majority of these withdrawals came from ground water (about 97 percent) with surface water accounting for the remainder. These two categories accounted for just over 100,000 af annually of basin depletions with ground water again accounting for the vast majority.

Reservoirs

Evaporation from reservoirs upstream of Elephant Butte Reservoir that had a storage capacity of 5,000 af or more amounted to about 53,000 af of annual basin depletions. Evaporation from Elephant Butte Reservoir has been quite variable historically, ranging from around 50,000 af to over 250,000 af depending on Reservoir elevation. During the 1990s, the total annual evaporation from Elephant Butte Reservoir was on the order of 210,000 af annually.

Other

Water use by mining and power entities accounted for a small fraction (about 2,800 af) of the basin withdrawals and depletions. Livestock, commercial, and industrial water use accounted for about 13,800 af of the basin withdrawals, with ground water making up over 93 percent of them. These categories accounted for about 9,400 af of the basin depletions. Ground water accounted for 92 percent of the depletions with surface water making up the remainder.

The following is considered a non-exhaustive list of non-Federal entities and proposed non-Federal actions:

A. State of New Mexico

As described below, the State has a wide range of agencies that actively represent different aspects of the State's interest in water management. The State Engineer has no jurisdiction over Indian water rights.

- The New Mexico State Engineer has "general supervision of the waters of the State and of the measurement, appropriation and distribution thereof" N.M. Stat. Ann. §72-2-1 (Repl. Pamp. 1994). The Office of the State Engineer grants state water rights permits and is responsible for ensuring that applicants meet State permit requirements and otherwise enforcing the water laws of the State.

- The New Mexico Interstate Stream Commission (ISC) is authorized to develop, conserve, protect and to do any and all things necessary to protect, conserve, and develop the waters and stream systems of the State and is responsible for representing New Mexico's

interests in making interstate stream deliveries, as well as for investigating, planning, and developing the State's water supplies. The ISC has entered into annual cooperative agreements with Reclamation since 1956 to perform construction and maintenance work on the Rio Grande and its tributaries in the Middle Rio Grande. In the past, this work has included river maintenance on the Rio Chama, maintenance of the flood-control levee south of San Acacia, maintenance of the Drain Unit 7 extension and other drains built with ISC funds, drain and canal maintenance within the Bosque del Apache National Wildlife Refuge, similar work at the State refuges, and temporary pilot channels into Elephant Butte Reservoir.

- The New Mexico Department of Game and Fish administers programs, including the State's conservation of endangered species activities, that affect the State's game and fish resources; it also manages the La Joya State Game Refuge and Bernardo Waterfowl Area.

- The New Mexico Environment Department administers the State's water quality program.

B. Counties

All counties that border the Rio Grande and Rio Chama and their respective tributaries perform actions or can perform actions that may at least indirectly affect these rivers. The primary area in which county actions may influence water management is providing for general development and infrastructure of these counties, which activities may include pumping of wells or land use regulations within the immediate Middle Rio Grande watershed. Some citizens within unincorporated areas of these counties use domestic wells for their water supply.

C. Villages, Towns, and Cities

Citizens in a multitude of villages, towns, and cities use domestic wells or are served by municipal and industrial water systems. While most use groundwater exclusively, Santa Fe also uses surface water supplies and both the Cities of Albuquerque and Santa Fe are planning to use surface water directly from the San Juan-Chama Project in addition to ground water. To the extent that future groundwater pumping or use of surface water by these entities depletes the river, the New Mexico State Engineer requires that these depletions be offset, either by acquiring other water rights, or with San Juan-Chama Project water. San Juan-Chama Project water contractors (e.g., Albuquerque, the Jicarilla Apache Nation, Santa Fe, Bernalillo, Los Lunas, Taos, and Belen) call for water to be released from Heron Reservoir and delivered to the river. Many of these contractors have voluntarily entered into annual lease programs with Reclamation to enhance Middle Rio Grande valley water management.

Municipalities also manage wastewater treatment systems that discharge into the Rio Grande.

The City of Albuquerque has an ongoing agreement with Middle Rio Grande Conservancy District (MRGCD) to maintain a discharge of at least 250 cfs at the Central Bridge in Albuquerque to address water quality issues. The current agreement expires at the end of 2001.

D. Irrigation Interests

Irrigation interests include a variety of acequias, individual irrigators, and ditches, as well as the MRGCD. Many of these irrigation interests have existed for hundreds of years. The MRGCD was established under state law in 1928 to address issues such as valley drainage and flooding, and currently operates the diversion dams of the Middle Rio Grande Project to deliver irrigation water to lands in the middle valley, including areas on six Middle Rio Grande Indian Pueblos (Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta). Currently, the MRGCD operates all Middle Rio Grande Project works with the exception of El Vado Dam, which is operated by Reclamation. These works are more fully described in the section on Federal actions, below.

2. Federal Actions:

A. Reclamation water and river management activities on the Upper and Middle Rio Grande and Rio Chama

1. Closed Basin Division, San Luis Valley Project

As part of the Reclamation Project Authorization Act of 1972 (Pub. Law No. 92-514, 86 Stat. 964), Congress authorized the Secretary to construct, operate, and maintain the Closed Basin Division, San Luis Valley Project, Colorado. This project salvages groundwater from the San Luis Valley near Alamosa, Colorado, utilizes a portion of it for irrigation and other purposes, and diverts part of the salvaged water into the Rio Grande for delivery to New Mexico.

The primary purposes of the Closed Basin Division, San Luis Valley Project are: 1) to assist in the annual delivery of water to New Mexico at the gaging station on the Rio Grande near Lobatos, Colorado, 2) to maintain the Alamosa National Wildlife Refuge, 3) to offset any accumulated deficit in water deliveries by Colorado, and 4) for irrigation and other beneficial uses in Colorado. These priorities of water use are established in the authorizing legislation for the project, Public Law (PL) 92-514. Purpose 3 does not currently apply since Colorado is not in debt under the Compact. The project provided an estimated 41,000 acre feet (af) in 1997 to assist Colorado in making its annual delivery of water to New Mexico under the Compact. This water is considered native to the Rio Grande and is subject to administration and appropriation by New Mexico interests after it crosses the state line.

Reclamation has determined that the Closed Basin Division, San Luis Valley Project is extremely limited in its ability to provide water for downstream purposes during the interim scope of this assessment and does not affect any listed species.

2. San Juan-Chama Project

The San Juan-Chama (SJC) Project was authorized by Congress in 1962 through PL 87-483, which amended the Colorado River Storage Act of 1956 (PL 84-485) to allow diversion of Colorado River Basin water into the Rio Grande Basin of New Mexico. The original planning projections for the SJC Project contemplated an ultimate diversion of 235,000 af per year, with an initial phase development to accommodate an average annual diversion of up to 110,000 af. Only the initial phase was authorized (by PL 87-483) and subsequently constructed by Reclamation. The project takes water from the Navajo, Little Navajo, and Blanco Rivers, which are upper tributaries of the San Juan River, itself a tributary of the Colorado River, for use in the Rio Grande Basin, New Mexico. Primary purposes of the SJC Project are to furnish a water supply, via trans-basin diversions, to the middle Rio Grande valley for municipal, domestic, and industrial uses. The project is also authorized for incidental recreation and fish and wildlife benefits.

SJC water is committed, primarily by contract, to the following uses (contract date in parentheses):

Municipal, domestic, and industrial purposes:

City of Albuquerque (1963)	48,200 af
Jicarilla Apache Nation (1992)*	6,500 af
City and County of Santa Fe (1976)	5,605 af
County of Los Alamos (1977)**	1,200 af
City of Española (1978)	1,000 af
Town of Belen (1990)	500 af
Village of Los Lunas (1977)	400 af
Village of Taos (1981)	400 af
Town of Bernalillo (1988)	400 af
Town of Red River (1990)	60 af
Twining Water & Sanitation District (1978)	15 af

Allocated, but uncontracted, water currently identified for future Indian water rights settlements and or use:

Taos Area	2,990 af
San Juan Pueblo	2,000 af

Irrigation:

Middle Rio Grande Conservancy District (District) (1963)	20,900 af
Pojoaque Valley Irrigation District (1972)***	1,030 af

Recreation:****

Corps - Cochiti Recreation Pool (1964)	Up to 5,000 af

Total Allocation: 96,200 af

* Contract in effect mid-1999 (contract in perpetuity)
** County of Los Alamos obtained annual allocation from the Department of Energy in September 1998.
*** "Soft" number used to offset storage in Nambé Falls Reservoir. This amount has varied from 800 to 1300 af on an annual basis.
**** Cochiti Recreation Pool allocations compensate for evaporation losses to maintain a minimum pool of 1,200 surface acres at Cochiti Lake. (PL 88-293.)

None of the existing contracts expire within the next five years. Potential renegotiation of the contracts and their terms is therefore not considered within the assessment. In coordination with the ISC, the currently uncontracted 4,990 af of SJC water has been identified for 2 future water contracts: 2,000 af for the San Juan Pueblo, and 2,990 af for the Taos area. (Beginning in 1996, this available water has been used, as needed, for releases to augment the total water supply in the Middle Rio Grande valley during irrigation season as part of Reclamation's "supplemental water" program. In turn, the MRGCD bypassed native Rio Grande flow, thus enhancing fish habitat downstream from MRGCD facilities.)

The 6,500 af of Jicarilla Apache Nation water was assigned to the Nation in a 1992 settlement contract as approved by PL 102-441. Pursuant to the terms of the contract, the Nation did not have access to this SJC water until the conditions of the settlement contract were met. This condition was met in the spring of 1999 with the entering of the final partial decree and judgement in the San Juan Basin. From 1997 through 1999, the Jicarilla Nation Council passed resolutions supporting Reclamation's use of this water for conjunctive water management that would benefit the silvery minnow. Reclamation is leasing the Nation's SJC water rights for a two-year term ending on December 31, 2002, to continue providing supplemental water. Thus, beginning in 1997, the Nation's SJC water has been consumptively used through exchange with MRGCD by Reclamation with the Nation's consent.

a. Heron Dam and Reservoir

Proposed Discretionary Action: Reclamation proposes to operate Heron Reservoir exercising some discretion over releases from Heron Reservoir within the following parameters:

- Request temporary waivers from contractors to modify the date of their water delivery into the following calendar year, if such waivers will benefit the United States (i.e., for enhanced winter flows and fisheries management on the Rio Chama, to take advantage of opportunities for supplemental water storage and management, and to provide improved overall management of upstream water supplies.)

- The assessment states that Reclamation may dispose of contractor water if not called for by the contracted delivery date and where consistent with the terms of the contracts or if uncontracted water within the firm yield is available. Reclamation also may have access to the annual allotment of Heron water by leasing it from existing contractors.

b. Pojoaque Tributary Unit

Proposed Discretionary Action: Reclamation releases water from Heron Reservoir to offset storage effects at Nambé Falls Reservoir. Reclamation has some discretion over the timing of the releases under the following constraints:

- Water is released in compliance with the Rio Grande Compact and in conjunction with other SJC Project water management, including storage for the supply of water to the Pueblos of Nambé, Pojoaque, and San Ildefonso.

c. Supplemental Water Program

Proposed Discretionary Action: Secure leased water from willing SJC Project contractors and manage the associated supplemental water program under the following constraints:

- SJC Project water must be put to beneficial consumptive use within the State of New Mexico.
- Cooperation of downstream users to exchange the SJC water for native flows.

3. Middle Rio Grande Project

Originally built by the MRGCD in the 1930s, Middle Rio Grande irrigation structures are used to divert and deliver water to MRGCD customers' lands, including 21,664 acres of Indian water right lands within MRGCD's service area. The Middle Rio Grande Project was established because of inadequate flood protection, water shortages for irrigation, stream bed aggradation, siltation of ditches, rising water tables, and increased urbanization in the Middle Rio Grande valley. Reclamation was legislatively authorized to develop and implement a comprehensive plan for flood control and water conservation for the Middle Rio Grande Project under the provisions of the Flood Control Acts of 1948 (PL 80-858, June 30, 1948) and 1950 (PL 81-516, May 17, 1950). The Project was authorized by Congress to improve and stabilize the economy of the Middle Rio Grande valley by rehabilitating MRGCD facilities and by controlling sedimentation and flooding of the Rio Grande. Reclamation was authorized to rehabilitate El Vado Dam and other irrigation and drainage facilities and construct and maintain channel rectification works.

Based on the now-complete U.S. Department of the Interior Solicitor's Office analysis anticipated in the October 1999 Assessment, it is the U.S. Department of the Interior's position that Reclamation obtained title to all of the Middle Rio Grande Project works, as anticipated by a 1947 Project Plan approved by Federal legislation and a subsequent 1951 contract between Reclamation and the MRGCD. Reclamation informed the MRGCD of this position in a July 6, 2000, letter.

The MRGCD operates the Cochiti heading and Angostura, Isleta, and San Acacia Diversion Dams as "transferred works" under the 1951 contract. According to the 1951 contract between Reclamation and the MRGCD, the MRGCD acts as the United States' agent when it operates those works. Reclamation currently operates El Vado Dam and Reservoir as "reserved works" at the MRGCD's direction, where the MRGCD pays in advance for that operation and maintenance under existing agreements.

Also under the 1951 contract, Reclamation retained discretion to take back operation and maintenance of transferred works upon notice to the MRGCD. Reclamation proposes to allow the MRGCD to continue to operate and maintain the transferred works and to continue to operate the reserved works consistent with current agreements. Since it is the U.S. Department of the Interior's position that the MRGCD acts as the United States' agent at transferred works (Cochiti heading, Angostura, Isleta, San Acacia) and since Reclamation retains discretion to operate and maintain the facilities itself or to allow the MRGCD to operate and maintain the facilities, Reclamation is consulting over the broad parameters of use of the transferred and reserved works as has historically occurred and the river flows and conditions, which have resulted from these historic operations. Insofar as the purpose of this consultation is to address the depletion and other flow-related effects of all Federal and non-Federal water management and use activities in the Middle Rio Grande, the outcome of this consultation is not dependant on the ultimate resolution of the issues regarding title to Middle Rio Grande Project works.

a. El Vado Dam and Reservoir

Proposed Discretionary Action: Operate and maintain El Vado Dam and Reservoir in coordination with the MRGCD under the following constraints:

- Meet water user delivery requirements and the MRGCD call for water;
- Maintain safe storage amount no higher than 6896.20 feet by June 1 except under specific exceptions which consider flood routing criteria and water surface elevation;
- Exercise U.S. storage right to store native flows in coordination with the MRGCD, unless storing flows would jeopardize listed species.
- Exercise U.S. storage right to store SJC water in coordination with the MRGCD.
- Store water, in accordance with the 1981 contract, to ensure the delivery of water to the six Middle Rio Grande Pueblos (Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta).

b. Diversion Dams

Proposed Discretionary Action: Allow the MRGCD to continue to operate and maintain diversion dams as an agent of the U.S. and as it has done historically. Since Reclamation does not retain control over the day-to-day operations decisions by the MRGCD, it is consulting over the broad parameters of operation and maintenance of the diversion dams to ensure that operation and maintenance are within the bounds of Federal law.

c. Low Flow Conveyance Channel

Proposed Discretionary Actions:

- In response to requests by the MRGCD and Bosque del Apache National Wildlife Refuge (BDANWR), adjust gates in existing check structures to increase the head on the water in the Low Flow Conveyance Channel (LFCC);
- Maintain the LFCC temporary outfall and other potential returns to the river;
- Pump water from the LFCC to augment river discharge as deemed appropriate and necessary through the management of the supplemental water program.

Reclamation has not requested consultation at this time on the operation and/or relocation of the LFCC, because they are currently preparing an Environmental Impact Statement and feasibility study for this project.

d. Negotiated, Cooperative Actions

Proposed Discretionary Action: The assessment states that Reclamation has discretion to enter cooperative, negotiated arrangements with river stakeholders. Reclamation proposes to continue to pursue such arrangements in a way beneficial to endangered species**.**

- Temporary Storage of Water at Refuges

The Sevilleta National Wildlife Refuge, La Joya Game Refuge, and BDANWR may have limited storage capacity (not to exceed 2,000 af total) in existing ponds that would be available for off-stream temporary storage. Reclamation would coordinate with these Refuges to store excess flows, which may be available as a result of Reclamations water leases and collaborate to manage the release of this water for silvery minnow benefits. Reclamation intends to comply with all applicable Federal and State laws.

- Use of Groundwater Wells

The assessment states that Reclamation will drill new wells or lease the right to pump existing supplemental wells from willing lessors to augment Rio Grande flows during emergency situations. Reclamation intends to comply with all applicable Federal and State laws.

- Reclamation has discretion to enter cooperative, negotiated arrangements with river stakeholders. Reclamation proposes to continue to pursue such arrangements in a way beneficial to endangered species pursuant to section 7(a)(1) of the ESA.

e. River Maintenance Program

Proposed Discretionary Action: Maintenance of the river channel for the Middle Rio Grande Project from Velarde, New Mexico to Caballo Dam.

4. Velarde Community Ditch Project

Discretionary Action: The assessment states that this action is subject to separate consultation because Reclamation has no authority for this work beyond annual appropriation.

5. State of New Mexico Cooperative Program

Reclamation performs annual construction and maintenance work under contract with the State. In the past this work has included some river maintenance on the Rio Chama, maintenance of Drain Unit 7, drain and canal maintenance within the BDANWR, and similar work at the State refuges at Bernardo and La Joya and other areas. These activities are not a component of the aforementioned San Luis Valley, SJC, or Middle Rio Grande Projects.

Work is performed at the request of the State and is fully reimbursable (i.e., no Federal funds are used). The State is also responsible for completing the necessary environmental compliance.

Discretionary Action: As a subcontractor, Reclamation states they have discretion regarding in what manner the contracted tasks are completed, but has no discretion over which projects will be undertaken.

Nothing in the above description constitutes any restriction on Indian water uses.

6. Annual Operating Plan

Each year, Reclamation, in cooperation with the Corps, prepares and distributes to interested parties an Annual Operating Plan (AOP) to address water operations in the Rio Grande Basin, including operations related to the SJC and Middle Rio Grande Projects. The AOP document contains streamflow forecasts, including snowmelt runoff forecasts, anticipated operations outlooks for the various Reclamation and Corps-operated facilities along the river, and hydrographs reflecting reservoir operations, including actual (to the date of the plan's publication) and anticipated inflow, outflow, and storage. Much of the planning information in the report is developed through the coordination, cooperation, and agreement of various parties.

The agencies provide monthly updates, informing interested parties of operations throughout the course of the water year.

The AOP process typically begins in March and contains the following steps:

1. The March runoff forecast, developed by the National Weather Service (NWS) and the Natural Resource Conservation Service (NRCS), is used to develop a hydrograph of native inflow into Heron and El Vado Reservoirs, in addition to the transmountain diversion into Heron Reservoir through the Azotea Tunnel.

2. Reclamation discusses possible irrigation demands with the MRGCD for the upcoming irrigation season. Reclamation and the Corps also meet with the Bureau of Land Management for input on the Wild and Scenic portion of the Rio Chama and receive directions and/or recommendations from the City of Albuquerque, the New Mexico Interstate Stream Commission (ISC), the Service, and the New Mexico Department of Game and Fish.

2(a). Based on the above information, Reclamation tentatively schedules the remainder of deliveries of SJC water from Heron Reservoir for that year; that is, the remainder of spring and the next winter.

3. Reclamation and the Corps discuss Compact deliveries by Colorado to New Mexico with the Engineer Advisor to the Rio Grande Compact Commission for Colorado. This information, along with the release schedules from Reclamation, is used by the Corps to develop a hydrograph for the mainstem of the Rio Grande.

4. Hydrographs for Heron, El Vado, Abiquiu, Cochiti, and Jemez Canyon Reservoirs are compiled by Reclamation and the Corps. This work is done jointly, as releases from each reservoir are interconnected.

5. By the time this work is finished, the April forecast has been released by NWS/NRCS, and steps 1 - 4 are repeated. By the end of this step, the May forecast has been released, and the process is repeated once again. Spring runoff is generally underway by the middle of May, and the AOP is modified, usually on a biweekly basis, to replace forecasted with actual figures.

Deliveries of the SJC contractors' Heron Reservoir allocations reflect the replacement of forecasts with actual figures, or, if possible within the law, reflect changes in conditions or needs. Deliveries should be completed by the end of the year. Reclamation and the Corps attempt to schedule the delivery of water so as to provide secondary benefits, including environmental benefits. Possible secondary benefits of scheduling discretion include, for example, fishery flows for brown trout on the Rio Chama between El Vado and Abiquiu, generation of hydroelectric power for Los Alamos County via its powerplant located at El Vado Dam, and boating flows on

the Rio Chama. In coordination with contractors, releases of water are timed to accomplish these secondary purposes. The assessment states that the effects of these timing changes do not extend downstream to the mainstem of the Middle Rio Grande.

The AOP process is an integral component of all of the aforementioned Federal, discretionary water operations and should be considered as part of the collective Federal action.

B. Reclamation's Supplemental Water Program

Reclamation has undertaken a program to lease water and work cooperatively with MRGCD to make flows available for the river downstream of Cochiti Dam. Reclamation cannot release SJC water solely for ESA section 7(a)(1) purposes and still conform with requirements under state law definitions of beneficial uses, contract requirements, and Compact limitations on the use and availability of SJC Project water. Therefore, to ensure that the water reaches the necessary sections of the Middle Rio Grande, the cooperation of downstream users is essential. To alleviate problems related to the use of SJC project water, MRGCD uses the available supplemental water leased by Reclamation for irrigation purposes and, in return, bypasses an equal amount of native flow at downstream diversion facilities.

To meet interim water needs of the Middle Rio Grande, Reclamation negotiated a contract with the City of Albuquerque to purchase the use of up to 30,000 af of their SJC water annually for a three-year period, 1997-1999. In 2000, court-ordered mediation made additional supplemental water available to achieve the goal of maintaining a continuous flow of water from Cochiti Dam to the headwaters of Elephant Butte Reservoir. City of Albuquerque water is not expected to be available in the future. Thus, Federal action regarding supplemental water, as discussed below, will always be contingent on the availability of water from willing sellers. Reclamation will continue to seek out and negotiate with willing sellers for sources of additional water for the future, although no minimum quantity of supplemental water can be guaranteed.

The following information describes Reclamation's supplemental water program during the irrigation season. The irrigation season is divided into pre-spring runoff, spring runoff, and post-spring runoff periods. Potential supplemental water management is considered throughout the entire irrigation season.

1. Supplemental Water Program

Proposed action: Reclamation will try to obtain water from willing sellers to supplement the Middle Rio Grande's total water supply.

The assessment states that "the goal of supplemental water management is to maintain a continuous flow of water from Cochiti Dam to the headwaters of Elephant Butte." The assessment also states "that when supplies of supplemental water are nearly exhausted,

Reclamation will use the remaining supplemental water to manage a gradual river recession to baseline conditions."

a. Pre-Spring Runoff

Water managers will provide a continuous flow of water from Cochiti Dam to the headwaters of Elephant Butte Reservoir during this period.

b. Spring Runoff

Reclamation does not propose to use available supplemental water to create a manufactured increase in flow downstream of Cochiti Dam. Instead, any supplemental water will be used to maintain continuous flow in the river.

c. Post Runoff

When needed and available, supplemental water will be released from upstream storage during the post-runoff period. Considering limited upstream channel losses in the Cochiti and Albuquerque reaches, discharge of supplemental water, when available, below Isleta Diversion Dam during this period may equal that released from Cochiti Dam. However, depending on river conditions and delivery efficiencies, available supplemental water may be conveyed from Isleta Diversion Dam to San Acacia Diversion Dam using both the river and off-channel delivery facilities. Under these conditions, discharge of available supplemental water below Isleta Diversion Dam would decrease. When available, supplemental water below Isleta Diversion Dam will be managed in conjunction with return flows from irrigation wasteways to maintain continuous flows throughout this reach. As discussed above, when supplies of supplemental water are nearly exhausted, Reclamation will use the remaining supplemental water to manage a gradual river recession to baseline conditions.

Reclamation, the City of Albuquerque, and MRGCD, in conjunction with the State, will establish a team to develop a new accounting and operating procedure for calculating the loss rate for supplemental water releases between Cochiti Dam and San Acacia Diversion Dam. Until such time as otherwise agreed by Reclamation and MRGCD, a 50 percent carriage loss rate for this reach as previously agreed to by Reclamation and MRGCD will remain in effect.

The monsoon period is a dynamic time for both river flow conditions and low flow water management. If supplemental water is still available during the monsoon season, efforts should be pursued to take advantage of extended rain events (longer than 5-7 days), to reduce upstream releases and conserve supplemental water. However, as experienced in 2000, given the unpredictability and often short duration of monsoon events and the extended lag time inherent in managing water from upstream reservoirs, it is extremely difficult to realize any saving of supplemental water while attempting to maintain continuous flow from Cochiti Dam to Elephant Butte Reservoir. In the absence of available supplemental water, river flow conditions below the

Isleta and San Acacia Diversion Dams will likely oscillate between continuous and intermittent flow during an active monsoon period.

2. Water Operations Summary

The following list contains a general strategy designed to guide water operations for the benefit of the silvery minnow and flycatcher during the pre-spring runoff, runoff, and post-runoff periods. The goal of supplemental water management is to maintain a continuous flow of water from Cochiti Dam to the headwaters of Elephant Butte Reservoir when sufficient supplemental water is available.

Pre-Spring Runoff

- Provide continuous flow of water from Cochiti Dam to the headwaters of Elephant Butte Reservoir during the pre-runoff irrigation season. Water managers should watch for significant changes to the flows at Otowi, Albuquerque, and below San Acacia Diversion Dam.

Spring Runoff

- Release a portion of the available supplemental water during the tailout of spring runoff to manage the transition from high to low flow.

Post-Spring Runoff

- When feasible, all available supplemental flows should be passed through Isleta Diversion Dam to maintain surface flows throughout the entire Belen Division. During dry periods, some flow may be delivered to San Acacia Diversion Dam through MRGCD's irrigation and ISC's drainage facilities to maximize transport efficiency and the amount of water available below San Acacia.
- Available supplemental water will be conserved to the extent possible when natural flow events, e.g., summer precipitation, meet operational goals.
- Interagency coordination will occur as frequently as necessary, oftentimes daily, to identify additional environmental opportunities or operational limitations.

3. Annual Coordination Process

The assessment states that a critical component of this programmatic consultation is formalizing the current, annual water operations inter-agency coordination process. A key to the success of water operations since 1996 has been the weekly, often daily, communications that developed among Reclamation, the Corps, the Service, the MRGCD, and the State of New Mexico during the irrigation season. This process involves meetings, conference calls, and information

exchange. The following is the general inter-agency process that has been developed and that will continue to be part of the annual water operations coordination process.

Water managers will meet in February, prior to the onset of the irrigation season, to discuss water operations issues, needs, and objectives for the upcoming year. The current water operations coordination team includes representatives from Reclamation, the Corps, the Service, MRGCD, environmental groups, and the ISC. These key agencies will also form the core of the coordination process in the future. Regular conference calls are the primary means of information exchange and decision making. Meetings will be scheduled as necessary.

Coordination with MRGCD is critical during the March to April pre-runoff time frame to ensure that there is a continuous flow from Cochiti Dam to the headwaters of Elephant Butte Reservoir. Conference calls will likely occur on a weekly basis during this period. The team will meet prior to spring runoff, after the April snowmelt forecast is available, to analyze the expected runoff hydrograph and consider opportunities to benefit the silvery minnow and the regeneration of native riparian vegetation. Conference calls will likely occur on a weekly basis during the spring runoff period. A meeting will be held prior to the tailout of spring runoff, normally in June, to discuss the management of available supplemental water.

After runoff, through the end of the irrigation season, frequent coordination becomes more critical. Conference calls often occur daily. An important component of the daily conference calls is to agree on the operational adjustments necessary to meet the suite of water management objectives, such as the management of available supplemental water, based on real-time data.

Finally, a meeting will be scheduled during the middle of the post-runoff irrigation season to assess the status of summer rain activity and available supplemental water use and to develop a plan through the end of the irrigation season. The plan will maximize efficient use of available supplemental water and benefits to the silvery minnow. Planning for the potential release of carry-over storage water can also occur at this meeting.

The above discussion presents some key points in the interagency annual water operations coordination process. Additional conference calls, meetings, and exchange of information will occur as necessary.

A public information process has been jointly developed by Reclamation and the Corps that includes open forum public meetings in March and April, and the distribution of a final AOP in April. Public meetings will normally be held in Albuquerque and Las Cruces, NM, or El Paso, TX. *Rio Grande Operations* is a new newsletter that will provide helpful information to stakeholders regarding water releases, supply forecasts and schedules of future meetings. The assessment asserts that this process will be adjusted from year to year based on public feedback.

C. Reclamation's River Maintenance Program

Reclamation has authority for maintenance of the river channel for the Middle Rio Grande Project from Velarde, N.M. to Caballo Dam authorized under the Flood Control Acts of 1948 and 1950. The goals stated in Reclamation's river restoration/maintenance program for the Project are to 1) rehabilitate the ecological health of the river and floodplain system, 2) protect and improve endangered species and their habitats, 3) reduce the rate of aggradation (i.e., bed raising through sediment accumulation) in the Rio Grande in the San Marcial area and headwaters of Elephant Butte Reservoir, 4) conserve surface water in the Rio Grande Basin, 5) provide for the effective transport of water and sediment to Elephant Butte Reservoir, 6) reduce the rate of channel degradation (i.e., channel bed lowering due to reduced sediment load) from Cochiti Dam south to Escondida, N.M., and 7) protect certain riverside structures and facilities.

Reclamation's future goals and considerations for the implementation of river maintenance alternatives are the following: endangered species, fish and wildlife ecosystem, restore ecological functioning of the river channel, post dam river changes, restoration of historical native habitats, effective water and sediment transport, Rio Grande bosque preservation initiative, Protection of certain riverside facilities, Clean Water Act sections 401 and 404, halt channel degradation and incision, State Water Quality Standards, allow fluvial process to occur to the maximum extent possible, National Environmental Policy Act (NEPA), re-establish floodplain/hydrology connectivity, Pueblo/Tribal Water Quality Standards, and remove high flow capacity constraints.

The assessment states that the primary objectives of evaluating Reclamation's river restoration/maintenance program through this assessment are to: 1) analyze the positive benefits of river restoration on Federally listed species, 2) analyze the impacts of river restoration/maintenance actions on Federally listed species, 3) determine actions to improve the ecological function at all project sites, 4) develop sideboards for the types of river restoration/maintenance activities to be considered and the level of effects expected, and 5) streamline the consultation process for individual projects.

The coordination phase of the planning and project design process is a critical component of all river restoration/maintenance projects. The same level of coordination with the Service from past individual river restoration/maintenance project consultations will be incorporated in all future projects considered under this assessment. It is through this interaction that the restoration of native aquatic and riparian habitat is accomplished and any net adverse impacts to the Middle Rio Grande ecosystem are avoided. All river restoration/maintenance projects are envisioned to provide a net positive effect on the ecosystem.

The assessment lists the general types of activities that would be used within a specific reach of the Middle Rio Grande. The Coordination Process subsection of the Description of Proposed Federal Action section outlines information and reports that will be developed as a part of the aforementioned coordination process. An environmental compliance document will summarize

activities associated with a project and document that the project falls within the sideboards established in the programmatic consultation. Some activities that are defined and analyzed in the assessment with sufficient detail may not require future consultation. Projects that include significant actions not considered in this assessment or potentially significant adverse impacts to Federally listed species will be consulted on separately.

1. Bioengineering and Habitat Enhancement Techniques

The assessment maintains that bioengineering and habitat enhancement techniques will be utilized to address river maintenance and rehabilitation objectives to restore ecological function and integrity of the riverine ecosystem. The following activities utilize the fluvial processes of the Rio Grande, native vegetation, and ecological perspectives to address river system concerns. Combinations of these activities will most likely be employed in maintenance and rehabilitation designs.

Terrace and Overbank Lowering (Re-establish floodplain hydrologic connectivity) - This type of activity would allow for the expansion of the active floodplain and to provide low terraces along the river's banks for the establishment of habitat. The newly created terraces would be placed in areas where the channel is relatively incised and the potential for overbank flows is minimal. The lowered terraces would be inundated at higher discharges providing refuge for aquatic organisms, restoration of native riparian vegetation, and re-establishment of a river channel/floodplain hydrologic interaction.

Channel Widening/Bank Destabilization - Widening the main river channel via vegetation clearing and bank terracing to initiate native species regeneration. Probable components of bank destabilization include, jetty jack removal, clearing vegetation via rootplowing and bank lowering along the bankline.

Woody Debris Snags and Boulder Placements - Woody debris snags and boulders would be placed at locations within the river channel or along river banks to provide aquatic habitat in itself or in association with other techniques. These techniques can provide instream habitats, planform stability, and promote river bar/island formation via sediment deposition. Woody debris snags and boulders could be placed individually or in groupings. Boulder placement would most likely occur in the upstream river channel reaches, e.g., Velarde and Española.

High Flow Side Channels - Provide backwater and slower velocity areas for aquatic and terrestrial species and increase the potential for overbank flooding and native species regeneration. The activity would most likely involve pilot channel excavation, inner channel terracing, and bank material removal or de-stabilization.

Removal of Lateral Confinements - In areas where the river channel is constricted, the removal and/or relocation of confining terraces, levee, low flow channel, and jetties could be performed for floodplain expansion. If relocation of either a levee or low flow channel is

pursued, landowner permission would be necessary. Under the Middle Rio Grande project congressional authorization, Reclamation does not have authority to purchase or condemn lands.

Vegetation Planting and Natural Re-generation - Restoration of native riparian habitat mosaic, including salt grass, shrub, and bosque communities via planting or through re-establishing hydrologic connectivity. Potential methods include planting individual pole and willow whips, willow bundles/mats, or other planting methods. Vegetative plantings may also be incorporated in re-establishing floodplain terraces.

Gradient Restoration Facilities (GRFs) - Gradient restoration facilities are low head grade control structures with fish passage aprons. These structures are utilized to halt channel degradation, reduce upstream velocities, trap finer sediments, and increase water surface elevations. Diverse velocities and flow depths will be created over the fish passage apron. Downstream sediment transport is not permanently reduced as sediment is only trapped by the GRF until an upstream equilibrium channel slope is attained. The amount of sediment deposited upstream of the GRFs is only a small percentage of the annual sediment load. Fish passage aprons will be designed with the most current silvery minnow criteria available. Currently, the apron design mimics natural riffles in the Rio Grande. As additional silvery minnow data are quantified and fish passage apron monitoring efforts evaluated, more efficient designs will be developed.

Increasing the Sand Load to Channel Reach - In reaches where the channel is degrading and the river is becoming gravel bedded, sand can be mechanically introduced into the river. This activity will assist in raising the river bed, changing gravel substrate to sand, increase channel width, and decrease the average depth. The activity may involve either moving river terrace sediment deposits with land based equipment or possibly hauling sediment materials from upland areas for placement in the river channel. Reclamation does not have the authority to address the issues of passing more sediment through Cochiti or Jemez Canyon Dam.

Oxbow Re-establishment - Re-establishing a flow source to an oxbow to serve as a wetlands for wildlife habitat and vegetation enhancement. These areas will be designed to provide backwater and side channel habitat adjacent to, and connected to the river channel for silvery minnow habitat and restoration of native riparian vegetation.

Deformable Bankline(s) - A deformable bankline consists of a stone toe that is sized to be mobile at the five-year return interval flood event, and native vegetation plantings. The stone toe is required to temporarily stabilize the bank to allow planted vegetation to become established. The rock utilized in the toe will be wrapped in biodegradable fabric to ensure stability during the first three to five years. After the fabric degrades and the toe becomes mobile by subsequent events, the vegetation/soil interaction and natural fluvial processes will control the bank shape. Deformable banklines can also be comprised of fabric encapsulated soils as opposed to stone toes, dependant on location in the floodplain and stability criteria. Deformable banklines will most often be established on barren banks, when riverside facilities will not be threatened by a

migrating bend or on newly created banks through activities such as channel re-alignment and terrace lowering.

Non-Native Vegetation Clearing and Floodplain Expansion - Mechanical clearing of non-native species vegetation adjacent to the river channel to promote native species regeneration within the floodplain and also expanding the floodplain. This includes creating paths for river waters to inundate the cleared area during peak spring runoff flows. These areas will be designed to provide backwater and side channel habitat adjacent to, and connected to the river channel for silvery minnow habitat and restoration of native riparian vegetation.

Rock Weirs - Varying types of rock weir structures (Vortex and "W" rock weirs and cross vanes) would be utilized for bed control and raising the river bed/water surface elevation. These structures are intended to alleviate excessive bank erosion, create grade stabilization, and create instream cover and diversity of velocity and depth across the width of the river channel. Both structures allow for fish passage and may trap finer sediments upstream of the structures. The apex of Vortex rock weirs is pointing upstream, while the apexes of "W" rock weirs are pointing both upstream and downstream.

Channel Avulsions - Realignment of the river channel along a new route to promote new habitat development involving vegetation clearing, partial blocking of the old river channel, and pilot channel excavation. The old river channel will develop into a backwater area, providing refuge for aquatic species. Additionally, as sediments are deposited in the old channel, a low floodplain will evolve, allowing new age classes of native vegetation to establish.

Channel Realignment/Pilot Channel Work - Relocation of the river channel away from an existing riverside facility that is threatened by erosion and/or to bring the channel to an equilibrium slope and planform. Channel realignment may incorporate deformable banks to establish the new channel pattern and allow for natural fluvial process to shape the banks.

Culvert and Low Water Crossings - Installation of culverts and low water crossings within the berm and levee systems to provide water to disconnected areas of the floodplain for habitat improvement.

River Bar/Island Enhancement - River bars can be enhanced from a habitat standpoint by various combinations of non-native species vegetation clearing, plantings, lowering, pilot channel work, and creation of high flow side channels. This activity can also be used in conjunction with other techniques to expand the active floodplain, dissipate stream energy, and reduce sheer stress along vulnerable bankline.

Jetty/Snag Removal - Removal of jetty jacks from areas where their function is no longer necessary as a means to establish new banklines or where the jetties have been moved into the main river channel where they may pose a hazard as a result of erosional processes. The removal of jetties alone may not increase channel width or improve silvery minnow habitat due to the

current degradational trend experienced between Cochiti Dam and Escondida. In this reach the jetty fields are no longer the dominant factor leading to the reduction of available habitat and channelized nature of the system. The river system in this reach is experiencing a trend of decreasing channel width, increasing depths, increasing velocities, and increasing meandering due to a lack of sediment. Snags (vehicles, trash, etc.) may be removed from the river in rare occasions to prevent them posing a serious public hazard.

2. River Training Works

River engineering techniques analyzed in the assessment include a variety of methods for influencing flow alignment, bank stabilization, and controlling and managing overbank flow. The assessment states that every effort will be made to use the previously described river restoration techniques to maximum extent possible before considering these techniques. River engineering activities will be incorporated only in cases when river restoration alone is not adequate for the protection of critical riverside facilities and the protection of in-stream structures. All projects that include river engineering works would include river restoration components to provide a net positive effect on the ecosystem. River engineering works will require periodic maintenance.

Rock Vanes - These weir structures are intended to act as in-stream cover, deflect flows away from eroding bankline, and break up the secondary circulation cells, which add to the stress in the near bank region.

Toe Revetment Plantings - These structures utilize a combination rock or riprap material and willow planting to protect an eroding bank. The rock or riprap material is placed at the toe of the bank while the plantings are placed along the top of the bank or on terraces along the bank.

Native Material Bank Stabilization-rock and/or Log Spurs - These structures are intended to provide bank stabilization and create in-stream cover through various alternatives of root wad and boulder placement, J-Hook and Rootwad Vanes, cross vanes, log revetments, and vegetation planting.

Groins/Bendway Weirs - Groins and Bendway Weirs are embankments or dikes projecting from the bank into the channel to regulate river flow alignments. Both may be perpendicular to the bank or angled either up or down stream in an “L” or “T” shape. These can be used in combination with bar reconstruction to move the channel away from a trouble spot along a safer alignment. Groins and Bendway Weirs could be used in all reaches except the Velarde Reach where the river is generally too narrow for them to be practical. These are essentially the same structure as rock vanes but have larger top widths to enable heavy equipment to place the rock.

Training Dikes - Training dikes are constructed more or less parallel to the channel to guide the flow. Most future training dikes would be built in conjunction with revetment works or

channel re-alignment/pilot channel projects and would most likely be used in the Middle Reach and below where the river banks are low.

Freeboard Dikes - Freeboard dikes are built to contain high flows with an adequate factor of safety to protect other works or facilities. Freeboard dikes are most often required in areas where there are no levees, or development or farmland is at the river's edge.

Pilot Channels/Pilot Cuts - Pilot channels are excavated to establish new river courses. Pilot channels may require stabilization with revetments or other works. Pilot channels will most likely be needed in areas where channel alignments are least defined and sediment plug formation is a problem. Pilot cuts encourage the river to move the sediment and reform the channel and allow for minimal disturbance as opposed to channel dredging. The construction of temporary channels to the Elephant Butte Reservoir pool is a pilot channel activity.

Revetments - A revetment is a facing placed on a riverbank to resist and prevent further erosion. Many types of materials and systems are available for revetting banks. Economic and feasibility of construction considerations, aquatic and riparian habitat, and aesthetic factors governs the choice of a particular revetment system. All types of bank stabilization works require periodic maintenance. Rock riprap has generally been used in all reaches to revet banks. The use of native material revetment is currently being explored.

Windrows - Windrows are used alone or in conjunction with revetments to limit future bank erosion. Riprap is piled in a windrow on top of the bank along a desired alignment. When the bank erodes back to the windrow, the rock is undermined and drops down the bank controlling erosion. After the rock begins to drop down the bank, additional rock is required to redress and shape the bank. Windrows could be used in all reaches to stabilize bank erosion.

Permeable Jetties - Steel or wood Kellner jacks (jetty jacks) have been previously used to stabilize the Rio Grande. The effectiveness of permeable Jetties depends on an adequate supply of sediment being transported by the river, and on site specific hydraulic conditions. Currently no jetty jack installations are planned for the Middle Rio Grande Project, however this item is included because of the remote possibility of future installations.

Curve Shaping - The realignment of river banks may be necessary in all reaches. Curve alignments are determined by right-of-way considerations and hydraulic parameters. This activity could be a component of previously mentioned river training works techniques or be used alone.

Stabilized Soil, Manufactured Revetment Units, and Cellular Confinement Systems - The chemical treatment of soils makes them less susceptible to erosion. The most common soil treatment is soil cement. Soil and cement are mixed and compacted to make an erosion-resistant material. Soil cement cannot be constructed underwater. This technique would only be used in unusual circumstances. Several types of manufactured units are available for revetment

construction. These units are typically made of concrete and are designed to be laid on the bank in interlocking patterns. The high cost of these systems would limit their use to very special cases. Plastic grid systems designed to limit movement of soils can be used to prevent erosion. These systems use a honeycomb cell sheet anchored to the bank to contain fill material. These systems may be practical in conditions where erosion potential is small.

3. Sediment Removal

Removal of sediment from the river channel by mechanical means may be necessary to maintain flow capacity. Disposal of spoil material is an important consideration when planning these operations.

Arroyo Plug Grading and Removal - Sediment deposited in the river channel at the mouths of tributary arroyos sometimes must be removed by excavation. In many arroyos the sediment deposits are sand size material, are readily washed away during high flows, and provide a sediment supply for the river. Below Cochiti Dam additional sediment supply is badly needed, and arroyo sediments provide some sediment enrichment. Very large arroyo plugs can diminish channel capacity or deflect flows excessively into riverside facilities, only in these instances would Reclamation undertake arroyo plug removal or grading. Most arroyo deposits would remain untouched. Because of regulation by dams, mainstem flow is often inadequate to remove arroyo plugs containing large gravel or cobble sized materials that might otherwise be removed naturally. Arroyo plugs are usually excavated or graded by dozers or scrapers. Spoil material may be destabilized or relocated within the river channel to be naturally redistributed by the river to provide a sediment source to enrich the sediment load.

Dredging/Sediment Settling Basins - Dredging includes all underwater excavation of bottom material. Dredging may be done by machines scooping the bottom material up in buckets (bucket dredging) or by pumping a solid/water mixture and discharging through pipes (hydraulic dredging). Hydraulic dredging often requires the construction of settling ponds where the discharged solids are separated from the water. Construction of settling ponds usually requires building up embankments or dikes to contain the dredged material and overflow structures to carry away the water. Size of settling ponds depends on quantity of material to be discharged and the type and size of the solids to be settled out. In open water areas, silt curtains may be used to diminish or limit turbidity effects caused by dredging. Dredging would be used to construct or maintain channels in areas where sediment is depositing. Reclamation only has plans for bucket dredging in areas where active flows are routed around job sites with a coffer dam, and local fish siening is performed.

4. Vegetation Management

Vegetation management has a variety of components and objectives: 1) restoring native tree species, 2) removal of non-native species, 3) reduction of net depletions (i.e., evapotranspiration), and 4) maintaining floodway capacity.

Historically, vegetation management activity was concentrated in the Middle Reach (Bernalillo - Highway 44 to Isleta Diversion Dam) and the upper portions of the Belen Reach where river bars were mown annually to prevent growth of woody vegetation. Under the current mowing program, Reclamation does not wish to eliminate mowing, but postpone this activity to further evaluate its effectiveness in meeting Reclamation's river restoration/maintenance goals. Until further analysis and studies are performed, the mowing of native riparian vegetation on river bars is temporarily postponed. This program is currently being re-evaluated based on current geomorphic, hydrologic, and environmental conditions. Vegetation management will also likely be necessary as the Elephant Butte Reservoir pool recedes, and salt cedar grows on the exposed delta.

Transect Brushing - Vegetation may be trimmed to create a clear line of sight along a transect as part of Reclamation's data collection program for river channel monitoring. Impacts to any desirable vegetation present would be minimized to the extent possible. All brushing locations would be reviewed by Reclamation biologists for potential impacts prior to any brushing activity. Brushing activities located near flycatcher habitat will not occur during the breeding season (April 15 through August 15). Transect clearing or maintenance will not occur in occupied flycatcher habitat. Transect endpoints are set as close to the river bank as possible to avoid overbank areas and also moved upstream and downstream in the field to avoid impacts to riparian areas.

To accomplish successful river restoration, river maintenance, and reach-wide hydrologic/morphologic/sediment transport studies, data collection of current river channel and floodplain conditions is necessary. Studies, projects, and models (e.g., Upper Rio Grande Water Operations Model, GSTARS, HEC-6T, FLO-2D models, the Albuquerque Overbank Project, and the Santa Ana Project) all require data collection. The collection of hydrographic data from transects provides for better management of the Middle Rio Grande floodplain and river channel which directly benefits endangered species and ecological function of the entire system. All river data collection efforts involve non-destructive means of gathering data for the purposes of studies, research, and monitoring activities. These data provide Reclamation with the necessary information to assess the river channel's geomorphic condition (i.e., width, depth, slope, and substrate).

Reclamation needs river transect data to determine river channel shape and size for all design information and analysis under its river restoration/maintenance program required to meet Clean Water Act and ESA requirements. Transect data are necessary to quantify project requirements, determine quantities for permitting, assess site changes from a project, and evaluate the efficacy of all restoration projects (Monitoring).

Mowing - Vegetation may be cut with mowers. Mowing controls development of woody and perennial species, while minimizing disturbance to grasses and forbs.

Rootplowing - A rootplow is a large blade that is pulled through the ground beneath the surface by a tractor to destroy underground rootstocks. Rootplowing would ordinarily be used to eliminate non-native woody species such as salt cedar and Russian olive trees. Vegetative debris could be piled and left within the cleared area, stacked and burned within the cleared area, or removed to an offsite location.

Clearing of Understory Vegetation - This activity would involve the removal of deadfall and/or non-native species vegetation beneath a native species vegetation canopy. This activity would offset any net depletions in the riverine corridor created by river restoration projects. Offsetting these net depletions is required by the ISC.

5. Levee Maintenance

Reclamation regularly maintains the levee system below Socorro. In other areas, Reclamation may perform levee maintenance on an intermittent, occasional, or emergency basis at the request of MRGCD. Levee failure caused by bank erosion at less than flood flows is also a Reclamation responsibility. Levee maintenance includes raising levee heights, reinforcing by widening levee bases, filling and repairing washouts, stabilization with revetments or groins, drainage improvements, grading, shaping, and road graveling. Under the current levee maintenance program, impacts to endangered species and their habitat are avoided.

Below Cochiti Dam the relocation of the levees, irrigation canals, and riverside drains may occur in selected locations. This option would increase the available floodplain width, and will be explored at each site. Efforts will be made to enlist the cooperation of willing landowners. Reclamation has approached several landowners in the past for permission to relocate the levee. Since most land owners generally are using the land immediately outside of the levee and riverside canals and drains, none of the landowners agreed. In addition under the Middle Rio Grande Project Congressional authorization, Reclamation does not have authority to condemn and/or purchase land. Therefore, without landowner approval Reclamation cannot pursue the levee relocation alternative. Reclamation is considering moving the levee, river channel and LFCC south of the San Marcial Railroad Bridge where Reclamation owns the land. This is part of a longer term study currently underway to evaluate operational and structural modifications to the river and LFCC system. Separate ESA and NEPA compliance will be developed for this projected work.

6. Access and Construction Requirements

Haul Roads and Operating Areas - Access construction may require clearing, placement of fill, grading, installation of culvert pipes, and graveling.

Stockpiles - Sites for stockpiling material may require clearing, grading, and fencing. Material may be stockpiled for a particular construction project or may be stored for unspecified maintenance. Stockpiles may be in place temporarily or permanently.

Cofferdams/Inflatable Water Bladders - Cofferdams or inflatable water bladders are sometimes needed to divert water temporarily during construction operations.

Borrow Areas for Fill Material - Fill material for bank shaping or embankment construction may be imported from borrow areas off site or excavated from adjacent bars or islands.

Spoil Areas - Excess material excavated or dredged from the river channel is disposed in designated spoil areas.

Storage Yards - Temporary storage of equipment, material and supplies is often needed at a location convenient to a job site. Storage areas may require clearing, grading, graveling, drainage, and fencing.

7. Reasonable Alternative Techniques

Traditional river maintenance techniques performed by Reclamation have evolved over time since the 1950s. Legislation such as NEPA, Clean Water Act, ESA, and river system needs have necessitated the exploration of new river maintenance techniques that go beyond the original goal of effective water and sediment transport. Promising new technology for restoration, bio-engineering, bank stabilization, and river engineering would be evaluated for effectiveness, cost, and environmental effects as the need arises. New methods found to be practical and appropriate may be used in future river management projects. These methods will be defined over time as they are developed.

8. Net Depletions

The New Mexico State Engineer requires that any increase in non-Indian net depletions of water be offset in the Middle Rio Grande Project area. Restoration activities such as increasing the channel width could potentially increase the amount of evaporation and seepage losses from the main river channel in a project reach. Due to the variability in channel morphology and bosque composition of the Middle Rio Grande valley, a reach specific water budget analysis will be performed for future restoration projects to assess the potential for increasing net depletions.

Six structural types of plant communities have been described in the riparian zone (Crawford et. al, 1993). These include mostly mature overstory trees with and without a shrubby understory; intermediate-aged trees with and without understory; dense low vegetation; and sparse, low vegetation types. Due to past river management practices, the bosque in many areas is comprised of predominantly similar age class and type of plant community. In order to have a healthy bosque ecosystem having more variability of bosque plant communities types is essential.

Given these considerations and the prevalence of non-native species vegetation in the bosque, Reclamation believes any net depletions created by a restoration project can be offset while

simultaneously improving the ecological health of the bosque such as has been done at the Bosque Del Apache National Wildlife refuge. This can be accomplished through a detailed vegetation management plan and a water budget analysis for any restoration project(s).

9. Reach-Specific Analysis

The following section describes and lists the specific river restoration/maintenance activities that could occur within a given reach. Refer to the previous section for a general description of each activity. All of the activities described for each reach in the following sections are the most likely to be pursued, but every technique previously identified may be used in each reach. Each reach has different river restoration/maintenance activities identified due various anthropogenic, hydrologic, and geomorphic conditions and influences.

Velarde, New Mexico, to Rio Chama Confluence - (Velarde Reach)

The Velarde Reach is currently maintained for the safe and effective passage of flow discharges up to 5,000 cfs. Restoration opportunities include; preserving and creating native riparian habitat, especially potential flycatcher habitat, expanding the active floodplain, and creating wetlands.

The control of bank erosion is the most prevalent ongoing maintenance requirement. Because the riparian and floodplain lands are largely privately-owned, developed, and farmed; opportunities for restoration are limited. Given these factors, even relatively minor bank erosion causes concern among private landowners. The San Juan Pueblo subreach has the greatest potential for restoration activities due to the riparian zone still existing between the river channel and agricultural fields. The most likely maintenance activities would be the following:

- Rock Weirs
- Deformable Bankline
- Vegetation Planting and Natural Regeneration
- Non-native Vegetation Clearing and Floodplain Expansion
- Terrace Lowering (Re-establish Floodplain Hydrologic Connectivity)
- River Bar/Island Enhancement
- Oxbow Re-establishment
- Jetty/Snag Removal
- Woody Debris Snags and Boulder Placement
- Rock Vanes
- Toe Revetment Planting
- Native Material Bank Stabilization - Rock and/or Log Spurs.
- Freeboard dikes
- Revetments and Windrows
- Curve Shaping
- Arroyo Plug Grading and Removal
- Transect Brushing
- Vegetation planting and natural re-generation

The preferred methodology for the control of bank erosion includes bioengineering techniques and floodplain interaction. On a limited basis due to lack of flood control regulation, freeboard

dikes may be necessary to protect property. Islands and bars may also be used as a convenient source of borrow material in conjunction with restoring the river's connectivity with the floodplain, and enhancing aquatic and terrestrial habitat. In critical situations where native material or bioengineering techniques are not suitable, river engineering activities such as revetments and windrows may be utilized.

Rio Chama Confluence to Otowi - (Española Reach)

The channel capacity in the Española Reach increases to 7,850 cfs. Restoration opportunities include; removing non-native vegetation and encouraging native revegetation, enhancing aquatic habitat in reaches impacted by gravel mining, restoring oxbows, and creating wetlands.

Groins and rootwad/boulder placement have been used at some sites to protect eroding river banks. Oxbow re-establishment has been performed in this reach through culvert installation, and small pilot channel and pond excavation. Sediment deposits on the downstream side of the groins have created small side channels. The groins and rootwads/boulders also create areas where snags lodge, and areas of slow and fast water that enhance fish habitat. The most likely river restoration/maintenance activities would be the following:

- Rock Weirs
- Deformable Bankline
- Vegetation Planting and Natural Re-generation
- Non-native Vegetation Clearing and Floodplain Expansion
- Channel Realignment/Pilot Channel
- Terrace Lowering (Re-establish Floodplain Hydrologic Connectivity)
- River Bar/Island Enhancement
- Oxbow Re-establishment
- Jetty/Snag Removal
- Channel Widening/Bank Destabilization
- Channel Avulsions
- Woody Debris Snags and Boulder Placement
- Rock Vanes
- Toe Revetment Planting
- Native Material Bank Stabilization -Rock and/or Log spurs Groins/Bendway Weirs
- Freeboard dikes
- Revetments and Windrows
- Curve Shaping
- Arroyo Plug Grading and Removal
- Transect Brushing

Because the river widens considerably below the Rio Chama confluence, bioengineering techniques may be used to influence the river's future alignment while controlling excessive and damaging bank erosion. Islands and bars may also be used as a convenient source of borrow material in conjunction with restoring the river's connectivity with the floodplain, and enhancing aquatic and terrestrial habitat. In critical situations where native material or bioengineering techniques are not suitable, river engineering activities such as revetments and windrows maybe utilized.

Cochiti Dam to Highway 44 Bridge, Bernalillo - (Cochiti Reach)

Maximum releases from Cochiti are expected to be in the 7,000-10,000 cfs range. Currently, releases are much lower because of flow capacity constraints. In the Cochiti Reach, the clear water releases from Cochiti dam have caused channel degradation (i.e., river bed lowering through sediment removal). As a direct result of the degradation, mean channel velocities, depths and meandering tendencies have increased and the width decreased. The river bed material has coarsened from a sand to a gravel substrate. There is also a disconnection between the river channel and its floodplain due to the bed lowering. Restoration opportunities include; raising the river bed and lowering terraces to reconnect it with the abandoned floodplain, removing non-native vegetation and encouraging native revegetation, encouraging localized sedimentation, and creating side channels, oxbows, and wetlands. The most likely river restoration/maintenance activities would be the following:

- Woody Debris Snags and Boulder Placement
- High Flow Side Channels
- Increase Sand Load to Reach
- Terrace Lowering (Re-establish Floodplain Hydrologic Connectivity
- Grade Restoration Facilities
- Rock Weirs
- Deformable Banklines
- Vegetation Planting and Natural Regeneration
- Non-native Vegetation Clearing and Floodplain Expansion
- Channel Realignment and/or pilot Channels
- River Bar/Island Enhancement
- Oxbow Re-establishment
- Jetty/Snag Removal
- Levee Maintenance
- Clearing of Understory Vegetation
- Channel Avulsions
- Removal of Lateral Confinements
- Restoration of Native Riparian Mosaic
- Channel Widening/Bank Destabilization
- Rock Vanes
- Toe Revetment Planting
- Native Material Bank Stabilization -Rock and/or Log spurs
- Groins/Bendway Weirs
- Training Dikes
- Revetments and Windrows
- Curve Shaping
- Arroyo Plug Grading and Removal
- Transect Brushing
- Mowing and Root Plowing

If the magnitude of peak flow releases out of Cochiti are increased during the spring runoff season, the river channel will have a tendency to migrate laterally because of the armoring of the river channel downstream of the dam. Problems associated with bank erosion could be particularly severe in this reach because the dam has diminished the sediment supply.
In many arroyos, the sediment deposits are sand-sized materials. These deposits are readily washed away during high flows and provide a sediment supply for the river. Below Cochiti

dam, additional sediment supply is badly needed; arroyo sediments provide some sediment enrichment. Very large arroyo plugs can diminish channel capacity or excessively deflect flows into riverside facilities, only in these instances would Reclamation undertake arroyo plug removal or grading. Most arroyo deposits would remain untouched. Islands and bars may be cleared of vegetation, reshaped, or destabilized to promote native species regeneration or increase the channel's width as part of restoring the river's connectivity with the floodplain, and enhancing aquatic and terrestrial habitat. In critical situations where native material or bioengineering techniques are not suitable, river engineering activities such as revetments and windrows maybe utilized. Reclamation would perform levee maintenance in the Cochiti Reach on an intermittent basis at the request of MRGCD.

Highway 44 Bridge, Bernalillo to Isleta Diversion Dam - (Middle Reach)

A 600-foot wide floodway created by Kellner jetties exists throughout most of the Middle Reach. Restoration opportunities include; restoring areas disturbed by fire, enhancing aquatic habitat and riparian vegetation potential on alternate river bars, destabilizing river banks to encourage channel widening, removing of non-native vegetation and encouraging native revegetation, and creating low terraces and wetlands. The river is narrowing to an average width of less than 600 feet because of reduced sediment supplies and lower peak flows. The river is now a partially gravel bed channel. There is also a disconnection between the river channel and its floodplain due to the bed lowering.

The northern part of the Middle Reach is more likely to experience bed lowering at a more pronounced rate as a result of Cochiti Dam, halting degradation and localized storage of sandy material through gradient restoration facilities may be required. The most likely river restoration/maintenance activities would be the following:

- Woody Debris Snags and Boulder Placement
- High Flow Side Channels
- Increase Sand Load to Reach
- Terrace Lowering (Re-establish Floodplain Hydraulic Connectivity)
- Grade Restoration Facilities
- Rock Weirs
- Deformable Banklines
- Vegetation Planting and Natural Regeneration
- Non-native Vegetation Clearing and Floodplain Expansion
- Channel Realignment/Pilot Channels
- River Bar/Island Enhancement
- Channel Avulsions
- Removal of Lateral Confinements
- Restoration of Native Riparian Mosaic
- Channel Widening/Bank Destabilization
- Rock Vanes
- Toe Revetment Planting
- Native Material Bank Stabilization-Rock and/or Log spurs
- Groins/Bendway Weirs
- Training Dikes
- Revetments and Windrows
- Curve Shaping

- Oxbow Re-establishment
- Jetty/Snag Removal
- Mowing and/or Rootplowing
- Clearing of Understory Vegetation
- Arroyo Plug Grading and Removal
- Transect Brushing
- Levee Maintenance

The degradation trend throughout this reach may result in increased future bank erosion. In critical bank erosion situations where native material or bioengineering techniques are not suitable, river engineering activities may be utilized.

Islands and bars may cleared of vegetation, reshaped, or destabilized to promote native species regeneration or increase the channel's width as part of restoring the river's connectivity with the floodplain, and enhancing aquatic and terrestrial habitat. Reclamation would perform levee maintenance in the Middle Reach on an intermittent basis at the request of MRGCD.

Isleta Diversion Dam to Rio Puerco Confluence - (Belen Reach)

Conditions and river restoration/maintenance needs in the Belen Reach are very similar to the Middle Reach. Restoration opportunities are also the same as for the Middle Reach. The most likely river restoration/maintenance activities would be the following:

- Woody Debris Snags and Boulder Placement
- High Flow Side Channels
- Increase Sand Load to Reach
- Terrace Lowering (Re-establish Floodplain Hydraulic Connectivity)
- Grade Restoration Facilities
- Rock Weirs
- Deformable Banklines
- Vegetation Planting and Natural Regeneration
- Non-native Vegetation Clearing and Floodplain Expansion
- Channel Avulsions and Channel Realignment
- River Bar/Island Enhancement
- Oxbow Re-establishment
- Jetty/Snag Removal
- Channel Widening/Bank Destabilization
- Clearing of Understory Vegetation
- Removal of Lateral Confinements
- Restoration of Native Riparian Mosaic
- Toe Revetment Planting
- Native Material Bank Stabilization-Rock and/or Log spurs
- Groins/Bendway Weirs
- Training Dikes
- Pilot Channels
- Revetments and Windrows
- Curve Shaping
- Arroyo Plug Grading and Removal
- Transect Brushing
- Mowing and/or Rootplowing
- Levee Maintenance
- Rock Vanes

River banks in the Belen Reach have been stabilized by extensive jetty jack fields. However, the degradation trend throughout this reach may result in increased future bank erosion. In a degrading channel environment, it is unlikely that extensive new jetty jack fields would be installed. Islands and bars may cleared of vegetation, reshaped, or destabilized to promote native species regeneration or increase the channel's width as part of restoring the river's connectivity with the floodplain, and enhancing aquatic and terrestrial habitat. In critical situations where native material or bioengineering techniques are not suitable, river engineering activities such as revetments and windrows maybe utilized. Reclamation would perform levee maintenance in the Belen Reach on an intermittent basis at the request of MRGCD.

Rio Puerco Confluence to San Acacia Diversion Dam - (Rio Puerco Reach)

The river channel and floodplain through the Rio Puerco Reach is generally wide and braided with extensive infestation of non-native species vegetation. The river is also now partially a gravel bed channel. Restoration opportunities include; restoring areas disturbed by fire, destabilizing river banks or terrace lowering to encourage channel widening, random woody debris pile placement to promote bar formation and micro aquatic habitats, enhancing aquatic habitat and riparian vegetation potential on alternate river bars, removing of non-native vegetation and encouraging native revegetation, and creating low terraces, high flow side channels, and wetlands.

The most likely restoration/maintenance activities would be the following:

- Woody Debris Snags and Boulder Placement
- High Flow Side Channels
- Increase Sand Load to Reach
- Terrace Lowering (Re-establish Floodplain Hydraulic Connectivity)
- Rock Weirs
- Deformable Bankline
- Vegetation Planting and Natural Regeneration
- Non-native Vegetation Clearing and Floodplain Expansion
- Channel Avulsions and Channel Realignment
- River Bar/Island Enhancement
- Oxbow Re-establishment
- Jetty/Snag Removal
- Channel Widening/Bank Destabilization
- Removal of Lateral Confinements
- Restoration of Native Riparian Mosaic
- Channel Widening/Bank Destabilization
- Grade Restoration Facilities
- Toe Revetment Planting
- Native Material Bank Stabilization-Rock and/or Log spurs
- Groins/Bendway Weirs
- Training Dikes
- Pilot Channels
- Revetments and Windrows
- Curve Shaping
- Arroyo Plug Grading and Removal
- Transect Brushing

- Rock Vanes
- Levee Maintenance
- Mowing and Rootplowing
- Clearing of Understory Vegetation

Some levee maintenance may be necessary below the confluence of the Rio Puerco because of changing geomorphic conditions and the location of various critical riverside facilities for both the State of New Mexico and MRGCD.

San Acacia Diversion Dam to River Mile 78 (middle of BDANWR) - (Socorro Reach)

The majority of silvery minnows are found in this reach of the river. Preservation and enhancement of existing aquatic habitat is a priority in this reach. Degradation and continued narrowing of the river channel will reduce available aquatic habitat. Restoration opportunities are similar to those presented for the Rio Puerco Reach.

Channel degradation is occurring below San Acacia Diversion Dam through the Escondida/Socorro area due to changing upstream geomorphic factors, which have diminished the sediment supply. The river channel is in a condition of instability characterized by vertical incision and lateral erosion. The river is now partially a gravel bed channel and will be entirely gravel bedded in approximately 3-5 years. There is also a disconnection between the river channel and its floodplain due to the bed lowering. The channel's planform is changing below San Acacia through Socorro from a wide braided condition to a single thread sinuous narrow channel. This has led to bank erosion, which has threatened the levee in areas downstream of San Acacia. A levee system exists on the west side of the floodplain to control flooding. River restoration/maintenance methods will be used that will enhance aquatic and terrestrial habitat, while meeting other river maintenance goals. The most likely river restoration/maintenance activities would be the following:

- Woody Debris Snags and Boulder Placement
- High Flow Side Channels
- Increase Sand Load to Reach
- Terrace Lowering (Re-establish Floodplain Hydraulic Connectivity)
- Grade Restoration Facilities
- Rock Weirs
- Deformable Banklines
- Vegetation Planting and Natural Regeneration
- Clearing of Understory Vegetation
- Non-native Vegetation Clearing and Floodplain Expansion
- Removal of Lateral Confinements
- Restoration of Native Riparian Mosaic
- Channel Widening/Bank Destabilization
- Toe Revetment Planting
- Native Material Bank Stabilization-Rock and/or Log spurs
- Groins/Bendway Weirs
- Training Dikes
- Pilot Channels/Pilot Cuts
- Revetments and Windrows
- Curve Shaping

- Channel Avulsions and Channel Realignment
- River Bar/Island Enhancement
- Oxbow Re-establishment
- Jetty/Snag Removal
- Rock Vanes
- Arroyo Plug Grading and Removal
- Transect Brushing
- Mowing and/or Rootplowing
- Levee Maintenance

Activities associated with levee maintenance would be anticipated below San Acacia Diversion Dam because of changing geomorphic conditions and deterioration of the levee. Islands and bars may be cleared of vegetation, reshaped, or destabilized to promote native species regeneration or increase the channel's width as part of restoring the river's ecological function and enhancing aquatic and terrestrial habitat. In critical situations where native material or bioengineering techniques are not suitable, river engineering activities such as revetments and windrows may be utilized.

River Mile 78 (middle of BDANWR) to Headwaters of Elephant Butte Reservoir - (San Marcial Reach)

The river channel throughout this reach is aggrading due to influences of Elephant Butte Reservoir pool, and a constricted floodplain established by the levee system. Due to its aggradational nature the river channel (lying between the eastern mesa and the levee) in this reach is characterized as a perched channel being elevated above the western portions of the valley floor.

There are several known flycatcher nesting sites within this reach. Additional riparian habitat has been developed by relocating the river channel into Elephant Butte Reservoir and providing a water source to overbank areas during spring runoff. Development of additional habitat is a priority in this reach. Restoration opportunities include; removing non-native vegetation and encouraging native revegetation, increasing the main channel width, creating channel avulsions, and high flow channels for overbank flows to inundate cleared areas, creating side channel and backwater refugia areas, and creating wetlands.

Managing the location of sediment deposition in the delta of Elephant Butte Reservoir through temporary channels, culvert and low water crossings, channel avulsions, non-native vegetation clearing, and floodplain expansion in addition to maintaining the channel flow capacity will be the most common river restoration/maintenance practices. Specifically, the most likely river restoration/maintenance alternatives would be the following:

- Woody Debris Snags and Boulder Placement
- High Flow Side Channels
- Increase Sand Load to Reach
- Removal of Lateral Confinements
- Restoration of Native Riparian Mosaic
- Channel Widening/Bank Destabilization

- Deformable Bankline
- Vegetation Planting and Natural Regeneration
- Clearing of Understory Vegetation
- Non-native Vegetation Clearing and Floodplain Expansion
- Channel Avulsions and Channel Realignment
- Culvert and Low Water Crossing
- River Bar/Island Enhancement
- Oxbow Re-establishment
- Jetty/Snag Removal
- Channel Widening/Bank Destabilization
- Random/Bank Boulder and Snag Placements
- Rock Vanes
- Rock Weirs
- Native Material Bank Stabilization-Rock and/or Log spurs
- Groins/Bendway Weirs
- Training Dikes
- Pilot Channels/Pilot Cuts
- Revetments and Windrows
- Permeable Jetties
- Curve Shaping
- Transect Brushing
- Mowing and Rootplowing
- Levee Maintenance
- Dredging/Sediment Settling Basins
- Toe Revetment Planting

Levee maintenance, e.g., raising, widening, and repairing, is necessary to maintain a 8,500 cfs capacity with 2 feet of freeboard and to maintain the levee's integrity by preventing seeps, slope, and foundation failure. Maintenance of a river channel to the Elephant Butte Reservoir pool will involve channel excavation and temporary berm construction. Pilot cut excavation, sediment plug removal, and riverside berm maintenance may be necessary to maintain channel flow capability up to 8,500 cfs and efficiently move sediment. Re-establishment of an outfall from the LFCC to the river is dependent on reservoir and river conditions. Native material, bioengineering, and other bank protection works may be utilized to protect the LFCC and existing levees. Excavation of sediment detention ponds in the reservoir delta may occur to capture and better distribute some of the in flowing sediment during period of extreme high reservoir pool contents.

Levee maintenance on the levee at its current location is anticipated to continue another 5 to 8 years. During this time Reclamation may propose to move the river and the low flow channel to the west side of the valley below San Marcial. This future action is contingent upon completion of an Environmental Impact Statement, congressional appropriations, and consultation with the Service. All activities associated with moving the river and low flow realignment will require separate ESA and NEPA compliance.

10. River Maintenance Schedule

The following table describes estimated proposed river maintenance projects by river reach.

River Reach	Project Name	Key Issues
1)Velarde, New Mexico to Rio Chama Confluence (Velarde Reach)	Lyden Ditch Bank Repairs	uncontrolled river flows into an irrigation system
2) Rio Chama Confluence to Otowi (Española Reach)	Espanola Dikes Cross Drainage	provide drainage for agricultural lands
	Phil Blood Pipe	provide drainage for wetlands (wetland maintenance)
	San Ildelfonso Phase 1	river bank erosion threatening tribal lake, river needs restoration from gravel mining
	Santa Cruz	river threatening bridge abutment, levee, sewer lift station
	Santa Clara Side Channel and Willows	river restoration/habitat enhancement
	Vigil Ditch Area Phase 7	river threatening irrigation facilities and river restoration from gravel mining
3) Cochiti Dam to Bernalillo-Highway 44 (Cochiti Reach)	Santa Ana Phases 2 and 3 (consultation complete)	channel degradation and levee threatened via erosion
	San Felipe Phase 3	experimental bio-engineering for bank stability/habitat
	Cochiti Pueblo Phase 1, 2, 3	channel degradation and levee threatened via river bank erosion
	Santo Domingo Phase 4	channel degradation and levee threatened via erosion
4) Bernalillo-Highway 44 to Isleta Diversion Dam (Middle Reach)	Albuquerque Overbank Phase 2, 3	river restoration, floodplain expansion , native vegetation regeneration, clearing of understory vegetation
	Albuquerque Area Channel Widening Phase 1,2,3	river restoration, widen narrow areas for minnow habitat, clearing of understory vegetation.

	Highway 44 to Corrales Reach	river restoration, floodplain expansion , native vegetation regeneration, clearing of understory vegetation.
	Albuquerque Area	river restoration, floodplain expansion , native vegetation regeneration, clearing of understory vegetation.
5) Isleta Diversion Dam to Rio Puerco Confluence (Belen Reach)	Isleta Reach	river restoration, floodplain expansion, native vegetation regeneration, clearing of understory vegetation.
6) Rio Puerco Confluence to San Acacia Diversion Dam (Rio Puerco Reach)	Rio Puerco Reach	river restoration, floodplain expansion, native vegetation regeneration, clearing of understory vegetation
	La Joya Overbank Project Phase 2	river restoration, floodplain expansion , native vegetation regeneration
7) San Acacia Diversion Dam to River Mile 78 (Socorro Reach)	San Acacia to Escondida Reach	river restoration, floodplain expansion, native vegetation regeneration, clearing of understory vegetation
	Socorro Division Channel Widening	river restoration, floodplain expansion , native vegetation regeneration, clearing of understory vegetation
8) River Mile 78 to Headwaters of Elephant Butte Reservoir (San Marcial Reach)	Tiffany Mitigation & Channel Widening	river restoration, floodplain expansion , native vegetation regeneration
	Tiffany Mitigation	river restoration, floodplain expansion , native vegetation regeneration
	San Marcial Channel Avulsion	river restoration, floodplain expansion , native vegetation regeneration
	BDANWR - San Marcial Levee	channel aggradation/sediment deposition(channel capacity)
	BDANWR Overbank Project Ph. 2	river restoration, floodplain expansion , native vegetation regeneration
	San Marcial Berm Phases 2 & 3	channel aggradation/sediment deposition(channel capacity)

	Temporary Channel into Elephant Butte	channel aggradation/sediment deposition(channel capacity)
9. Elephant Butte Dam to Headwaters of Caballo Reservoir (Hot Springs Reach)	Sediment Excavation	annual removal of arroyo sediment deposits
	Bank Stabilization	localized bank instability
	Temporary Stage Control Dike	low river stage reduces flow to hot springs

The following is an estimate of the total number of proposed and unforeseen river maintenance projects over the next three-year period, by reach, including long-term, annual, and emergency work. Consideration was given to the number of projects constructed in recent years, current workload limitations, and the evolution of the river maintenance program.

Reach Name	Number of Projects
Velarde	6
Española	6
Cochiti	12
Middle	4
Belen	2
Rio Puerco	2
Socorro	8
San Marcial	14
Hot Springs	3
Total	**57**

11. Coordination Process for River Maintenance Activities

The timely coordination of river maintenance activities with the Service and other resource management agencies is essential to insure efficient project completion. While all river maintenance projects include intensive effort by Reclamation staff and numerous internal meetings, there are main points of coordination with the Service that are critical for effective ESA consultation. These include early project scoping, alternative development, and project design and description.

The assessment states that long term projects will allow for advanced planning and more time for hydrologic, geomorphic, and biological surveys. The general scheduling steps outlined in Table 3 also apply to long term projects but the time frame is often extended over several years. The same meetings and project reports would be developed for long term projects. Project scoping, analysis, and description and ESA compliance report guidelines follow. These report guidelines not only present the general content of each report but also a systematic approach to riverine problem solving. Again, this is only a general outline and should be customized to fit each project. It should be emphasized that informal consultation with the Service will begin early and occur as often as needed for specific projects.

Scoping Report - In general this report introduces the goals and objectives of the project, summarizes the historic, current and future geomorphology of the reach, and addresses environmental concerns.

Alternative Analysis Report - In general this paper summarizes the project and reach geomorphology, analyzes the alternatives and evaluates their feasibility, and defines the preferred alternative.

Project Description (Draft and Final) - In general this report summarizes the previous two reports and details the preferred alternative design.

ESA Compliance Report - In general, this report will: 1) reference information from the above reports, 2) document the ESA coordination process followed for a specific project, and 3) confirm compliance with conditions/sideboards developed through this programmatic consultation. It is anticipated that the majority of river maintenance projects will fit within the sideboards developed in this document. ESA compliance for a specific project should then consist of early and often informal consultation with an approximate 1 month period prior to construction to present the ESA compliance document and gain Service concurrence.
Two additional reports are prepared after completion of the river maintenance project.

Construction Report - Summary of construction procedures and inspection reports

Project Evaluation Report (s) - In general this/these post-construction reports evaluate the project effectiveness and impacts on upstream/downstream geomorphology.

- short term geomorphic response
- long term geomorphic response

The scheduling process for emergency projects is necessarily truncated but still must contain the same critical points of coordination with the Service, project scoping, alternative development, and project design. The development of ESA compliance documentation will take place during and after completion of the project. Reclamation would, as standard procedure, follow-up with

adequate analysis once the immediate threat has become manageable. At this point, it would be determined if additional long term planning needs to occur at the site.

The aforementioned coordination guidelines have been established for developing successful projects. These guidelines are not all-inclusive or meant to be project management "recipes." They are intended to provide a framework around which meetings and reports can be developed, ultimately leading to a sound engineering design and ESA compliance.

D. Monitoring

Biological studies will include regular fish population monitoring at about 16 sites below Cochiti Dam and flycatcher presence/absence surveys and nest monitoring. Reclamation and the Service will cooperatively monitor discharge at critical river locations to ensure that management goals are being achieved. Based in part on the results of these and other monitoring efforts, Reclamation will use adaptive management principles to adjust future actions within the sideboards set forth in this document to maximize benefits to all resources.

Should isolated pools be found that sustain significant numbers of silvery minnow, Reclamation will cooperate with the Service in rescue operations to relocate any stranded fish. Relocation of silvery minnow may also occur during periods of continuous flow if there is a need to augment upstream or captive populations.

Reclamation, the Corps, and the Service will closely monitor low flow or river drying events as they occur. Reclamation and/or the Corps will notify the Service of potential low flow conditions with sufficient lead time to ensure an adequate response time for rescue efforts. The Service has the lead for calling and coordinating a rescue event. Other Federal and non-Federal parties will provide assistance with rescue efforts upon request of the Service. The primary method for coordinating with the Service during these critical periods will be the daily conference call.

If the Service is not represented on the call that day, or if a low flow condition is detected after that day's conference call, Reclamation or the Corps will immediately notify the Service's New Mexico Ecological Services Field Office Supervisor, Endangered Species Branch Chief, or the person temporarily acting in either of those roles. During typical week day business hours, Reclamation will call 505-346-2525. During non-working hours, evenings, and weekends, Reclamation will call the 24-hour cellular phone line. The Service representative will then notify the Service's silvery minnow rescue coordinator, who will notify the rescue crew. The primary points of contact in Reclamation and the Corps for early notification of low flow conditions is Jaci Gould, Water Resources Division Manager, 505-248-5381 and Dick Kreiner, Water Operations Branch, 505-342-3383, respectively.

This monitoring plan considers the following divisions of the Middle Rio Grande:

Division Name	Description
Velarde	Velarde, New Mexico to Rio Chama Confluence
Cochiti	Cochiti Dam to the Angostura Diversion Dam
Albuquerque	Angostura Diversion Dam to Isleta Diversion Dam
Belen	Isleta Diversion Dam to San Acacia Diversion Dam
Socorro	San Acacia Diversion Dam to Elephant Butte Reservoir headwaters

Rio Grande Silvery Minnow Monitoring

Long-term population monitoring is conducted bi-monthly, usually occurring in February, April, June, August, October, and December at 16 locations between Angostura Diversion Dam and the headwaters of Elephant Butte Reservoir (see below). Prior to 1999 population monitoring was conducted quarterly.

Albuquerque Division

1. Angostura Diversion Dam, Angostura. River Mile 209.70
2. NM State Highway 44 Bridge Crossing, Bernalillo. River Mile 203.80
3. About 4 miles downstream of NM State Highway 44 Bridge Crossing at Rio Rancho Wastewater Treatment plant, Rio Rancho. River Mile 200.00
4. Central Avenue (U.S. Highway 66) Bridge Crossing, Albuquerque. River Mile 183.40
5. Rio Bravo (NM State Highway 500) Bridge Crossing, Albuquerque. River Mile 178.30
6. I-25 Bridge Crossing, Albuquerque. River Mile 172.60

Belen Division (Sampling at the two sites on the Isleta Pueblo has been suspended due to access issues)

1. Los Lunas Bridge. River Mile 161.4 (new site)
2. About 1.0 mile upstream of NM State Highway 309/6 Bridge Crossing, Belen. River Mile 151.50
3. Transwestern Pipeline crossing at Jarales. River Mile 143.2 (new site)
4. U.S. Highway 60 Bridge Crossing, Bernardo. River Mile 130.60
5. About 3.5 miles downstream of Bernardo. River Mile 127.0 (new site)

Socorro Division

1. Directly below San Acacia Diversion Dam, San Acacia. River Mile 116.2
2. About 1.5 miles downstream of San Acacia diversion Dam, San Acacia. River Mile 114.60
3. East of Socorro, 0.5 miles upstream of Socorro-LFCC Bridge, east and just upstream of Socorro Wastewater Treatment Plant, Socorro. River Mile 99.50
4. About 4.0 miles upstream of U.S. Highway 380 Bridge Crossing. River Mile 91.70

5. U.S. Highway 380 Bridge Crossing, San Antonio. River Mile 87.10
6. Directly east of Bosque del Apache National Wildlife Refuge Headquarters. River Mile 79.10
7. San Marcial Railroad Bridge Crossing, San Marcial. River Mile 68.60
8. Confluence of LFCC, 16 miles downstream of the southern end of Bosque del Apache National Wildlife Refuge. River Mile 60.50
9. About 10 miles downstream of San Marcial. River Mile 58.8 (new site)
10. About 11 miles downstream of San Marcial. River Mile 57.7 (new site)

During 2000, bi-weekly fish monitoring was initiated at 13 sites in the Socorro Division (the above 8 sites plus locations at the end of the LFCC levee road, Ft. Craig, Tiffany, the north boundary of the Bosque del Apache National Wildlife Refuge, and Escondida). Daily qualitative monitoring of flow and habitat conditions on the Rio Grande between Isleta Diversion Dam and the headwaters of Elephant Butte Reservoir was also conducted. Related information is available on a Rio Grande Monitoring web site at http://www.uc.usbr.gov/progact/rg/rgm/index.html. These efforts can be continued in subsequent years as needed based on water management and river conditions.

In 2000, another cooperative monitoring program was initiated and supported by the Corps for the Albuquerque and Belen reaches to obtain critical data on the distribution and abundance of wild and repatriated silvery minnow. Monthly sampling was conducted in four sections of the Albuquerque Reach and at 10-15 points in the Belen Reach. Qualitative habitat characteristics were also obtained at all sampling locations and included habitat type, mean depth, substrate type, temperature, and velocity.

Pre- and post construction fish monitoring will continue at constructed and proposed river maintenance sites throughout the Velarde, Cochiti, Albuquerque, Belen, and Socorro divisions. Sites are monitored twice yearly, summer and winter, with a raft electroshocker. Efforts are focused on habitat types most impacted by river maintenance work, e.g., eroding banklines and sloping river bar shorelines. Eroding bank habitat is generally characterized by deep, high velocity conditions which are not intensively sampled during the long-term population monitoring efforts.

Reclamation initiated a three year study of silvery minnow spawning and egg transport in 1998. The first year of study focused on the timing, magnitude and duration of silvery minnow spawning within the Albuquerque, Belen and Socorro divisions. Previous studies have only identified that silvery minnow spawn during high flows associated with spring runoff. The second year of study addressed the question of how far eggs and larvae drift after spawning occurs. This is a critical research need on the Rio Grande due to variable downstream habitat conditions, flow management, and the presence of irrigation Diversion Dams that act as barriers to upstream fish migration.

<u>Southwestern Willow Flycatcher</u>

Future project sites with occupied or suitable habitat shall be surveyed for at least 1 breeding season prior to the start of any project activities. If flycatchers are detected, Reclamation will monitor the sites for at least 1 year after project completion. Exceptions will be explored in consultation with the Service in extraordinary circumstances. It is Reclamation's intent to use the principles of adaptive management and monitor project sites sufficiently to accumulate the necessary data and information for future decision-making.

Brown-headed cowbird research, monitoring, and trapping is addressed in a separate consultation as is a related winter riparian grazing utilization study.

Bosque

In addition to the potential for qualitative monitoring of river flow and habitat, as described above, Reclamation's Socorro Field Division, will conduct regular daily visual inspections of the upper Socorro Division during dry/high peak demand periods to provide information and/or early alerts if conditions appear to be trending toward intermittency or dewatering.

Reclamation funded a study conducted by the New Mexico Natural Heritage Program during 1996 to monitor transects at several river bars and measure vegetation composition, abundance, and structure (Muldavin et al. 1997). Reclamation expects to expand this study during the interim period with vegetation monitoring on additional river bars. Information from this study will help determine how Reclamation's historical and potential future floodway mowing program affects vegetation composition and structure on river bars in the Albuquerque and Belen divisions.

E. Additional Environmental Commitments

Reclamation is committed to applying the concepts of adaptive management to all of the proposed Federal actions described in this assessment. The general framework for adaptive management follows the scientific perspective of managing in the face of uncertainty. The underlying premises of adaptive resource management are:

- There is uncertainty in the systems we manage,
- Management is necessary despite existing uncertainty,
- Monitoring is required to evaluate decision making, and
- Learning is important to the extent that it helps managers achieve their objectives.

This approach is especially relevant to the issues facing water managers on the Middle Rio Grande. Reclamation will continue to develop meaningful management goals with involvement of all stakeholders in the Middle Rio Grande and implement and monitor actions related to those goals. Finally, based partly on the results of monitoring and research, Reclamation will use adaptive management principles to adjust future actions within the sideboards set forth in this document to maximize benefits to all resources.

Many modifications were made to the proposed Federal actions to further address the needs of threatened and endangered species and benefit riparian and aquatic habitats. The majority of these commitments are discussed and included in the Description of Proposed Federal Actions and Analysis of Effects sections above. The following are environmental commitments gathered from the aforementioned sections with some additional commitments added in response to informal consultation with the Service.

Southwestern Willow Flycatcher

- Avoid construction disturbance as defined on a case-by-case basis near occupied and known flycatcher territories from April 15 through August 15. Based on current research and data, a pre-determined distance is not applicable in all cases.

- Future project sites with occupied or suitable habitat shall be surveyed for at least one breeding seasons prior to the start of any project activities. If flycatchers are detected, monitoring will occur for at least one year after project completion. Exceptions will be explored in consultation with the Service in extraordinary circumstances. It is Reclamation's intent to use the principles of adaptive management and monitor project sites sufficiently to accumulate the necessary data and information for future decision-making.

- Reclamation will minimize the number of new transects that are cleared in conjunction with river surveying activities. As stated in the Description of Proposed Federal Actions section, the collection and use of hydrographic data from transects provides for better management of the Middle Rio Grande floodplain and river channel. Transect clearing or maintenance will not occur in occupied habitat. Out-of-use transects will be allowed to revegetate. Brushing will occur only when necessary for project purposes. In the event that transect brushing is necessary, the breeding period (April 15 through August 15) shall be avoided to minimize this habitat disturbance. Suitable habitat can also be avoided in certain cases by only surveying to river's edge and not clearing on banks containing suitable habitat. All sites proposed for transect clearing will be reviewed by Reclamation biologists. If the site is determined as not containing suitable flycatcher habitat, transect clearing will proceed under the above conditions.

- Reclamation will carry out its actions to encourage seasonal overbank flooding and associated low velocity aquatic habitats in or near suitable flycatcher habitat within the bounds of the expected natural hydrograph. By restoring the active river channel through sediment plug management in the San Marcial Reach, Reclamation's river maintenance program helps to prevent prolonged, detrimental inundation of riparian and flycatcher habitat.

- Brown-headed cowbird research, monitoring, and trapping along with grazing issues associated with Elephant Butte Reservoir are currently being addressed in a separate

consultation. The section 7 ESA consultation process for the Elephant Butte and Caballo Reservoirs Resource Management Plan has been completed and contains specific conservation recommendations for the defined resource management area.

Rio Grande Silvery Minnow

- Reclamation will continue to conduct fish population monitoring at established locations in the Middle Rio Grande between Angostura Diversion Dam and the headwaters of Elephant Butte Reservoir. Pre- and post-construction fish monitoring will continue at constructed and proposed river maintenance sites through the Middle Rio Grande.

- If it is necessary to redirect flows away from a construction site, steps will be taken to allow flows to recede from the area gradually so silvery minnow can avoid entrapment. Any disconnected aquatic habitat, e.g., isolated pools, associated with a river maintenance site will be sampled for silvery minnow which, if found, will be relocated into adjacent areas of flowing water.

- Construction activities requiring the movement of equipment within the river channel will avoid potential silvery minnow habitat to the extent possible. Work will be done in the dry when feasible to minimize direct impacts to silvery minnow. While many of the proposed habitat enhancement activities involve extensive construction activity in or near the river channel (to avoid disturbance to native riparian vegetation, for example), unnecessary disturbance to the aquatic environment will be avoided.

- Reclamation will work with the MRGCD to: 1) facilitate fish passage at the three main Diversion Dams to allow upstream movement of the silvery minnow, 2) investigate the effects of fish, eggs and larvae passage over the structures, and 3) alleviate the entrainment of silvery minnow into the irrigation system. Reclamation is currently conducting a planning study that focuses on some of these issues at San Acacia Diversion Dam.

General Environmental Commitments

- Reclamation will pursue habitat restoration along the Middle Rio Grande, in coordination with other parties, that includes the restoration of the river channel to create and enhance aquatic habitat for the silvery minnow and native riparian habitat for the flycatcher and bald eagle. The principles of adaptive resource management will be incorporated into habitat restoration. Reclamation, as a component of the river maintenance program, will perform two river restoration projects annually. Consultation with the Service on the preferred alternative for each site will tier to this programmatic consultation.

- Habitat restoration will occur when bioengineering cannot be used in river maintenance projects. Habitat restoration will occur within the reach (of the activity) or the adjoining reach or tributaries within those reaches, in consultation with the Service.

- Reclamation will pursue habitat enhancement activities including gradient restoration facilities, non-native vegetation clearing and floodplain expansion, willow/cottonwood plantings, channel realignment/avulsions, channel widening and bank destabilization, river bar and island enhancement, jetty/snag removal, culvert/low water crossings, reestablishment of floodplain hydraulic connectivity, floodplain expansion, and other related activities to promote the number of sites with backwaters, oxbows, a wider river channel, and lower banks to produce shallow water habitats, overbank flooding and regenerating stands of willow and cottonwoods. These environmental restoration actions can be a component of a site specific river maintenance project or incorporated in upstream or downstream areas.

- Restoration and bioengineering projects will be maintained for the life of the project in consultation with the Service. Adaptive management and monitoring should be used to evaluate the success of these projects, the need for continued maintenance, and recommend adjustments, if needed.

- Increase the number and distribution of overbank flooding sites and sites with shallow, low velocity water conditions to enhance silvery minnow habitat, assist in regeneration of native vegetation, and provide for flooding in suitable habitat for the willow flycatcher during the breeding season. Monitoring will be conducted to quantify the extent of overbank flooding.

- Proposed actions associated with Reclamation's river maintenance program, including river restoration and river engineering techniques will strive to increase channel capacity and the potential number of sites with overbank flooding. As stated in the biological assessment, a fundamental goal of Reclamation's river maintenance program is to address system constraints so that a more natural hydrograph can be experienced throughout the Middle Rio Grande below Cochiti Dam during periods of peak runoff flow. Reclamation's actions that could influence peak flows and overbank flooding are those activities associated with the river maintenance program.

- A priority of Reclamation's river maintenance program is to strive to identify and alleviate potential constraints that prohibit the passage of seasonal high flows in the active floodplain. Federal agencies have no direct authority to control development in the flood plain, however, Reclamation will continue to work with other entities to address this issue. River maintenance activities that alleviate or eliminate discharge bottlenecks and facilitate higher peak releases from Cochiti Dam are beneficial to the endangered species and the bosque. Also, Reclamation's river maintenance actions will

also lead to increased channel capacity and should not allow local river conditions to degrade to the point that reservoir releases are further reduced.

- Eliminate mowing of native riparian vegetation unless it contributes to habitat restoration or is required for safe conveyance of flood flows. Vegetation mowing activities associated with the LFCC has been addressed in a separate consultation as mentioned in the Description of Proposed Federal Actions and Environmental Baseline sections.

- Construction activities will avoid, to the maximum extent possible, mature cottonwoods and cottonwood snags. In areas where impacts to mature cottonwoods cannot be avoided, Reclamation will replace the trees at a 10:1 ratio.

- Reclamation and the Corps will continue to work with the MRGCD to improve gaging and real-time monitoring of water operations.

- Reclamation will coordinate with the Service with the goal of minimizing destruction or reduction of potential or suitable flycatcher habitat when installing pumps or groundwater wells, or pumping from the LFCC or groundwater. Reclamation will coordinate or consult, as appropriate, with the Service if there is the potential for adverse impacts from these activities on potential or suitable flycatcher habitat.

F. Corps Proposed Discretionary Actions

The water-operating rules that the Corps has some limited discretion in implementing can be classified into five main categories: 1) flood control; 2) release of "carry-over" flood water; 3) delivery of Cochiti recreation pool replacement water; 4) Cochiti fish screen placement; and 5) Abiquiu tunnel inspection.

a. Flood Control

The Corps has a limited amount of discretionary authority as it relates to flood control operations. Flood control criteria are established at each reservoir project by the maximum channel capacity for flood control operations. However, if the Corps determines that the current channel conditions cannot safely convey the entire maximum flow rate that is approved in the Water Control Manual, then releases can be less than the defined channel capacity. An example of this is illustrated with the current conditions of the Rio Grande at the San Marcial Railroad Bridge. The present (June 1999) channel conditions at the Bridge will only allow about 5,000 cfs to be released from Cochiti, yet the operating criteria allow a maximum of 7,000 cfs as measured at the Albuquerque gage.

The Corps, Reclamation, and the New Mexico Interstate Stream Commission are involved in a process (Upper Rio Grande Water Operations Review - URGWOPS) to reevaluate Rio Grande

systems operations down to Fort Quitman, Texas. An Environmental Impact Statement (EIS) will be prepared for this process. The results of the EIS and associated ESA, section 7, consultation could be the basis for a change in the Water Control Manual for Cochiti Dam and Lake.

i. Spring Runoff

The Corps is responsible for regulating flood waters on the Middle Rio Grande. Consistent with the authorized purposes of Corps projects, dam releases will be equal to the rate of inflow, up to the maximum safe flow and not beyond the determined channel capacity. If inflows exceed downstream channel capacity, flood storage is initiated until the water can be safely evacuated. Rio Grande flood control projects of the Corps are operated in accordance with the Flood Control Act of 1960 (PL 86-645). Public Law 86-645 provides very specific operating criteria that limit the reservoirs to minimal regulation of carry-over flood waters. The stipulation for carry-over storage authorizes storage of native Rio Grande water in these reservoirs. The rate at which each reservoir is evacuated prior to spring snowmelt runoff is restricted to the downstream channel capacity, as determined by the Corps.

Flood control storage during spring runoff will be initiated at Cochiti and Jemez Canyon dams when inflows or intervening flows downstream exceed the downstream channel capacity. The existing channel capacity at Albuquerque is 7,000 cfs. However, existing river channel conditions in the San Marcial area, or other system bottlenecks, may limit the ability to make releases to the designated channel capacity (see the System Constraints subsection).

As stated, the Corps normally will pass inflow, as it occurs, until channel capacity is reached. However, if snowmelt runoff increases abruptly, releases will be staged up at 500 cfs increments while downstream channel conditions are monitored. These staged increases are normally not necessary below a total combined release from Cochiti and Jemez Canyon reservoirs of 4,000 cfs. Two known areas of concern during the ramping up of releases are the San Pasquale Indian ruins on the Bosque del Apache National Wildlife Refuge and the San Marcial railroad bridge. Both of these locations were closely monitored in 1997. In 1997, the limitation in discharge capacity at the San Marcial railroad bridge caused the Corps to limit reservoir releases to approximately 6,000 cfs at Albuquerque.

Therefore, the spring runoff flood control action that is considered in this biological assessment is the effect of lowering peak spring flows to 6,000 cfs at Albuquerque when combined inflows to Cochiti and Jemez Canyon dams exceed 7,000 cfs. It is understood that this reduced operation to 6,000 cfs at Albuquerque is a temporary situation because of the limited capacity at the San Marcial railroad bridge, which could increase or decrease with time.

At the tail end of the spring snowmelt runoff, PL 86-645 may affect the Corps' flood water evacuation at Abiquiu and Cochiti dams. After July 1, when natural inflow into Cochiti Lake, exclusive of flood water being evacuated from Abiquiu, falls below 1,500 cfs, the Corps must

postpone flood water evacuation until the following November 1st. There is one exception to this criterion and that is when Cochiti has less than 212,000 af of summer flood space. The Corps generally operates Abiquiu and Cochiti such that if a carry-over situation is foreseen, the reservoirs are regulated so the water is carried over at Abiquiu Reservoir. The Corps will also manage, to the extent possible, the descending limb of the spring runoff hydrograph to aid in the regeneration of native vegetation, especially in the lower reaches of the Middle Rio Grande where over bank flooding is common. Refer to the Environmental Baseline section for a more detailed discussion on the hydrograph most conducive to the recruitment of native riparian vegetation.

ii. Summer Thunderstorms

The Corps has responsibility for managing flood waters resulting from summer thunderstorms in accordance with PL 86-645. The Corps has mandated authority to operate its reservoirs consistent with measures necessary to protect downstream life and structures in the event of summer floods.

The most likely summer thunderstorm events are low volume and short duration (less than 24 hours of increased discharge) that are passed through the reservoir with essentially no regulation. Less common are large thunderstorms that produce longer duration and larger volumes, requiring more regulation. In order to conform with PL 86-645, the Corps regulates flood inflows to the projects in a manner to release the inflow up to the maximum rate practicable under the conditions at the time. This results in only short-term storage of inflow from summer rains and replacing high spike inflows with longer duration lower flows downstream. Through this management, the Corps prevents unexpected high flows from damaging downstream properties or resulting in loss of life. Under PL 86-645, the Corps cannot store this flood water beyond the extent of time needed to safely evacuate the inflow. In addition, this legislation requires that any deviation from the operational guidelines set forth in the law require approval by the Rio Grande Compact Commission. How the Corps proposes to utilize its discretion in regulating flood inflows is the Federal action described for purposes of this consultation.

The specific conditions that the Corps considers in determining the pattern of release of summer floods include: 1) the existing downstream discharge (both actual and forecasted), 2) a safe rate of increase, 3) evacuation within a short time period (usually about 24 to 48 hours) of the event, and 4) weather forecasts.

1. If the existing downstream discharge is already at flood stage due to thunderstorms downstream of the dams, or weather forecasts indicate thunderstorms might produce significant flooding, flood inflows may be released over a longer time to facilitate flood protection.

2. The rate of increase below the dams is limited to flow changes that are not likely to result in property damage or loss of life downstream. For example, the rate of increase at Cochiti Dam is limited to one-half foot increase in river stage at the gage below the dam per hour. Usually the

increases are limited to about 500 cfs change per hour. The maximum rate of the release is determined primarily by the total volume needed to be evacuated and not to exceed 7,000 cfs at the Albuquerque gage.

3. The release rate is adjusted to evacuate the flood storage within a short time period, usually within about a 24 to 48-hour period after the peak inflow for the most common thunderstorm events. These measures are taken in conformity with project purposes to protect downstream structures from flood damage, to prevent affecting interstate compact deliveries, and, in the case of Cochiti Lake, to not violate easement agreements with the Cochiti Pueblo.

To demonstrate summer operation of Cochiti Dam, as well as other Corps projects, for regulating flood waters resulting from summer thunderstorms, Figure 1A in the assessment displays two actual events when the Corps regulated summer flooding at Cochiti Dam. These two events can be considered normal operations and reflect the kind of events that would occur during the interim period under the proposed action by the Corps.

b. Delivery of "Carry-Over" Flood water

The Corps is directed by PL 86-645 to hold (carry-over) flood water in Abiquiu or Cochiti Reservoirs after July 1 when the natural river flow at Otowi falls below 1,500 cfs. This water must subsequently be released between the following November 1 and March 31. Any deviation from this criterion would require the unanimous consent of the Rio Grande Compact Commission. The Corps does have discretion as to how this water is evacuated. Normal procedures are to coordinate with the New Mexico ISC so that these operations minimize affects of New Mexico making its Rio Grande compact obligation to Texas.

According to PL 86-645, the Corps is required to release carry-over water (flood water not released due to July 1 conditions/criteria mentioned above) after November 1st and completely evacuate the storage by March 31st of the following year. No specific time or rate of release is required under the law. Alternatives for delivering this water range from a constant low-flow release from Abiquiu Dam over the entire 5-month period to a maximum release equal to the channel capacity of the Rio Chama, about 1,800 cfs, for as long as necessary. The water in both scenarios is assumed to be released from Abiquiu and is passed through Cochiti Dam and delivered to Elephant Butte Reservoir.

The Corps conducted informal, ESA consultation with the Service during the fall of 1995 regarding the release of about 98,000 af of carry-over water. The primary species of concern was the minnow. Other threatened and endangered species considered included the bald eagle, the flycatcher, and the whooping crane. Alternatives were evaluated based on the potential impact of increased winter discharges on physical habitat conditions (depth and velocity distributions) available in the reach of the river where silvery minnow are most abundant. The Corps considered several release alternatives to meet the water delivery requirements and examined possible impacts to the aforementioned Federally listed species for each one. The final

determination was that a constant flow of 325 cfs over normal flows during a 5-month period maintains the natural hydrograph shape with a minimum change in magnitude and is not likely to adversely affect the silvery minnow or its habitat. In addition, it was determined that the action would have no effect on the bald eagle, the flycatcher, or the whooping crane.

The Corps proposes to deliver future carry-over water from Abiquiu Dam, through Cochiti Dam, to Elephant Butte Reservoir at a constant low-flow rate over the entire winter period from November 1 to March 31 (about 150 days). The volume of carry-over water in any given year is dependent on reservoir storage conditions on the Rio Chama and the magnitude of spring runoff. The actual low flow release from Abiquiu Dam is then simply calculated as a function of the total volume of water available and the 150-day release period.

In previous years, the Corps has been asked to deliver all carry-over water by late December for New Mexico to meet its compact obligation. It is possible that New Mexico or the Rio Grande Compact Commission would request that the Corps evacuate carry-over storage different than a constant low-flow rate. The State could also consider delivering carry-over water outside of the November to March period. If carry-over water is released during the irrigation season, the State would need to coordinate with MRGCD to ensure flows reached the downstream delivery point. If any of these alternative scenarios occur, the Corps will reconsult with the Service to hopefully lessen the impact on listed species while enabling New Mexico to make Rio Grande Compact delivery obligations.

c. Delivery of Cochiti Recreation Pool Replacement Water

The Corps also uses discretion regarding how the 5,000 ac-ft of SJP Project water is used to replace evaporation loss from the Cochiti recreation pool. The proposed method of delivery to Cochiti Lake is to deliver about a third of this water during the first part of July to enhance fish and wildlife habitat at the upper end of the lake in what is known as the Cochiti delta. The remaining water would be delivered from November to February at a rate targeted to achieve a total release (including native inflow) from Abiquiu of about 70 cfs in order to protect the downstream fishery. Because the native inflow varies from day to day, the amount of replacement water released varies from 0 to about 50 cfs on any given day during this period.

d. Cochiti Fish Screen Placement

Under normal conditions, the native flow entering Cochiti is discharged through the outlet works, in compliance with the Rio Grande Compact. The head works for the Sile and Cochiti Eastside Main Canals are incorporated in the upper stilling basin. Operation of the head works for the Sile and Cochiti Eastside Main Canals began when the dam was completed and filled, but soon revealed a problem in design that entrained fish from the stilling basin through the head works into the canals. A significant die-off of fish stranded in the canals occurred when the canals dried, creating a major maintenance problem as well as a waste of resources. The solution was the installation of approximately 1-inch mesh grated metal fish screens on the stilling well side of each head works opening.

The proposed action is to remove the fish screens in November and install bulkheads to prevent flow from entering the canals during the non-irrigation season. At the end of February, the bulkheads will be removed, and the fish screens reinstalled for the irrigation season. These operations routinely require reduction in flows to approximately 75 cfs for 3-4 hours to permit access by maintenance workers to the screen guides and bulkhead fasteners.

e. Abiquiu Tunnel Inspection

The Corps must conduct periodic inspections of the outlet tunnel that requires stopping releases from Abiquiu Dam for approximately 1 hour. These inspections normally occur during the winter but could occur at any time of the year. The proposed operation is to conduct these shutdowns in the morning hours.

ACTION AREA

For purposes of this document, the "Middle Rio Grande" is defined as the area from the headwaters of the Rio Chama watershed and the Rio Grande, including all tributaries, from the Colorado/New Mexico state line downstream to the headwaters of Elephant Butte Reservoir. For discussion relating to Federal discretionary actions related to water operations, the Middle Rio Grande below Cochiti Dam is further designated by four divisions/reaches defined by locations of mainstream irrigation diversion dams. The Cochiti Division/Reach extends from Cochiti Dam to Angostura Diversion Dam. The reach from Angostura Diversion Dam to Isleta Diversion Dam is called the Albuquerque Division/Reach. The Belen Division/Reach is bounded upstream by Isleta Diversion Dam and downstream by San Acacia Diversion Dam. Finally, the reach below San Acacia Diversion Dam to the headwaters of Elephant Butte Reservoir is the Socorro Division/Reach.

For discussions about geomorphology and Reclamation's river maintenance program, the following reaches and associated designations will be used:

Reach Name	Description
Velarde	Velarde, New Mexico to Rio Chama Confluence
Española	Rio Chama Confluence to Otowi
White Rock Canyon	Otowi to the headwaters of Cochiti Reservoir
Cochiti	Cochiti Dam to Bernalillo-HWY 44
Middle	Bernalillo-HWY 44 to Isleta Diversion Dam
Belen	Isleta Diversion Dam to Rio Puerco Confluence
Rio Puerco	Rio Puerco Confluence to San Acacia Diversion Dam
Socorro	San Acacia Diversion Dam to River Mile 78
San Marcial	River Mile 78 to Headwaters of Elephant Butte Reservoir
Hot Springs	Elephant Butte Dam to headwaters of Caballo Reservoir

River maintenance analyses include the entire Project area with the exclusion of the reach from Otowi to Cochiti Dam. At the Otowi gage, the Rio Grande enters White Rock Canyon. This reach includes not only the deep narrow canyon, but also Cochiti Lake, a Corps flood control facility. No future river maintenance activities are expected to occur within this reach.

II. Status of the Species/Critical Habitat and Environmental Baseline

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress. This section defines the current status of the silvery minnow and the flycatcher and their habitat in the action area to help determine effects of the proposed project.

Rio Grande Silvery Minnow

a. Species/Critical Habitat Description

The silvery minnow was federally listed as endangered under the ESA on July 20, 1994 (U.S. Fish and Wildlife Service 1994). The species is listed by the State of New Mexico as an endangered species. Primary reasons for listing the silvery minnow involve a number of factors, described below, that contributed to a massive collapse of the species throughout its historic range.

Critical habitat was designated for the silvery minnow on July 6, 1999. Critical habitat for this species included the Rio Grande from the New Mexico Highway 22 Bridge, immediately downstream of Cochiti Dam, to the railroad bridge near San Marcial, New Mexico, representing 163 miles (262 kilometers [km]) of stream channel.

The designated critical habitat for the silvery minnow was challenged in the consolidated cases of *MRGCD, State of New Mexico, and Forest Guardians v. Bruce Babbitt*. On November 21, 2000, the District Court of New Mexico ordered the Service to complete a new proposal to re-designate critical habitat and prepare an environmental impact statement within 120 days. The Court ordered that the previous critical habitat designation remain in effect until March 21, 2001, at which time the critical habitat designation expired. Critical habitat has not yet been re-designated and therefore will not be considered in this opinion.

The final recovery plan for the silvery minnow was released in July 1999 (U.S. Fish and Wildlife Service 1999c). The primary objectives are to increase numbers of the silvery minnow, enhance its habitat in the Middle Rio Grande valley, and expand its range by reestablishing the species in at least three other areas in its historic range.

The silvery minnow is a stout minnow, with moderately small eyes and a small, subterminal mouth, and the snout pointed, projecting beyond the upper lip (Sublette *et al.* 1990). The coloration of the body is silvery to olive on the back and upper sides with a broad, greenish mid dorsal stripe; with the lower sides and the abdomen silver. Maximum length attained by this species is about 3.5 inches (90 mm). The only readily apparent sexual dimorphism is the expanded body cavity of ripe females during spawning (Bestgen and Propst 1994).

The silvery minnow has a confused taxonomic and systematic history, and in the past was included with other species of the genus *Hybognathus* due to morphological similarities. Phenetic and phylogenetic analyses corroborated the hypothesis that it is a valid taxon that is distinctive from other species of *Hybognathus* (Cook *et. al.* 1992, Bestgen and Propst 1994).

b. Life History

The silvery minnow travels in schools and tolerates a wide range of habitats (Sublette *et al.* 1990), but generally prefers low velocity (less than 0.33 feet per second, 10 centimeters/second [cm/sec]) areas over silt or sand substrate that are associated with shallow (less than15.8 inches [40 cm]) braided runs, backwaters or isolated pools (Bestgen and Platania 1991, Platania and Dudley 1997). Adults are most commonly found in shallow and braided runs over sand substrate; while young-of-year occupy shallow, low velocity backwaters with sand-silt substrates (Bestgen and Platania 1991, Platania and Dudley 1997, Dudley and Platania 1997). Young-of-year and adults are seldom found concurrently in the same habitat. A recent habitat study conducted between 1994 - 1996 characterized habitat availability and use at two sites in the Middle Rio Grande at Rio Rancho and Socorro (Dudley and Platania 1997). Dudley and Platania (1997) reported that this fish species was most commonly found in habitats with depth less than 7.9 inches (20 cm) or between 12.2 - 15.8 inches (31 - 40 cm), and were not found in habitats with water depths greater than 19.7 inches (50 cm). Over 85 percent were collected from low velocity habitats (less than 0.0325 feet/sec [10 cm/sec]) (Dudley and Platania 1997). Habitat for the silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Areas with detritus and algal-covered substrates are preferred. The lee sides of islands and debris piles often serve as good habitat. Stream reaches dominated by straight, narrow, incised channels with rapid flows are not typically occupied by the silvery minnow (Sublette *et. al.* 1990, Bestgen and Platania 1991).

During the winter, the silvery minnow tends to concentrate in low-velocity areas in conjunction with vegetation for cover, such as debris piles (Dudley and Platania 1996, Platania and Dudley 1997). This species is rarely collected in high velocity conditions that are associated with mid-channel areas. The silvery minnow is not generally found associated with cool water, gravel or cobble substrates, strong currents, high salinity, highly channelized reaches, or areas where extended periods of channel drying have recently occurred. Bestgen and Platania (1991) indicate that juveniles occupy primarily shallow, low-velocity backwaters with sand-silt substrates during summer and fall.

The species is a pelagic spawner that produces more than 3,000 semi-buoyant, non-adhesive eggs during a spawning event (Platania 1995, Platania and Altenbach 1998). Adults spawn in about a one-month period in late spring-early summer (May-June) in response to spring runoff. Smith (1999) collected the highest number of eggs in mid May, with lower frequency of eggs being collected in late May-June in 1997. These data suggest multiple spawning events, and it appears likely that the silvery minnow spawns multiple times during the summer, perhaps concurrently with flow spikes. An artificial flow spike of 1,800 cfs (54 cm) for 24 hours was released from Cochiti Dam on May 19, 1996. This flow spike apparently stimulated a spawning event and resulted in the collection of 49 silvery minnow eggs by researchers at Albuquerque on May 22, the day after the spike passed (Platania and Hoagstrom 1996).

The majority of the spawning fish are one year old, and two-year-old fish comprise less than 10 percent of the spawning population. Furthermore, Platania (1995) found that a single female in captivity could broadcast 3,000 eggs in eight hours. Females produce 3 to 18 clutches (mean clutch of 270 eggs) of eggs in a 12-hour period. Females have multiple spawning events, and may ultimately release up to 6,000 eggs during the spawning season. The high reproductive potential of this fish appears to be one of the primary reasons that it has not been extirpated from the Middle Rio Grande.

Platania (1995) made the following observations concerning early development. Development and hatching of eggs are correlated with water temperature. Eggs of the silvery minnow raised in 30°C water hatched in about 24 hours while eggs reared in 20 - 24°C water hatched within 50 hours. Eggs were 0.06 inches (1.6 mm) in size upon fertilization, but quickly swelled to 0.12 inches (3 mm). Recently hatched larval fish are about 0.15 inches (3.7 mm) in standard length and grow about 0.005 inches (0.15 mm) in size per day during the larval stages. Eggs and larvae remain in the drift for 3-5 days, and may be transported from 134 to 223 miles (216 to 359 km) downstream depending on river flows. About three days after hatching the larvae began moving to low velocity habitats where food (mainly phytoplankton and zooplankton) is abundant and predators are scarce.

The recovery plan summarizes the mortality, longevity, and growth of the silvery minnow (U.S. Fish and Wildlife Service 1999c). Spawning causes high mortality on the silvery minnow, and very few adults are found in late summer. By December, the large majority (>98 percent) of individuals are young-of-the-year (Age 0). This population ratio does not change appreciably between January and June, as Age I fish usually constitute over 95 percent of the population just prior to spawning. Generally, the population consists of only two age classes. They continue to grow through the winter months, although less rapidly than during the warmer months. In low-velocity habitats (backwaters and embayments), growth is rapid. Young-of-the-year attain lengths of 1.5 to 1.6 inches (39 to 41 mm) by late autumn. Age 1 fish are 1.8 to 1.9 inches (45 to 49 mm) by the start of the spawning season. Most growth occurs between June (post spawning) and October. Maximum longevity is about 25 months, but very few survive more than 13 months.

Platania (1995) indicated that the downstream transport of eggs and larvae of the silvery minnow over long distances was, historically, beneficial to the survival of their populations. This behavior may have promoted recolonization of reaches impacted during periods of natural drought (Platania 1995). The spawning strategy of releasing floating eggs allow the silvery minnow to replenish populations downstream, but the presence of the Diversion Dams (Angostura, Isleta, and San Acacia Diversion Dams) prevents recolonization of upstream habitats (Platania 1995). As populations are depleted upstream, and diversion structures prevent upstream movements, isolated extirpations of the species through fragmentation may occur. Silvery minnows, eggs and larvae are also transported downstream to Elephant Butte Reservoir. It is not believed that any survival of these fish occurs because of poor habitat, and, even more important, by predation from reservoirs fishes.

The silvery minnow is herbivorous (feeding primarily on algae); this is indicated indirectly by the elongated and coiled gastrointestinal tract (Sublette *et al.* 1990). In addition, detritus, including sand and silt, is filtered from the bottom (Sublette *et al.* 1990, Bestgen and Platania 1991).

c. Population Dynamics

This fish is one of seven species in the genus *Hybognathus* in the United States; and was formerly one of the most widespread and abundant minnow species in the Rio Grande basin of New Mexico, Texas, and Mexico (Pflieger 1980, Bestgen and Platania 1991). Currently, *Hybognathus amarus* is the only remaining endemic pelagic spawning minnow in the Middle Rio Grande. The other four endemic cyprinid species (speckled chub, Rio Grande shiner, phantom shiner, bluntnose shiner) have been extirpated from the Middle Rio Grande (Dudley and Platania 1999, New Mexico Department of Game and Fish 1998b). Given the loss of the other four pelagic spawning endemic minnow species, it is reasonable to presume that this species would likely be the next fish to be extirpated (Dudley and Platania 1997).

Historical populations were known to have occurred from Española upstream from Cochiti Reservoir; in the downstream portions of the Chama and Jemez Rivers; throughout the Middle and Lower Rio Grande to the Gulf of Mexico; and in the mainstem of the Pecos River from Sumner Reservoir downstream to the confluence with the Rio Grande (Bestgen and Platania 1991). Comparison of fish surveys between 1986 and 1996 in the Middle Rio Grande indicated a continued decline in its abundance (Bestgen and Platania 1991, Platania 1993, Platania and Dudley 1997). Preliminary data collected during the summer of 2000 indicate a near-absence of Age 0 silvery minnows in the Middle Rio Grande, suggesting that the population may have dramatically decreased, even since the period of 1996 to 1999 (Chris Hoagstrom, New Mexico Fisheries Resource Office, *in litt.*, August 14, 2000).

The decline of the species throughout much of its historic range is related to the modification of its habitat by alteration of stream discharge patterns, channel desiccation caused by impoundments, water diversion for agriculture, and stream channelization (Bestgen and Platania

1991, Cook *et al.* 1992). Further adverse effects have been attributed to the introduction of nonnative fish species (competition and predation), and degradation of water quality (U.S. Fish and Wildlife Service 1994).
The species occupies less than five percent of its historic range; therefore, the likelihood of extinction from adverse environmental impacts is greatly increased (Hoagstrom and Brooks 2000, Service 1999). If the species were extirpated in certain reaches of the current range, the reaches could not be repopulated from downstream due to diversion dams. In addition, repopulation from the downstream movement of drifting eggs would be severely limited due to low numbers of fish upstream reaches. At the present time, the silvery minnow is only abundant in limited reaches downstream of the Isleta and San Acacia Diversion Dams. Silvery minnows in these two areas are frequently threatened with dewatering and death during the dry summer months. The inability of the population to find adequate refugia during poor conditions and repopulate extirpated reaches, creates a very unstable population. If the population is significantly reduced in the Isleta and San Acacia Reaches, extinction of the species could occur (Platania 1997).

The short life span of the silvery minnow, usually one year, (90 percent Age I), increases its instability. If a sufficient level of successful reproduction does not occur for two or more successive years, the species may not survive. Lack of flows also reduces backwater habitats needed for survival.

d. Status and Distribution

The silvery minnow was federally listed as endangered for the following reasons:

1. Regulation of stream waters, which has led to severe flow reductions, often to the point of dewatering extended lengths of stream channel;
2. Alteration of the natural hydrograph, which impacts the species by disrupting the environmental cues the fish receives for a variety of life functions, including spawning;
3. Both the stream flow reductions and other alterations of the natural hydrograph throughout the year can severely impact habitat availability and quality, including the temporal availability of habitats;
4. Actions such as channelization, bank stabilization, levee construction, and dredging result in both direct and indirect impacts to the silvery minnow and its habitat by severely disrupting natural fluvial processes throughout the floodplain;
5. Introduction of nonnative fishes that directly compete with, and can totally replace, the silvery minnow, as was the case in the Pecos River, where the species was totally replaced in a time frame of 10 years by its congener the plains minnow (*Hybognathus placitus*); and

6. Discharge of contaminants into the stream system from industrial, municipal, and

agricultural sources also impact the species (U.S. Fish and Wildlife Service 1993b, 1994).

The silvery minnow occurs in 170 miles (274 km) of the Rio Grande, from Cochiti Dam downstream to Elephant Butte Reservoir, five percent of its historic range. Surveys by Bestgen and Platania (1991) indicate a continued decline of silvery minnows in the entire reach during surveys from 1986 to 1989. In 1997, it is estimated that 70 percent of the silvery minnow population was found in the reach below San Acacia Diversion Dam, the downstream most diversion dam (Dudley and Platania 1997). During surveys in 1999, over 95 percent of the silvery minnows captured occurred downstream of San Acacia Diversion Dam (Dudley and Platania and Dudley 1999a, Smith and Jackson 2000). Probable reasons for this distribution include:

- The species' reproductive strategy, which entails the spawning of buoyant eggs during the spring and early summer high flows, resulting in downstream transport of eggs and larval fish;
- Diversion Dams that restrict the dispersal of mature fish into upstream reaches; and
- Reduction in the amount of available habitat due to the effects of Cochiti Dam, such as streambed degradation, reduction in off-channel habitat, and the general narrowing and incising of the stream channel.

The river reach downstream of San Acacia Diversion Dam to the railroad bridge at San Marcial, where the silvery minnow is found in the greatest abundance is 28 percent of the total length of the Middle Rio Grande from Cochiti Dam to the San Marcial Railroad Bridge (47.6 miles [76.6 km]). In 1996, at least 36 river miles in the Middle Rio Grande were dry for 128 days. In 1997, at least 16 river miles were dry for approximately five to seven days. Approximately 16 river miles were dry for 28 days in 1998. The river was also dry in 1999 for four to five days for at least 28 river miles. Drying also occurred in 2000 for less than a week in late July. While some dead silvery minnows were collected in each drying event, it is assumed that many more mortalities occurred before they were documented.

During the past few years, flows in the Rio Grande were provided for the silvery minnow in areas that would have otherwise been intermittent. However, this water may not be available in the future. The City of Albuquerque and other SJC project contractors, allowed the use of its SJC water for the purpose of providing flows in the river that were crucial for the remaining silvery minnow population in this reach. Albuquerque intends to fully utilize its SJC water in the future for municipal uses; therefore, this water may not be available for future activities involving conservation of silvery minnow populations.

e. Factors affecting species environment within the action area

The action area for this project includes the Rio Chama from the Colorado-New Mexico border to its confluence with the Rio Grande, and the Rio Grande and all of its tributaries from the Colorado-New Mexico border to the headwaters of Caballo Reservoir.

Past actions have eliminated and severely altered habitat conditions for the silvery minnow. Changes in natural flow regimes, narrowing and deepening of the channel, and restraints to channel migration adversely affect the silvery minnow. These effects result directly from constraints placed on channel capacity by structures built in the floodplain. These environmental changes have and continue to degrade and eliminate spawning, nursery, feeding, resting, and refugia areas required for species survival and recovery (U.S. Fish and Wildlife Service 1993a). The active river channel width that flowing water can occupy in the Middle Rio Grande has been severely reduced. Comparison of this potentially suitable habitat for the silvery minnow has decreased by 49 percent between 1935 and 1989 (Crawford *et al.* 1993).

Prior to measurable human influence on the system, up to the fourteenth century (Biella and Chapman 1977), the Rio Grande was a perennially flowing, aggrading river with a shifting sand substrate. In general, the river was slightly sinuous, braided, and freely migrated across the floodplain. There is now strong evidence that the Middle Rio Grande only started drying up on a fairly regular basis after the development of Colorado's San Luis Valley in the 1870s. Prior to this, there are only two examples of its flow ceasing, and that occurred during prolonged, severe droughts in 1752 and 1861. Over the past century, the Middle Rio Grande has been frequently dewatered, particularly in the Isleta and San Acacia Reaches.

Water management and use has resulted in a large reduction of suitable habitat for the silvery minnow. Lack of water is the single most important limiting factor for the species. Agriculture accounts for 90 percent of the water consumption in the Middle Rio Grande (Bullard and Wells 1992). The average annual diversion of water in the Middle Rio Grande by the MRGCD was 535,280 ac/ft (65,839 hectare meters) for the period from 1975 to 1989 (Bureau of Reclamation 1993). The silvery minnow historically survived low-flow periods because such events were infrequent, of lesser magnitude, and there were no diversion dams to restrict free movement of silvery minnows in the river. The present situation (low population numbers, over 95 percent of the species is present in the San Acacia Reach) is so severe that additional water withdrawals could result in the extinction of the species in the wild.

Water in the active river channel has also been reduced with the construction of drains along both banks of the Rio Grande. The majority of the Middle Rio Grande valley has drains paralleling the river. The west side of the Rio Grande has 160 miles (258 km) of drains, including the LFCC, in a 180-mile (290 km) stretch between Cochiti Dam and the Narrows at Elephant Butte Reservoir. This represents 89 percent of the total length between Cochiti Dam and Elephant Butte Reservoir. The east-side drains also parallel the river to San Acacia Diversion Dam for a distance of 100.5 miles (162 km).

Water withdrawals have not only reduced overall flow quantities, but also caused the river to become locally intermittent and/or dewatered for extended reaches. Irrigation diversions and drains significantly reduce water volumes in the river. Reaches particularly susceptible to these conditions, as documented during the spring and summer of 1996 by the Service, are

immediately downstream of the Isleta Diversion Dam (river mile 169), a 5-mile (8 km) reach near Tome (river miles 150-155), a 5-mile (8 km) reach near the U.S. Highway 60 Bridge (river miles 127-132) and an extended 36-mile (58 km) reach from near Brown Arroyo (downstream of Socorro) to Elephant Butte Reservoir. Massive fish kills, including tens of thousands of silvery minnows, in the lower reaches, have occurred in these dried stretches of streambed. In 1996, at least 36 river miles in the Middle Rio Grande were dry for 128 days. In 1997, at least 16 river miles were dry for approximately five to seven days. Approximately 16 river miles were dry for 28 days in 1998. The river was also dry in 1999 for four to five days for at least 28 river miles. Drying also occurred in 2000 for less than a week in late July. While some dead silvery minnows were collected in each drying event, it is assumed that many more mortalities occurred before they could be documented.

The historic flow regime that provided a high spring peak flow has been eliminated in many cases. The current flow regime as dictated by irrigation, municipal uses, flood control, and water delivery for interstate compacts, substantially reduced the volume of peak flows and changed the time of peak flows. Encroachment into the floodplain, through construction of bridges, houses, and irrigated lands has required a reduced release to prevent damage. A specific example includes the railroad bridge at San Marcial. Because this bridge is so low, flow releases from Cochiti Dam have been reduced to avoid damage to the bridge. Another example is the construction of houses in the floodplain on the east side of the river at Socorro. Releases from Cochiti Dam are reduced to prevent damage to these private structures. These reduced releases decreased the available habitat for the silvery minnow.

Water management has resulted in a large reduction of suitable habitat for the silvery minnow, including peak flows that historically initiated spawning. The silvery minnow has adapted to higher flows and a subsequent reduction in flows to begin and complete egg development, fertilization, embryo growth, and dispersal. A reduction in peak flows and/or improper timing of flows may prevent adequate reproduction. This condition was especially severe in the spring and summer of 1996. Because of the additional adverse condition of drought, the Service was concerned that reproduction might not occur or would be seriously reduced. A moderate flow spike was coordinated with the cooperation of the City of Albuquerque. River and habitat conditions prior, during, and following the spike were monitored. This spike was successful in triggering spawning by the silvery minnow and improved habitat conditions temporarily (Platania and Hoagstrom 1996).

Due to the severity and extent of dewatering prior to the moderate flow spike in 1996, the Service conducted an emergency rescue of silvery minnows trapped in drying pools downstream of Isleta Diversion. Approximately 10,000 silvery minnows were rescued, transported, and released in a perennial reach of the Rio Grande near Albuquerque in 1996. Mortality of silvery minnows from dewatering downstream of Isleta Diversion Dam has been documented as recently as 1999 (Dudley and Platania 1999b), and several additional rescues of silvery minnows have occurred between 1997 and 2001. These drying events, particularly the 1996 event, may have effectively eliminated every silvery minnow in the desiccated reaches. The areas that were dry

may not have been repopulated by silvery minnows until the following spring spawning event (Smith 1999).

Complete mortality of silvery minnows were documented in both 1996 and 1997 in specific isolated pools during river intermittency (Smith and Hoagstrom 1997, Smith 1999). These studies focused on both the relative size of the pool (i.e., estimated surface meters and maximum depth) in relation to pool longevity (i.e., number of days pool existed) and fish community of the isolated pools. Smith (1999), found that the typical isolated pools found during intermittent conditions typically only lasted for 48 hours. Those that persisted longer lost greater than 81 percent of their estimated surface area and greater than 26 percent maximum depth in 48 hours. Therefore, in persistent river intermittency, complete mortality of silvery minnows can be expected.

Status surveys estimated that approximately 70 percent of the total range-wide population of silvery minnows inhabited the San Acacia reach (San Acacia Diversion Dam to Elephant Butte Reservoir) in 1997 (Dudley and Platania 1997). In 1999, surveys have shown that an even larger portion, over 95 percent of the total silvery minnow population, are present in the downstream reach below San Acacia Diversion Dam (Dudley and Platania 1999, Smith and Jackson 2000). Mortality estimates for the April 1996, dewatering event have been as high as two-thirds of the silvery minnows present in the San Acacia reach, which would represent 47 percent of the total range-wide population of the species (based on the 70-percent total population estimate). The consequences of the 1996 mortality event are currently unknown, but certainly the species' near-term status, and likely long-term recovery potential have been adversely affected. Continued conditions that dewater sections of the Middle Rio Grande, resulting in reduced silvery minnow reproduction and recruitment throughout the species' range, could lead to its extinction (U.S. Fish and Wildlife Service 1993a, Dudley and Platania 1997). Every year since 1996, there has been a dry riverbed in some portion of the action area. Dead silvery minnows were documented in a dry riverbed in both 1999 and 2000 (Platania and Dudley 1999, Smith, pers. comm., 2000).

The LFCC that parallels the river for up to 75 miles (121 km) was designed to expedite delivery of compact water to Elephant Butte Reservoir. Water was diverted to the LFCC from the Rio Grande from 1959 to 1985. Built to more efficiently deliver water to Elephant Butte Reservoir during low-flow conditions, the LFCC has the capacity to take approximately 2,000 cfs of the river's flow. If natural flow is 2,000 cfs or less, the LFCC can dewater the Rio Grande from its heading at San Acacia Diversion Dam south to Elephant Butte Reservoir. The LFCC has not been fully operated since 1985, because of outfall problems at Elephant Butte Reservoir. In 1997, 1998, and 2001 experimental operations occurred in the upper 10 miles of the LFCC for sedimentation studies; however, the diverted flows were returned to the Rio Grande via a temporary outfall near Escondida. Even without water diversion into the LFCC, seepage from the river to the LFCC is occurring, causing some loss of surface flows in the river channel. It is estimated that 67 percent of the flow in the Rio Grande is lost to seepage in the project area, with much of this water seeping into the LFCC (pers. comm. Jim Wilber).

The active river channel where the majority of silvery minnow currently exists is being modified, especially by invasion of non-native plant species. Saltcedar and Russian olive are replacing native riparian vegetation. These non-native plants are very erosion-resistant; consequently, river flows often scour out the streambed rather than eroding the plants. Native vegetation allows the river to widen and change its location in the floodplain. Erosion resistant vegetation produces a narrow, deep river channel that is poor habitat for silvery minnows. Native riparian vegetation that is removed through scouring flows, fire, grazing, or other impacts is being replaced by non-native plants, primarily for two reasons: (1) A change in the flow regime that favors non-native species, and (2) the reproductive strategy of cottonwoods and saltcedar. The non-native saltcedar produces seeds throughout spring, summer, and fall that can germinate during a 6-month window. Cottonwood seeds can only germinate over a period of a few weeks.

Any newly formed river channels in the floodplain are often straighter and lack the meanders that were present in historic times. Channel straightening also results from the construction of levees for flood protection and excavation of straight pilot channels. The availability of wide, shallow habitats that are important to the silvery minnow are decreasing in the historically extensive range of the species. This channel configuration produces fewer backwater habitats with low velocities that are important for silvery minnow survival of eggs, fry, and juveniles. Habitat studies during the winter of 1995 and 1996 (Dudley and Platania 1996, U.S. Army Corps of Engineers 1996), demonstrated that a wide, braided river channel with low velocities resulted in higher catch rates of silvery minnows, and narrower channels resulted in fewer fish captured.

Where the silvery minnow now persists, human development and use of the floodplain have greatly restricted the width available to the active river channel. A comparison of "river" area between 1935 and 1989 shows a 52-percent reduction, from 26,598 acres (10,764 ha) to 13,901 acres (5,626 ha) (Crawford *et al.* 1993). These data refer to the Rio Grande from Cochiti Dam downstream to the "Narrows" in Elephant Butte Reservoir. Within the same stretch, 234.6 miles (378 km) of levees occur, including levees on both sides of the river. Analysis of aerial photography taken by the Bureau in February 1992, for the same river reach, shows that of the 180 miles (290 km) of river, only 1 mile (1.6 km), or 0.6 percent of the floodplain has remained undeveloped. Development in the floodplain, makes it harder if not impossible to send down large quantities of water that would overbank and create low velocity habitats that the silvery minnow prefers.

Water quality can also impact the silvery minnow. Fish surveys in the Rio Grande through the City of Albuquerque and immediately downstream showed a depauperate fish fauna that may be caused by poor water quality (Bestgen and Platania 1991). Other inputs from toxic sources can also occur, such as sewage spills, runoff from construction, and livestock feedlots. Poor water quality also impacts the silvery minnow indirectly. Other fish species may be better adapted to certain water quality parameters and therefore may be more abundant.

On the Middle Rio Grande, the following past and present Federal, State, private, and other human activities, in addition to those discussed above, have affected the silvery minnow:

1. Release of Carryover Storage from Abiquiu Reservoir to Elephant Butte Reservoir: The Corps consulted with the Service on the release of water during winter. Ninety-eight thousand ac/ft (12,054 hectare-meter) of water was released from November 1, 1995, to March 31, 1996, at a rate of 325 cfs (9.8 cm). This flow rate is above the historic winter flow rate. Substantial changes in the flow regime that do not mimic the historic hydrograph can be detrimental to the silvery minnow. For example, during the winter release habitat study, Dudley and Platania (1996) observed an apparent increase in flow between two winter sampling trips, January 19-26, 1996, and February 3-5, 1996, resulting in a decrease in low-velocity and side-channel habitats favored by silvery minnows.

2. Corrales, Albuquerque, and Belen Levees: These levees contribute to floodplain constriction and habitat degradation for the silvery minnow. Levees at these sites contribute to the degradation of the environmental baseline by reducing the amount of suitable habitat for the silvery minnow.

3. Water Management in the Middle Rio Grande by the Corps and Reclamation: Flood control operations at dams on the Rio Chama and Rio Grande have greatly reduced peak flows in the Rio Grande. The natural hydrograph sustained native vegetation and ecosystem processes that previously maintained habitat for the silvery minnow. Without peak flows, especially during spring, natural reproductive processes are disrupted and can be completely eliminated. These two impacts combined result in: (1) changes in the channel dimension, pattern and profile, and (2) disruption of spawning, could lead to severe population declines and extinction of the silvery minnow.

   Water management has also resulted in adverse effects to silvery minnow habitat. Dewatering miles of silvery minnow habitat not only caused direct mortality to the species and fragmented habitat. Each life stage of the silvery minnow has specific requirements at precise times during the year. Water releases from dams, or changes in releases, often do not mimic the flows required to sustain each life stage. For example, if flows are greatly reduced, then shallow water habitat that occurs near river fringes can become dewatered, resulting in only high-velocity habitats that will not support earlier life stages. If one life stage is impacted, then the population as a whole is impacted.

   Because of the change in vegetation in the Rio Grande floodplain to saltcedar, and the change in the water regime (i.e., dewatered river channel, lower flows, lack of high flows, improper timing), the wetted river channel will become narrower and deeper. Within the action area, open channel habitat, including the river and adjacent cleared areas, has been reduced from 7,648 acres (3,059 hectares) in 1935, to 3,352 acres (1,340 hectares) in 1989 (Crawford *et al.* 1993), a 56 percent reduction in suitable and

potentially suitable habitat for the silvery minnow.

The continual loss of water from the river channel to the LFCC will result in further mortality of silvery minnows. Water management has resulted in dewatered habitat, causing direct mortality, and the resulting isolated pools have caused silvery minnow mortality due to poor water quality (low dissolved oxygen, high temperatures) and predation from other fish and predators (*i.e.*, birds, raccoons etc.). The Rio Grande in the action area was severely dewatered in 1996. This represented about 34 miles (58 kilometers [km]) of dewatered habitat out of the 56 miles (90 km) from San Acacia Diversion Dam to Elephant Butte Reservoir. In 1997, water flows ceased at the south boundary of the BDANWR, resulting in dewatering 14 miles (22.5 km) of habitat. In 1998, the Rio Grande was discontinuous within the BDANWR, dewatering about 20 miles (32 km) of habitat. In 1999, flows ceased about one mile upstream of the BDANWR boundary, dewatering about 24 miles (39 km) of habitat. A similar event occurred in 2000 only not to the extent of the 1999 drying. Due to lack of water in these reaches almost all silvery minnows there were killed. The current low-quality habitat was created by water management resulting in lack of high and permanent flows, restriction of the floodplain by levees, and invasion by non-native vegetation.

Spawning success of silvery minnows has been poor. An unnatural flow regime can preclude the spike in flows that may stimulate spawning. If peak flows occur at the wrong time, then suboptimal water temperatures could severely reduce egg and fry survival. Recruitment of fish will continue to be poor because eggs drift downstream to habitats that are dewatered in most years.

4. LFCC Experimental Operations: In December 1994, Reclamation submitted a biological assessment addressing the diversion of water from the Rio Grande into the LFCC to study the effects of channel gradient and sedimentation on water delivery. The Federal action evaluated the alternative of installing a temporary outfall to the river and diverting water during spring runoff for three consecutive years. Experimental diversions into the LFCC began in May 1997, and continued through June 1997. Experimental diversions began again in early March 1998, and continued until the end of spring runoff. This resulted in the entrainment of silvery minnow eggs and subsequent recruitment of silvery minnow adults into the LFCC. Experimental operations began again on May 20, 2001. Since then, no entrainment of silvery minnows has been documented. This lack of entrainment has lead to speculation that there was little or no spawning occurring in the upstream reaches.

5. Tiffany Plug Removal: This Reclamation project cut a pilot channel in the Rio Grande upstream of the bridge at San Marcial. The purpose of this project was to direct water flow through the excavation, rather than allow the water to flow into the adjacent floodplain, resulting in a straighter, narrower, deeper channel. This caused the narrowing of the river channel which reduced the hydrologic diversity needed by

the silvery minnow.

6. Temporary Channel to Elephant Butte: This Reclamation project involved the construction of a temporary channel through the delta area of Elephant Butte Reservoir to increase the efficiency of sediment and water conveyance. An additional project goal was to initiate some degradation of the river bed through the San Marcial reach to increase overall channel capacity and potentially allow for higher peak releases from Cochiti Dam during subsequent spring runoff periods.

   Measures were implemented to minimize impacts on the silvery minnow and flycatcher and their associated habitats and to enhance local riparian conditions. These environmental actions included adding sinuosity to the temporary channel, constructing the channel with variable width, constructing low water crossings along the temporary channel to allow overbank flows to inundate existing native riparian vegetation and encourage native revegetation, a channel widening project in the southern reach of the Bosque del Apache National Wildlife Refuge to improve aquatic and riparian habitat, and creation of an inflow channel to a portion of the eastern floodplain north of Black Mesa to encourage sediment deposition and new habitat creation.

7. Santa Ana River Restoration Project: In August 1999, Reclamation submitted a biological assessment to the Service to proceed with a restoration project located on Santa Ana Pueblo in an area where the river channel was incising and eroding into the levee system. This project is currently under construction and involves components such as a Gradient Restoration Facility (GRF), channel re-alignment, bioengineering, riverside terrace lowering, and erodible banklines. The primary component of the Santa Ana Restoration Project is a GRF which will provide control of the river hydraulics upstream of its location and also river bed control. The GRF was designed to 1) store more sand sediments at a stable slope for the current sediment supply, 2) decrease the velocities and depths and increase the width in the river channel upstream 3) to be hydraulically submerged at higher flows while simultaneously increasing the frequency and duration of overbank flows upstream, 4) to provide velocities and depths suitable for passage of the silvery minnow through the structure, and 5) to halt limit further channel degradation upstream of its location. The channel re-alignment involves moving the river away from the levee system and over the grade control structure. This activity involves excavation of a new river channel and floodplain. Another large component of the Santa Ana Restoration project is riverside terrace lowering for the creation of a wider floodplain. The bioengineering and deformable banklines are also involved to assist in establishing the new channel bank and re-generating native species vegetation in the floodplain.

8. Cochiti Fish Screens: This Corps project involved the reparation of fish screens located on the headworks of the Sile and Cochiti Eastside Main Canals in the stilling

basin of Cochiti Dam in November 1999. The repair work took approximately six hours per work day for four days and involved reducing outflow from Cochiti Dam to approximately 100 cfs during the six hours of work each day. Certain conditions had to be met for the work to progress: (1) a minimum 700 cfs release prior to and following the release reduction to 100 cfs for repairs; (2) the release reduction could not occur before 9:00 AM and could last for a maximum duration of six hours; (3) drawdown to 100 cfs for six hours could be undertaken only for two consecutive days, and additional repair and release reduction would be deferred to no more than two consecutive days the following week if needed; and (4) all repairs had to be completed prior to December 1, 1999, to minimize disturbance of bald eagles.

9. Silvery Minnow Augmentation: The Service completed an intra-Service section 7 consultation on the salvage and controlled propagation of silvery minnow in 2000. This consultation covered the collection of free floating silvery minnow eggs below the San Marcial Railroad Bridge and the collection of wild adult silvery minnows for spawning. This consultation set forth measures to limit silvery minnow mortality during collection and rearing.

10. Rescue of Silvery Minnows: The Service completed an intra-Service section 7 consultation of the rescue of silvery minnows from isolated pools in 2000. This consultation set forth measures to limit silvery minnow mortality during collection.

11. Creation of a Conservation Pool for Storage of Native Water in Abiquiu and Jemez Canyon Reservoirs and Release of a Spike Flow: This Corps project created space (100,000 af) in Abiquiu and Jemez Canyon Reservoirs to store Rio Grande Compact credit water for use in 2001, 2002, and 2003 for the benefit of listed species. While this project analyzed effects of storing this water and discussed the potential management or release of this water, it was understood that the management of that water would be decided in later settlement meetings or later during water operations conference calls. In addition, a supplemental release (spike) was released in May 2001 to accommodate movement of sediment as a part of habitat restoration/construction on the Rio Grande and Jemez River on the Santa Ana Pueblo.

12. Bosque del Apache National Wildlife Refuge Water Management Plan: BDANWR completed an intra-Service section 7 consultation in May 2001, under which they will use 869 af of their consumptive appropriation water right from the Rio Grande for the years 2001 through 2004 to aid in maintenance of habitat for the silvery minnow if: 1) BDANWR is presented with data indicating that the addition of limited Refuge water will foster survival of the species, 2) an equal or greater percentage of water by other water users in the Middle Rio Grande Valley is also contributed, and 3) legal permitting from the Office of the State Engineer is obtained prior to the emergency transfer request. The Refuge will use the remaining 6,540 af for agricultural and wetland habitat management for migratory birds and other wildlife.

There are 18 federally-recognized Indian Pueblos in the action area: Taos, Picurís, San Juan, Santa Clara, San Ildefonso, Pojoaque, Nambé, Tesuque, Jemez, Zia, Acoma, Laguna, Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta. The Pueblos hold aboriginal, time immemorial, reserved and in some instances contract water rights that are recognized and protected under Federal law. With respect to the six Middle Rio Grande Pueblos (Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta), a certain portion of their water rights is statutorily recognized under the Act of March 13, 1928, 42 Stat. 312, and the Act of August 27, 1935, 49 Stat. 887. These Acts of Congress do not establish the full extent of the water to which these Pueblos are entitled. In addition, the Navajo Nation and certain Navajo allottees hold aboriginal, time immemorial, or reserved water rights within the action area.

The Jicarilla Apache Nation (Nation) has existing uses of water rights in the Rio Grande Basin, including rights under a Federal settlement contract and legislation and a partial final decree in the Rio Chama adjudication.

The Nation received a Congressionally authorized and approved perpetual contract for the diversion and depletion of 6,500 af per year of SJC Project water as part of the settlement of its water rights claims in 1992. The Nation became entitled to those rights in April 1999 when the conditions of the settlement contract were fulfilled. Beginning in 1997, this water has been consumptively used through exchanges with the MRGCD by Reclamation with the Nation's consent.

In the Rio Chama Basin, the Nation also has adjudicated water rights for historic and existing uses on Reservation lands. The Nation's reserved water rights for historic and existing uses total an annual diversion of 65.14 af or the quantity of water necessary to supply an annual depletion of 40.32 af, whichever is less, and a net evaporation of 1,786.85 af. The Nation's water rights for historic and existing uses perfected under state law and located within the lands proclaimed as part of the Reservation on September 13, 1988, total an annual diversion of 1,492.93 af or a quantity of water necessary to supply an annual depletion of 1,095.01 af, whichever is less, and a net evaporation of 765.74 af.

In summary, the remaining population of the silvery minnow is restricted to five percent of its historic range. Every year since 1996, there has been at least one drying event in the river that has further reduced the silvery minnow population. Data collected during the summer of 2000 indicate a near-absence of Age 0 silvery minnows in the Middle Rio Grande, suggesting that the population has dramatically decreased since 1999 (Hoagstrom and Brooks 2000, Smith and Jackson 1999). At the present time, the population is unlikely to expand its distribution, because three diversion dams block upstream movement of silvery minnows, which is required for recolonization. Water withdrawals from the river and water releases from dams are severely limiting the survival of silvery minnows. The consumption of water from the river for municipal, industrial, and irrigation use continues to reduce the amount of flow in the Rio

Grande. The reduced quantity of water has decreased the length of flowing water in the Rio Grande.

Southwestern Willow Flycatcher

a. Species/Critical Habitat Description

The flycatcher is a small passerine bird (Order Passeriformes, Family Tyrannidae) measuring approximately 5.75 inches (15 centimeters [cm]) in length from the tip of the bill to the tip of the tail and weighing 0.4 ounces (11 grams). It has a grayish-green back and wings, whitish throat, light gray-olive breast, and pale yellowish belly. Two white wing bars are visible in adults; juveniles have buffy wing bars. The eye ring is faint or absent. The upper mandible is dark, the lower is light yellow grading to black at the tip.

One of four currently recognized flycatcher subspecies (Phillips 1948, Unitt 1987, Browning 1993), the flycatcher is a neotropical migratory species that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). The historical range of the flycatcher included southern California, Arizona, New Mexico, extreme western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja) (Unitt 1987).
The States of California (California Department of Fish and Game 1992) and New Mexico (New Mexico Department of Game and Fish 1998a) list the flycatcher as endangered. Arizona lists the flycatcher as a species of special concern (Arizona Game and Fish Department 1996). A final rule listing this species as endangered was published on February 27, 1995 (U.S. Fish and Wildlife Service 1995) and became effective on March 29, 1995. Final determination of the critical habitat was published on July 22, 1997, and became effective on August 21, 1997. A correction notice was published in the *Federal Register* on August 20, 1997, which provided additional information on the critical habitat designation.

The Service designated critical habitat for this species in areas that contain the remaining known flycatcher nesting areas, and/or formerly supported nesting flycatchers, and/or have the potential to support nesting flycatchers. These areas contain, or with recovery will contain, suitable nesting habitat in a patchy, discontinuous distribution. This distribution is partially the result of natural regeneration patterns of riparian vegetation and is expected to shift over time. All of these areas contain some unoccupied habitat or former (degraded) habitat that is needed to recover ecosystem integrity and support larger flycatcher numbers. Constituent habitat elements are provided by thickets of riparian shrubs and small trees and adjacent surface water (*i.e.*, surface water that is present throughout the mid-April through early September breeding season). Constituent elements include the riparian ecosystem above the water's surface or within 328 feet (100 meters) of the water's edge, or areas where suitable vegetation may become established.

There are 18 critical habitat units, totaling 599 river miles (964 kilometers) in Arizona,

California, and New Mexico. In New Mexico, critical habitat includes the Gila River and the East and West Forks of the Gila River (Catron and Grant Counties); Gila River, confluence of Hidden Pasture Canyon to confluence of Steeple Rock Canyon (Grant and Hidalgo Counties T18S, R21W, S33); San Francisco River from the confluence of Trail Canyon (T6S, R20W, S4) to San Francisco Hot Springs (T12S, R20W, S23) (Catron County); and Tularosa River and Apache Creek from the confluence of the Tularosa River and San Francisco Rivers (T7S, R19W, S23) to the source of Tularosa River (T4S, R15W, S33) and upstream from Apache Creek to the confluence with Whiskey Creek (T4S, R18W, S25) (Catron County). The boundaries include areas within 328 feet (100 meters) of the edge of areas with surface water during the mid-April through early September breeding season and within 328 feet (100 meters) of areas where such surface water no longer exists due to habitat degradation but may be recovered with habitat rehabilitation.

b. Life History

The flycatcher breeds in dense riparian habitats from sea level in California to just over 7,000 feet in Arizona and southwestern Colorado. Historic egg/nest collections and species' descriptions throughout its range document the flycatcher's widespread use of willow (*Salix* sp.) for nesting (Phillips 1948, Phillips *et al.* 1964, Hubbard 1987, Unitt 1987, T. Huels *in litt.* 1993, San Diego Natural History Museum 1995). Currently, flycatchers primarily use Geyer willow, Goodding willow, boxelder (*Acer negundo*), saltcedar (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolio*) and live oak (*Quercus agrifolia*) for nesting. Other plant species less commonly used for nesting include: buttonbush (*Cephalanthus* sp.), black twinberry (*Lonicera involucrata*), cottonwood (*Populus* sp.), white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* sp.). Based on the diversity of plant species composition and complexity of habitat structure, four basic habitat types can be described for the flycatcher: monotypic willow, monotypic exotic, native broadleaf dominated, and mixed native/exotic (Sogge *et al.*1997).

Open water, cienegas, marshy seeps, or saturated soil are typically in the vicinity of flycatcher territories and nests; flycatchers sometimes nest in areas where nesting substrates were in standing water (Maynard 1995; Sferra *et al.* 1995, 1997). However, hydrological conditions at a particular site can vary remarkably in the arid Southwest within seasons and between years. At some locations, particularly during drier years, water or saturated soil is only present early in the breeding season (*i.e.*, May and part of June). However, the total absence of water or visibly saturated soil has been documented at several sites where the river channel has been modified (e.g., creation of pilot channels), where modification of subsurface flows has occurred (e.g., agricultural runoff), or as a result of changes in river channel configuration after flood events (Spencer *et al.* 1996).

Throughout its range, the flycatcher arrives on breeding grounds in late April and May (Sogge and Tibbitts 1992; Sogge *et al.* 1993; Sogge and Tibbitts 1994; Muiznieks *et al.* 1994; Maynard

1995; Sferra *et al.* 1995, 1997). Nesting begins in late May and early June and young fledge from late June through mid-August (Willard 1912; Ligon 1961; Brown 1988a,b; Whitfield 1990; Sogge and Tibbitts 1992; Sogge *et al.* 1993; Muiznieks *et al.* 1994; Whitfield 1994; Maynard 1995).

Flycatcher nests are fairly small (3.2 inches tall and 3.2 inches wide) and nest placement in a shrub or tree varies throughout the species' range (2.0 feet to 59.1 feet or more off the ground). Nests are open cup structures and are typically placed in the fork of a branch. Nests have been found against the trunk of a shrub or tree (in monotypic saltcedar and mixed native broadleaf/saltcedar habitats) and on limbs as far away from the trunk as 10.8 feet (Spencer *et al.* 1996). Flycatchers using predominantly native broadleaf riparian habitats nest low to the ground (5.9 to 6.9 feet on average), whereas birds using mixed native/exotic and monotypic exotic riparian habitats nest higher (14.1 to 24.3 feet on average).

The flycatcher is an insectivore, foraging in dense shrub and tree vegetation along rivers, streams, and other wetlands. The bird typically perches on a branch and makes short direct flights, or sallies to capture flying insects. Drost *et al.* (1998) found that the major prey items of the flycatcher (in Arizona and Colorado), consisted of true flies (Diptera); ants, bees, and wasps (Hymenoptera); and true bugs (Hemiptera). Other insect prey taxa included leafhoppers (Homoptera: Cicadellidae); dragonflies and damselflies (Odonata); and caterpillars (Lepidoptera larvae). Non-insect prey included spiders (Araneae), sowbugs (Isopoda), and fragments of plant material.

c. Population Dynamics

Brown-headed cowbird (*Molothrus ater*) parasitism of flycatcher broods has been documented throughout its range (Brown 1988a,b; Whitfield 1990; Muiznieks *et al.* 1994; Whitfield 1994; Hull and Parker1995; Maynard 1995; Sferra *et al.* 1995; Sogge 1995b). Where studied, high rates of cowbird parasitism have coincided with flycatcher population declines (Whitfield 1994; Sogge 1995a,c; Whitfield and Strong 1995) or, at a minimum, resulted in reduced or complete nesting failure at a site for a particular year (Muiznieks *et al.*1994; Whitfield 1994; Maynard 1995; Sferra *et al.* 1995; Sogge 1995a,c; Whitfield and Strong 1995). Cowbird eggs hatch earlier than those of many passerine hosts, thus giving cowbird nestlings a competitive advantage (Bent 1960; McGeen 1972; Mayfield 1977a,b; Brittingham and Temple 1983). Flycatchers can attempt to renest, but renesting often results in reduced clutch sizes, delayed fledging, and reduced nest success (Whitfield 1994). In one study, cowbird parasitism was often the cause of delayed fledging. Nestlings that fledged later than July 20th had a significantly lower return rate than those fledging earlier (Whitfield and Strong 1995).

Flycatcher territory size likely fluctuates with population density, habitat quality, and nesting stage. Estimated territory sizes are 0.59 to 3.21 acres for monogamous males and 2.72 to 5.68 acres for polygynous males at the Kern River (Whitfield and Enos 1996), 0.15 to 0.49 acres for

birds in 1.48 to 2.22 acre patches on the Colorado River (Sogge 1995c), and 0.49 to 1.24 acres in a 3.71 acre patch on the Verde River (Sogge 1995a).

Seventy percent of the breeding sites where flycatchers have been found are comprised of five or fewer territorial birds. The distribution of breeding groups is highly fragmented, with groups often separated by considerable distances (*e.g,*. in Arizona, approximately 55 miles straight-line distance between breeding flycatchers at Roosevelt Lake, Gila County, and the next closest breeding groups known on either the San Pedro River, Pinal County or Verde River, Yavapai County). To date, survey results reveal a consistent pattern range-wide; the flycatcher population is comprised of extremely small, widely-separated breeding groups that frequently include unmated individuals. Movement data indicate that flycatchers can disperse to areas as much as 200 kilometers away from past recorded locations.

Intensive nest monitoring efforts in California, Arizona, and New Mexico have shown that cowbird parasitism and/or predation can often result in failure of the nest; reduced fecundity in subsequent nesting attempts; delayed fledging; and reduced survivorship of late-fledged young. Cowbirds have been documented at more than 90 percent of sites surveyed (Sogge and Tibbitts 1992; Sogge *et al.* 1993; Camp Pendleton 1994; Muiznieks *et al.* 1994; Sogge and Tibbitts 1994; Whitfield 1994; Griffith and Griffith 1995; Holmgren and Collins 1995; Kus 1995; Maynard 1995; McDonald *et al.* 1995; Sferra *et al.* 1995; Sogge 1995a,b; San Diego Natural History Museum 1995; Stransky 1995; Whitfield and Strong 1995; Griffith and Griffith 1996; Skaggs 1996; Spencer *et al.* 1996; Whitfield and Enos 1996; Sferra *et al.* 1997; McCarthey *et al.*1998). The probability of a flycatcher successfully fledging its own young from a cowbird parasitized nest is low (<5 percent). Also, nest loss due to predation appears consistent from year to year and across sites, generally in the range of 30 to 50 percent. Documented predators of flycatcher nests identified to date include common king snake (*Lampropeltis getulus*), gopher snake (*Pituophis melanoleucos affinis*), Cooper′ s hawk (*Accipiter cooperii*) and some corvid bird species (Paxton *et al.* 1997, McCarthey *et al.* 1998, Paradzick *et al.* 2000).

Cowbird trapping has been demonstrated to be an effective management strategy for increasing reproductive success for the flycatcher, as well as for other endangered passerines (e.g., least Bell's vireo [*Vireo bellii pusillus*], black-capped vireo [*V. atricapillus*], golden-cheeked warbler [*Dendroica chrysoparia*]). It may also benefit juvenile survivorship by increasing the probability that parents fledge birds early in the season. Expansion of cowbird management programs has the potential to not only increase reproductive output and juvenile survivorship at source populations, but also to potentially convert small, sink populations into breeding groups that contribute to population growth and expansion.

d. Status and Distribution

Unitt (1987) reviewed historical and contemporary records of *E. t. extimus* throughout its range, determining that it had "declined precipitously" and that although the data reveal no trend in the

past few years, the population is clearly much smaller now than 50 years ago, and no change in the factors responsible for the decline seem likely. Unitt documented the loss of more than 70 flycatcher breeding locations rangewide (peripheral and core drainages within its range) and estimated the rangewide population to be 500 to 1,000 pairs. There are currently 99 known flycatcher breeding sites (in California, Arizona, New Mexico, Nevada, Utah, and Colorado) holding approximately 712 territories (Table 1). Sampling errors may bias population estimates positively or negatively (e.g., incomplete survey effort, double-counting males/females, or composite tabulation methodology). It is likely that the total breeding population of flycatchers fluctuates annually. Unpublished data from U.S. Geological Survey (USGS) (M. Sogge, USGS, pers. com.) indicate that after the 1999 breeding season, just over 900 territories at 143 sites were known throughout the bird's range.

Declining flycatcher numbers have been attributed to loss, modification, and fragmentation of riparian breeding habitat, loss of wintering habitat, and brood parasitism by the brown-headed cowbird (Sogge *et al.* 1997, McCarthey *et al.* 1998). Habitat loss and degradation are caused by a variety of factors, including urban, recreational, and agricultural development, water diversion and groundwater pumping, channelization, dams, and livestock grazing. Fire is an increasing threat to flycatcher habitat (Paxton *et al.* 1996), especially in monotypic saltcedar vegetation (DeLoach 1991) and where water diversions and/or groundwater pumping desiccates riparian vegetation (Sogge *et al.* 1997). The presence of livestock and range improvements such as watering facilities and corrals, large scale agriculture, urban areas such as golf courses, bird feeders, and trash areas, may provide feeding sites for cowbirds. These feeding areas, coupled with habitat fragmentation, facilitate cowbird parasitism of flycatcher nests (Hanna 1928, Mayfield 1977, Tibbitts *et al.* 1994).

New Mexico Distribution and Abundance

Unitt (1987) considered New Mexico as the state with the greatest number of *E. t. extimus* remaining. After reviewing the historic status of the flycatcher and its riparian habitat in New Mexico, Hubbard (1987) concluded, "[it] is virtually inescapable that a decrease has occurred in the population of breeding flycatchers in New Mexico over historic time. This is based on the fact that wooded sloughs and similar habitats have been widely eliminated along streams in New Mexico, largely as a result of the activities of man in the area." Unitt (1987), Hubbard (1987), and more recent survey efforts have documented very small numbers and/or extirpation in New Mexico on the San Juan River (San Juan County), near Zuni (McKinley County), Blue Water Creek (Cibola County), and Rio Grande (Doña Ana County and Socorro County). Surveys and monitoring from 1993-1995 documented approximately 173 to 214 flycatcher territories in 8 drainages (Table 1). Parker (1997) documented 138 pairs (territories) along the Gila River in Grant County in 1996 and 174 pairs (territories) in 1997. Parker asserted that the results of four consecutive years of population surveys conducted along the Gila River (64 pairs in 1994, 107 pairs in 1995, 138 pairs in 1996, 174 pairs in 1997) show an expansion in this population. However, Skaggs (1996) saw no evidence of population trends because differences in survey objectives, methods, area, and levels of effort made comparisons inappropriate. Net increases

may be due to an increased level of survey effort. Even though conclusions about population trend cannot be made without repeated and methodologically consistent surveys over a span of 5 to 10 years, the various surveys clearly indicate the area has been, and remains, a significant regional stronghold for the species (Skaggs 1996).

In New Mexico, flycatchers have been observed in the Rio Grande, Chama, Canadian, Zuni, San Francisco, San Juan and Gila River drainages. Flycatchers were reported at Elephant Butte State Park in the 1970s; the majority nesting in salt cedar, although the exact location of the sightings was not reported (Hundertmark 1978, Hubbard 1987). Available habitat and overall numbers of flycatchers have declined Statewide. In recent years, breeding pairs have been found within the Middle Rio Grande Project action area from Elephant Butte Reservoir upstream to the vicinity of Taos, on both the mainstem Rio Grande and on the Rio Grande de Rancho, a tributary to the upper Rio Grande. In recent years, breeding pairs have also been found on the Chama River up to the vicinity of Los Ojos.

Arizona Distribution and Abundance

As reported by Paradzick *et al.* (2000), the greatest concentrations of flycatchers in Arizona in 1999 were near the confluence of the Gila and San Pedro rivers (236 flycatchers, 134 territories); at the inflows of Roosevelt Lake (140 flycatchers, 76 territories); between Fort Thomas and Solomon on the middle Gila River (9 flycatchers, 6 territories); Topock Marsh on the Lower Colorado River (30 flycatchers, 16 territories); Verde River at Camp Verde (7 flycatchers, 5 territories); Alpine/Greer on the San Francisco River/Little Colorado River (11 flycatchers, 8 territories); Alamo Lake on the Bill Williams River (includes Santa Maria and Big Sandy river sites) (43 flycatchers, 23 territories); and Lower Grand Canyon on the Colorado River (21 flycatchers, 11 territories). Unitt (1987) concluded that "probably the steepest decline in the population level of *E. t. extimus* has occurred in Arizona..." Historic records for Arizona indicate the former range of the flycatcher included portions of all major river systems (Colorado, Salt, Verde, Gila, Santa Cruz, and San Pedro) and major tributaries, such as the Little Colorado River and headwaters, and White River. As of 1999, 289 territories were known from 47 sites along 12 drainages Statewide. The lowest elevation where territorial pairs were detected was 197 feet at Adobe Lake on the Lower Colorado River; the highest elevation was at the Greer town site (8,300 feet). The majority of breeding groups in Arizona are extremely small. Of the 47 sites where flycatchers have been documented, 70 percent (n = 33) contain five or fewer territorial flycatchers.

California Distribution and Abundance

The historic range of *E. t. extimus* in California apparently included all lowland riparian areas in the southern third of the State. It was considered a common breeder where suitable habitat existed (Wheelock 1912, Grinnell and Miller 1944). Unitt (1984, 1987) concluded that it was once common in the Los Angeles basin, the San Bernardino/Riverside area, and San Diego

County. Specimen and egg/nest collections confirm its former distribution in all coastal counties from San Diego County north to San Luis Obispo County, as well as in the inland counties, i.e., Kern, Inyo, Mohave, San Bernardino, and Imperial. Unitt (1987) documented that the flycatcher had been extirpated, or virtually extirpated (i.e., few territories remaining) from the Santa Clara River (Ventura County), Los Angeles River (Los Angeles County), Santa Ana River (Orange and Riverside counties), San Diego River (San Diego County), lower Colorado River (Imperial and Riverside counties and adjacent counties in Arizona), Owen's River (Inyo County), and the Mohave River (San Bernardino County). Its former abundance in California is evident from the 72 egg and nest sets collected in Los Angeles County between 1890 and 1912, and from Herbert Brown's 34 nests and nine specimens taken in June of 1902 from the LCR near Yuma.

Survey and monitoring efforts since the late 1980s have confirmed the flycatcher's presence at a minimum of 11 sites on 8 drainages in southern California (including the Colorado River). Current known flycatcher breeding sites are restricted to coastal southern California from Santa Barbara to San Diego, and California's Great Basin near the towns of Kernville, Bishop, Victorville, the San Bernardino Mountains and along the lower Colorado River. The largest populations exist along the San Luis Rey, Santa Margarita, Santa Ynez, Kern and Owen's rivers. Combining survey data for all sites surveyed since the late 1980s for a composite population estimate, the total known flycatcher population in southern California is 95 territories, with possibly as many as 178 (M. Sogge, USGS, pers. com.).

Texas Distribution and Abundance

The Rio Grande and Pecos River in western Texas are considered the easternmost boundary for the flycatcher. Unitt (1987) found specimens from four locations in Brewster, Hudspeth (Rio Grande), and Loving (Pecos River) Counties where the subspecies is no longer believed to be present. Landowner permission to survey riparian areas on private property has not been obtained; thus current, systematic survey data are not available for Texas. There have been no other recent reports, anecdotal or incidental, of flycatcher breeding attempts in the portion of western Texas where the subspecies occurred historically. It is unknown at this time whether the flycatcher has been extirpated from Texas, but it is unlikely that there are significant numbers.

Nevada Distribution and Abundance

Unitt (1987) documented three locations in Clark County from which flycatchers had been found prior to, but not after, 1970. In 1998, two pairs of flycatchers were documented. Current survey efforts have documented breeding birds along the Amargosa, Pahranagat, Muddy, and Virgin Rivers (McKernan and Braden 1997, 1998, 1999) in southern Nevada.

Colorado Distribution and Abundance

The taxonomic status and the historic distribution and abundance of flycatchers in southwestern Colorado remain unclear due to a lack of specimen data and breeding records. Preliminary data

on song dialects suggest that the few birds recently documented in southwestern Colorado may be *E. t. extimus*. These sightings have prompted State and Federal agencies to delineate provisional boundaries for flycatchers and sponsor Statewide surveys. Surveys since 1993 have documented flycatchers at six locations in Delta, Mesa, and San Miguel Counties.

Utah Distribution and Abundance

Specimen data reveal that the flycatcher historically occurred in southern Utah along the Colorado River, San Juan River, Kanab Creek, Virgin River, and Santa Clara River (Unitt 1987). The flycatcher no longer occurs along the Colorado River in Glen Canyon, where Lake Powell inundated historically occupied habitat, nor in unflooded portions of Glen Canyon near Lee's Ferry where flycatchers were documented nesting in 1938. Similarly, recent surveys on the Virgin River and tributaries and Kanab Creek have failed to document their presence (McDonald *et al.* 1995).

In summary, more intensive and widespread surveys and monitoring efforts have documented the presence of a greater number of flycatchers than known at the time of listing. However, this does not imply an increase in the actual population, or that the status of the species has remarkably improved. Continuing losses of occupied habitats and degradation of other areas precludes the possibility of population increases. Recovery actions may take many years to implement and decades for habitat to be restored. Protection of occupied habitats as a consequence of section 7 consultation does provide some stability for those populations, but the net result is still a declining population.

Federal Actions Throughout Subspecies Range

Since listing in 1995, at least 47 Federal agency actions have undergone (or are currently under) formal section 7 consultation throughout the bird's range (Table 2). Six actions have resulted in jeopardy determinations. Many activities continue to adversely affect the distribution and extent of occupied and potential breeding habitat throughout its range (development, grazing, recreation, dam operations, etc.). Stochastic events also continue to adversely affect the distribution and extent of occupied and potential breeding habitat. For example, a catastrophic fire in June of 1996, destroyed approximately one half mile of occupied habitat on the San Pedro River in Pinal County. That fire resulted in the forced dispersal or loss of up to eight pairs of flycatchers (Paxton *et al.* 1996).

e. Analysis of the Species/Critical Habitat Likely to be Affected

The proposed action would take place in occupied habitats for the flycatcher that are important breeding and recovery habitat areas for the subspecies in relation to its rangewide distribution. No critical habitat for the flycatcher is designated in the action area. Recovery of this species will require these habitats to be able to support flycatchers at higher levels than are currently present.

Southwestern Willow Flycatcher: Environmental Baseline

a. Status of the Species within the Action Area

Presence/absence and nest monitoring surveys along the Rio Grande have been conducted since 1993. In 1994, eleven flycatcher territories were detected in the San Marcial area, all above the San Marcial Railroad Bridge (Mehlhop and Tonne 1994). In 1995, flycatchers were observed on the west bank of the Rio Grande south of Isleta Marsh within the Belen Division, and in the lower portion of the Socorro Division, both above and below the San Marcial Railroad Bridge (Ahlers and White 1995). Also in 1995, several individuals were observed along the river near Velarde, New Mexico, and nesting flycatchers were located on the San Juan Pueblo. In 1996, flycatchers were again detected during the breeding season below the San Marcial Railroad Bridge and in the Española valley (Ahlers and White 1996). Nesting attempts were documented at three sites in the Española valley and at one site in the San Marcial area (Johnson *et al.* 1999).

Surveys for presence/absence and habitat suitability along the Rio Chama below Abiquiu Dam in 1994 identified no flycatchers, but found small areas of suitable habitat (Eagle Ecological Services 1994). A Service biologist recorded an unidentified *Empidonax* about a quarter-mile from the Rio Chama near Chili, New Mexico (Eagle Ecological Services 1994). More recent data also indicate that the Rio Chama may be used by flycatchers. Several flycatcher territories were identified each breeding season from 1993-1998 in the Rio Chama drainage until surveys were discontinued, including areas near Parkview, above Heron Reservoir (New Mexico Department of Game and Fish 1995), and in the vicinity of Los Ojos.

In 1997, flycatchers were observed during Reclamation surveys at three sites between the San Marcial Railroad Bridge and Elephant Butte Reservoir (Ahlers and White 1997). Sites containing flycatchers in the San Marcial Reach were dominated by dense stands of willow with cottonwood interspersed, and were in or near flooded conditions at some point during the breeding season. Two nests were found in the headwater area of Elephant Butte Reservoir west of the LFCC in a patch of Goodding willows. Both of these nests may have been successful. The nests were located within the same territory about 5 meters apart. Because the second nest was being incubated following the estimated fledging date of the first nest, this could have been a renesting by the same pair (Ahlers and White 1997).

In 1998, a total of twenty flycatchers were observed from the San Marcial Railroad Bridge to Elephant Butte Reservoir including four confirmed pairs and two nests. A new nest was located on the east side of the river just below the San Marcial Railroad Bridge. The other nest was located near the 1997 nest site, west of the LFCC breach.

In 1999, 28 flycatchers established 10 pairs with 9 nests. At the San Marcial Reach, 12 territories were confirmed by 5 nests. Four of the nests were successful and one failed nesting attempt was due to cowbird parasitism. It is estimated that ten young fledged the nesting sites (Ahlers and White 2000). In 1999, four flycatcher territories within the Sevilleta National Wildlife Refuge

were discovered by Reclamation, while conducting routine neotropical migrant point counts in late May. Follow-up point counts confirmed the detected individuals to be residents and formal surveys in the area of detection began on June 21. Nesting was confirmed at three of the territories, two nests were successful, and the third failed for unknown reasons. Results of surveys for 2000 revealed two nests at this location. These were the first documented occurrences of territory establishment and successful breeding in areas adjacent to the river dominated by saltcedar and Russian olive within Reclamation's study area (Ahlers and White 2000).

The most recent published flycatcher information comes from 2000 monitoring efforts. Presence/absence surveys were conducted at selected sites along the Rio Grande from Velarde, New Mexico, to the headwaters of Elephant Butte Reservoir. Nest searches and monitoring were conducted in conjunction with survey efforts. A total of approximately 72 territories were identified along the Middle Rio Grande during the breeding season, as reported by Reclamation in their 2001 assessment (Table 3). In the San Marcial Reach, LF-27 (east of the Rio Grande below the San Marcial Railroad Bridge) had two pairs with nests, LF-11 (between the LFCC and the Rio Grande, below the Ft. Craig berm) had one pair with nest, and LF-17 (west of the LFCC outfall and Rio Grande above the Reservoir delta) had 14 pairs with nests. Successful nests in this area could be as high as 12 (Ahlers, Reclamation, 2000, pers. comm.).

Reaches or areas of the upper and Middle Rio Grande and tributaries with observed territories and/or nesting activity in recent years include Taos, Velarde, Española, Belen, Socorro, and San Marcial. Riparian habitat within all these reaches includes dense stands of willows and cottonwoods adjacent to or near the river channel. Other reaches in the Middle Rio Grande support local areas of suitable flycatcher habitat, e.g., the Middle Reach; however, no birds have been observed establishing territories. The Belen, Rio Puerco, Socorro and San Marcial reaches also contain dense stands of salt cedar. The entire Middle Rio Grande riparian corridor is used by migratory birds and flycatchers will use vegetation throughout as stop-over habitat. Flycatchers (and many other species of neotropical migrant landbirds) use the Rio Grande riparian corridor as stop-over habitat during migration. Studies have shown that during the spring and fall migration, flycatchers are more commonly found in willow habitats than in other riparian vegetation types, including the narrow band of coyote willows that line the LFCC within the BDANWR (Finch and Yong 1997). Recent presence/absence surveys during May have detected migrating flycatchers throughout the project area in vegetation types that are classified as "low suitability" for breeding habitat (Ahlers and White 1997).

The Velarde Reach has a narrow riparian zone with active plant regeneration and limited non-native vegetation. Habitat quality and vegetation varies considerably within this reach. Some bosque areas contain older, more mature trees that are 30-50 ft tall. Russian olive and Siberian elm trees occur on some banklines and river bars. Other areas support stands of dense willows with canopy trees. Overbank flooding is localized but regular. The high potential for bank erosion may increase the dynamics of riparian vegetation loss and regeneration. All habitat patches within this reach where flycatchers have been detected in the past were dominated by

willow and were inundated by overbank flooding or irrigation return flows. Nearby habitat included mature cottonwoods, open areas and Russian olives.

The Española Reach contains older aged riparian habitat with numerous oxbows and some encroachment of non-natives. A significant geomorphic feature of this reach is the destabilization of the channel and lowering of the river bed caused by within-channel gravel mining. About 20 acres of native vegetation have been lost due to a related drop in the water table.

The bosque in the Cochiti and Middle Reaches contains mainly single-aged stands of older cottonwoods and lacks the diversity of a healthy, multi-aged riparian forest. Non-native vegetation such as Russian olives and Siberian elms are also becoming established. Significant channel narrowing and degradation has significantly limited overbank flooding and reduced the potential for recruitment of native riparian vegetation, especially cottonwoods and willows. Known flycatcher habitat in the Belen Reach consists of dense willow and cottonwood stands associated with floodplain marshes below Isleta Diversion Dam and areas adjacent to the river within the Sevilleta National Wildlife Refuge containing salt cedar and Russian olive. The trend of channel narrowing and degradation reduces the amount of overbank flooding and the potential sites for existing and new native vegetation. Known flycatcher habitat in the Rio Puerco Reach is dominated by salt cedar.

Development of a flycatcher habitat suitability model by Reclamation was initiated in 1998, and further refined in 1999, by Larry White, Darrel Ahlers, and other individuals from Reclamation's Denver Technical Service Center. Vegetation within the reach was mapped using the Hink and Ohmart classification system through a cooperative effort with the U.S. Forest Service. Breeding habitat suitability was refined by identifying all areas that are within 100 meters of existing watercourses, ponded water, or in the zone of peak inundation. The 5 categories of flycatcher habitat that lie within 100 meters of water were defined as:

- Highly Suitable Native Riparian - Stands dominated by willow and/or cottonwood.
- Suitable Mixed Native/Non-native Riparian - Includes stands of natives mixed with various compositions of non-natives.
- Marginally Suitable Non-native Riparian - Stands composed of monotypic saltcedar or stands of saltcedar mixed with Russian olive.
- Potential with Future Riparian Vegetation Growth and Development - Includes stands of very young sparse riparian plants on river bars that could develop into stands of adequate structure with growth and/or additional recruitment. Reclamation believes this category requires regular monitoring to ascertain which areas contain all the parameters to become flycatcher habitat.
- Low Suitability - Includes areas where native and/or non-native vegetation lacks the structure and density to support breeding flycatchers, or exceeds the hydrologic parameter of greater than100 meters from water.

Currently, the Service groups the first three categories above as equally suitable habitat for the flycatcher, because a large number of sites are currently occupied that belong in the second and third categories above. At this time, it may not be accurate to define them as less suitable than native habitat for flycatchers and their reproductive success, unless data are, or have been, collected that demonstrate this result.

The Rio Grande in the San Acacia Reach supports a high value riparian ecosystem. The native riparian trees and shrubs are interspersed with stands of nonnative riparian plants, primarily saltcedar and Russian olive. Another factor that contributes to the habitat value of this area is its proximity to native desert habitat on both sides of the floodplain. This area is unlike reaches of the Rio Grande where agricultural and urban development has encroached on the outside edges of the floodplain. Thus, this area represents a relatively unfragmented landscape with associated high biological values. For this reason, the San Acacia Reach is considered to have high potential for riparian restoration.

Table 4 shows the extent of suitable and potential habitat in the San Acacia Reach, as defined by Reclamation. Approximately one-half of 50 hectares of potential habitat along the existing river channel have all the parameters needed for development into highly suitable habitat. The area of the delta is dependent on water from the outfall of the LFCC and fluctuation of Elephant Butte Reservoir. Any habitat being created by the current Reservoir elevation will be affected if the Reservoir recedes.

b. Factors Affecting Species Environment within the Action Area

In the Middle Rio Grande, past and present Federal, State, private, and other human activities that may affect the flycatcher include activities associated with irrigated agriculture, river maintenance, flood control, dam operation, water diversions, and downstream Rio Grande Compact deliveries. The Rio Grande and associated riparian areas are a dynamic system in constant change. Without this change, the riparian community will decrease in diversity and productivity. Sediment deposition, scouring flows, inundation, regular flows, channel realignment, and river realignment are processes that help to maintain and restore the diversity to the riparian community. Habitat elements for the flycatcher are provided by thickets of riparian shrubs and small trees and adjacent surface water (*i.e.*, surface water that is present throughout the mid-April through early September breeding season), or areas where such suitable vegetation may become established.

The Rio Grande historically had highly variable annual and seasonal discharge patterns (Platania 1993). Since 1973, flows in the Middle Rio Grande have been determined mainly by regulation of dam facilities and irrigation diversions. The highest flows now generally occur in the spring and early summer (April to June or July, depending on summer thunderstorm activity) as a result of snow-melt, irrigation water releases from the upstream reservoirs, and variable thunderstorms. Lowest flows generally occur from July or August (depending on summer thunderstorm activity) to October, when most of the available river flow is diverted for irrigation. Water and sediment

management have resulted in a large reduction of suitable habitat for the flycatcher, including the reduction of peak flows that helped to create and maintain habitat for this species.

Anthropogenic encroachment into the historic floodplain, through construction of bridges, houses, and irrigated lands has required reduced river releases from Cochiti Dam to prevent property damage. Overbank flooding is needed to create additional shallow, low velocity backwater habitats for the silvery minnow and flycatcher, and for maintenance and restoration of native riparian vegetation for the flycatcher. However, overbank flooding is also currently restricted by the San Marcial Railroad Bridge and urban development in the floodplain. There are three houses in the floodplain at Socorro, and a new residential development in the floodplain 0.25 mile (0.15 km) downstream of Bernalillo. These urban developments are not protected by levees.

Human development has greatly restricted the floodplain width, and the levees have functionally disconnected the river from most of the floodplain. A comparison of river habitat changes between 1935 and 1989 shows a 49 percent reduction of river channel habitat from 22,023 acres (8,916 ha) to 10,736 acres (4,347 ha) (Crawford *et al.* 1993). Between Cochiti Dam and the Elephant Butte headwaters, there are 235 miles (378 km) of levees (includes distances on both sides of the river).

The Middle Rio Grande is also exhibiting a trend of narrowing channel width over the last century. The trend can be attributed to reduced peak flows, channelization, and reduced sediments below Cochiti Dam. Channelization activities occurred between 1953 and 1972. Channelization is primarily responsible for the significant reduction in channel area that has eliminated thousands of acres of the shallow, low velocity habitats required by the flycatcher. Flow regulation below Abiquiu Reservoir and Cochiti Dam has further decreased channel capacity and reduced discharge peaks. A channel-forming discharge has never been released from Cochiti Dam. The lack of large peak flows combined with the adverse effects of channelization contributes significantly to channel narrowing, and the elimination of overbank

flooding that severely limits the development of backwater habitats essential to the survival of the flycatcher.

Water Operations

The operation of El Vado and Abiquiu Dams on the Rio Chama, Cochiti Dam on the Rio Grande, and the three mainstem diversion dams below Cochiti (Angostura, Isleta, and San Acacia) have modified river flows and downstream channel morphology. Downstream effects of Cochiti Dam include the narrowing of the river channel and associated loss of flycatcher habitats, the degradation of the river bed and concurrent reduction in overbank flooding. In addition, the diversion dams have the capability to dry up the river channel completely by diverting all the flow into the irrigation system. In 1996, dewatering of several miles of the river in the Isleta and San Acacia Reaches of the Middle Rio Grande between April 10 and June 29, 1996, may have

contributed to complete failure of adjacent flycatcher nests (Johnson *et al.*, 1999).

1996 Water Operations. Water availability in 1996 reflected severe drought conditions in the Rio Grande Basin of New Mexico, largely as a result of limited snowpack in the upper watershed. These conditions resulted in the absence of spring runoff and associated overbank flooding and the dewatering of significant portions of the Middle Rio Grande below Cochiti Dam beginning in mid-April. River reaches particularly susceptible to these conditions, as documented during the spring and summer of 1996 by the Service, are immediately downstream of the Isleta Diversion Dam (River Mile 169), in a five-mile reach near Tome (river miles 150-155), a five-mile reach near the U.S. Highway 60 Bridge (river miles 127-132), and a 36-mile reach from near Brown Arroyo (Socorro Division) to Elephant Butte Reservoir. In the Belen Division, irrigation return flows through 15 ditches to the Rio Grande sometimes provide the only surface flow during low flow periods in summer and autumn.

In 1996, flows were significantly reduced downstream of Isleta Diversion Dam; dry conditions were observed in the river downstream of the dam on July 23, 1996. A release of 40 cfs below the dam was made to alleviate these adverse conditions. Return irrigation flows at points in the Belen Division maintained some segments of flowing water. Water deliveries to the upper Socorro Division were made through the assistance of the MRGCD using their irrigation canals to deliver water downstream. Water was passed through to the river at San Acacia Diversion Dam and from the temporary outfall constructed by Reclamation in the LFCC approximately nine miles downstream from San Acacia. Both releases provided continuous flow conditions for about 20 miles, ending just downstream from Socorro, New Mexico, near Brown Arroyo. From that point for approximately 30 to 35 miles downstream to the headwaters of Elephant Butte Reservoir, the river was dry for most of the summer, connected only when inflow from summer thunderstorms provided sufficient water.

1997 Water Operations. In contrast to 1996, 1997 was a relatively wet year for the Rio Grande Basin in New Mexico. Flows in the Middle Rio Grande were continuous from the onset of the irrigation season to September 2, 1997. From about mid-July to the end of the month, flows were continuous in the lower reaches of the San Acacia reach, but were nearing intermittency. Flow measured by the New Mexico Fishery Resources Office (FRO) on July 18 was 60 cfs, and 32 cfs at Tiffany and San Marcial, respectively; on July 22, flow was 44 cfs and 40 cfs at Tiffany and San Marcial, respectively. Use of supplemental water during this period likely prevented complete drying in the San Marcial area.

From late July until late August 1997, summer thunderstorm events provided a considerable volume of flowing water throughout the system, with the discharge at San Acacia reaching a maximum of 5,600 cfs on July 30. However, intermittent flows were measured by the FRO on September 2 and September 4 at both Tiffany and San Marcial. During this period, increased supplemental flows were passing through San Acacia Diversion Dam, but had not yet arrived at San Marcial. Water flows ceased at the south boundary of the BDANWR, resulting in dewatering 14 miles (22.5 km) of habitat. Flows were once again continuous from Cochiti Dam

to Elephant Butte Reservoir following this period until the end of the irrigation season, when the river's baseflow increases naturally.

In April 1997, Reclamation negotiated a contract with the City of Albuquerque to purchase the use of up to 30,000 af of their SJC water annually for a three-year period, 1997-1999. Although Reclamation has stated that it will vigorously attempt to renew the current contract with the City to acquire the use of supplemental SJC Project water, the City has stated that this source of supplemental water may not be available after 1999 (John Stomp, City of Albuquerque, pers. comm. 1998). Therefore, Reclamation has not identified definite sources to supply a significant quantity of supplemental water for the time frame of the current consultation and no quantity will be available for assured use.

1998 Water Operations. In 1998, Reclamation increased the supplemental water to 56,000 af. However, even with this increased amount of supplemental water, for one day in June approximately one mile near the San Marcial Railroad Bridge in the Socorro Division became dry; and for four days in September, 12 miles from Tiffany to the San Marcial Railroad Bridge were dry. Overall, in 1998, approximately 16 to 20 river miles were dry for 28 days.

1999 Water Operations. An abnormally wet year in 1999 allowed Reclamation to carry over leased supplemental water that was not used. The 28,595 af of 1999 leased water was used by the end of April 2000. Reclamation began acquiring additional SJC water in March 2000. The first release of year 2000 lease water was an eight-day release from March 13 to March 20. The second release was April 3 through April 22. Supplemental water was then released on a continuous basis from May 6 through September 30. In 1999, flows ceased about one mile upstream of the BDANWR boundary, dewatering about 24 miles (39 km) of habitat. From October 1 through October 21, the City of Albuquerque moved 8,473 af of their SJC water from Abiquiu Reservoir to Elephant Butte Reservoir. The river was kept wet after October 21, 1999,

from MRGCD irrigation return flows and runoff from rain events that occurred intermittently throughout the Middle Rio Grande valley.

2000 Water Operations. Total supplemental water used in 2000 was 159,922 af, and an additional 8,473 af of water was moved by the City of Albuquerque to Elephant Butte Reservoir in October, bringing the total water moved in 2000 to 168,395 af. Drying occurred in 2000 for less than a week in late July.

Impact and Benefit of Water Operations to the Flycatcher. To summarize dewatering events in the Middle Rio Grande for these years, in 1996, at least 36 river miles in the Middle Rio Grande were dry for 128 days. In 1997, at least 16 river miles were dry for approximately 5 to 7 days. In 1998, approximately 16 river miles were dry for 28 days. In 1999, the river was dewatered for 4 to 5 days over at least 28 river miles. Drying also occurred in 2000 for less than a week in late July. Therefore, compared to 1996, the years since have shown greatly reduced amounts and durations of river dewatering, especially in 1997, 1999, and 2000.

During these same years, in 1996, the known flycatcher population numbered four nesting pairs and all nests failed. In 1997, there were three known pairs of flycatchers. In 1998, there were four known pairs with two nests. In 1999, there were 28 known flycatchers, including 12 territories, 10 pairs and 9 nests. In 2000, there were approximately 72 known flycatcher territories, with at least 17 nests. The large increase in 2000 is partly due to greatly increased survey coverage throughout the Middle Rio Grande. However, in the San Acacia Reach, an actual increase in number of territories is likely to have occurred. The decrease in prolonged river dewatering in this Reach in 1997, 1999, and 2000, may have contributed to the increase in flycatcher nesting, coupled with other factors, such as protection of known territories from disturbance. The increased quantity of continuous river flow would provide water adjacent to nesting areas that flycatchers require, along with production of their insect prey and dense riparian vegetation.

On the Middle Rio Grande, the following past and present Federal, State, private, and other human activities, in addition to those discussed above, have affected the flycatcher:

1. Corrales, Albuquerque, and Belen levees: These levees contribute to floodplain constriction and habitat degradation for the flycatcher. Levees at these sites contribute to the degradation of the environmental baseline by reducing the amount of suitable habitat for the flycatcher.

2. Water Management in the Middle Rio Grande by the Corps and Reclamation: Flood control operations at dams on the Rio Chama and Rio Grande have greatly reduced peak flows in the Rio Grande. The natural hydrograph sustained native vegetation and ecosystem processes that previously maintained habitat for the flycatcher. Water management has also resulted in adverse effects to flycatcher habitat. Dewatering miles of the river caused much of the flycatcher habitat to become unsuitable and fragmented. Because of the change in vegetation in the Rio Grande floodplain to saltcedar, and the change in the water regime (i.e., dewatered river channel, lower flows, lack of high flows, improper timing), the wetted river channel has become narrower and deeper, with greatly reduced areas of wetlands and floodplains.

3. Tiffany Plug Removal: This Reclamation project cut a pilot channel in the Rio Grande upstream of the bridge at San Marcial. The purpose of this project was to direct water flow through the excavation, rather than allow the water to flow into the adjacent floodplain, resulting in a straighter, narrower, deeper channel. This caused the narrowing of the river channel which reduced the overbank flooded habitat needed by the flycatcher.

4. Temporary Channel to Elephant Butte: Same as described previously.

5. Santa Ana River Restoration Project: Same as described previously.

6. Creation of a Conservation Pool for Storage of Native Water in Abiquiu and Jemez Canyon Reservoirs and Release of a Spike Flow: Same as described previously.

7. Bosque del Apache National Wildlife Refuge Conversion of Saltcedar to Native Habitats: The BDANWR completed an intra-Service section 7 consultation in April 2000, under which they will convert 1,845 acres of homogenous saltcedar *(Tamarix ramossima)* and mixed saltcedar/native bosque vegetative communities on the BDANWR to native riparian, wetland, and agricultural habitats. The proposal includes restoration of flycatcher habitat in the southern portion of BDANWR. The proposed restoration encompasses two to three areas of riparian/wetland habitat, each 60-acres or larger in size, to be restored to suitable flycatcher breeding habitat.

There are 18 federally-recognized Indian Pueblos in the action area: Taos, Picurís, San Juan, Santa Clara, San Ildefonso, Pojoaque, Nambé, Tesuque, Jemez, Zia, Acoma, Laguna, Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta. The Pueblos hold aboriginal, time immemorial, reserved and in some instances contract water rights that are recognized and protected under Federal law. With respect to the six Middle Rio Grande Pueblos (Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta), a certain portion of their water rights is statutorily recognized under the Act of March 13, 1928, 42 Stat. 312, and the Act of August 27, 1935, 49 Stat. 887. These Acts of Congress do not establish the full extent of the water to which these Pueblos are entitled. In addition, the Navajo Nation and certain Navajo allottees hold aboriginal, time immemorial, or reserved water rights within the action area.

The Jicarilla Apache Nation (Nation) has existing uses of water rights in the Rio Grande Basin, including rights under a Federal settlement contract and legislation and a partial final decree in the Rio Chama adjudication.

The Nation received a Congressionally authorized and approved perpetual contract for the diversion and depletion of 6,500 af per year of SJC Project water as part of the settlement of its water rights claims in 1992. The Nation became entitled to those rights in April 1999 when the conditions of the settlement contract were fulfilled. Beginning in 1997, this water has been consumptively used through exchanges with the MRGCD by Reclamation with the Nation's consent.

In the Rio Chama Basin, the Nation also has adjudicated water rights for historic and existing uses on Reservation lands. The Nation's reserved water rights for historic and existing uses total an annual diversion of 65.14 af or the quantity of water necessary to supply an annual depletion of 40.32 af, whichever is less, and a net evaporation of 1,786.85 af. The Nation's water rights for historic and existing uses perfected under state law and located within the lands proclaimed as part of the Reservation on September 13, 1988, total an annual diversion of 1,492.93 af or a quantity of water necessary to supply an annual depletion of 1,095.01 af, whichever is less, and a

net evaporation of 765.74 af.

III. Effects of the Action

Rio Grande Silvery Minnow

Non-Federal Activities

Withdrawals and depletions and related infrastructure, in the Middle Rio Grande basin adversely affect silvery minnows by changing the magnitude, timing, duration, and quality of flows available in the river. The extent of the effect of the withdrawal or depletion depends on the timing and the particular depletion. The withdrawal of water for agricultural, industrial, municipal, or other uses from the Rio Grande can reduce the quality and amount of riverine habitat available, thereby eliminating the overall amount of habitat available for the silvery minnow.

The recent approval by the Rio Grande Compact Commission and creation of a conservation pool will benefit the silvery minnow in the Middle Rio Grande. Approximately 30,000 af of water from the conservation pool (maximum of 100,000 af), will be released each year, unless it is not needed. Any additional water added to the Middle Rio Grande will provide or enhance silvery minnow habitat that may become dewatered without it.

A more detailed analysis of effects of diversion dams (Cochiti, Angostura, Isleta, and San Acacia Diversion Dams) on the silvery minnow is included under Federal Actions.

Reclamations's Discretionary Actions

Rio Chama System - Water Operations

El Vado Reservoir - Reservoir Storage

The storage of native water in El Vado reservoir normally occurs during spring runoff and summer rain events. Storing this water results in a proportional decrease in the amount of water that is passed through Abiquiu and Cochiti Reservoirs and is thus available to the Middle Rio Grande below Cochiti Dam. Spring runoff is an important cue for silvery minnow spawning, especially during the months of May and June.

Reducing peak flows in the Rio Grande by storing native flows in El Vado Reservoir during spring runoff cause: 1) reduction of overbank flooding and associated loss of low velocity overbank habitat that may be used by larval and juvenile silvery minnow, and 2) continued narrowing of the Rio Grande channel downstream due to the long term reduction in channel-forming discharge. Channel narrowing reduces the availability of shallow, low velocity habitat that is used by all life stages of silvery minnow.

In a dry or normal year, the storage of all or most of the native inflow to El Vado Reservoir will adversely affect the silvery minnow and it habitat. Complete river dewatering, especially in the Isleta and San Acacia Reaches would cause long term damage to the silvery minnow because large numbers of minnows will be stranded in isolated pools and die. In addition, the forage base for the minnow will be destroyed. The flora and fauna depleted in dewatered areas require a minimum of several months to reestablish. The recolonization of these areas by the silvery minnow would only occur after the flora and fauna that are a part of the food web for the species are reestablished. Therefore, such drying events effectively reduce the minnow forage base and available habitat for an extended period.

Diminished flow in the river will decrease habitat quality and quantity for the silvery minnow. With the expanding human population in the Middle Rio Grande Valley, consumption and use of water from the river will be accelerated. At the present time, the City of Albuquerque and other communities located in the Middle Rio Grande valley rely solely upon groundwater for municipal purposes. These groundwater aquifers are being depleted at a rate that is exceeding recharge rates. Structures such as riverside drains are pirating water that previously flowed to the groundwater. Industries that establish manufacturing plants in the vicinity of the Rio Grande also require additional water supplies, resulting in further groundwater withdrawals. Because of the dwindling groundwater supply, other sources of water are being explored, especially surface water supplies, such as the water in the Rio Grande (Hansen and Gorbach 1996).

El Vado Reservoir - Maintenance

Maintenance activities may include such activities as dam face maintenance, emergency spillway repairs, monitoring and instrumentation, and roadway and public safety concerns. These activities at El Vado Dam are generally scheduled in such a manner as to take advantage of existing and anticipated Reservoir conditions.

Properly scheduled maintenance projects at El Vado Dam are not anticipated to have any adverse impacts on the silvery minnow or its habitat. However, if such activities were to occur at a time when it would limit the release of native inflow from El Vado Dam when intermittency is likely in downstream reaches of the Middle Rio Grande, the potential exists for adverse affects to the species and its habitat by allowing a depression in flow, which would kill silvery minnows by stranding them in isolated pools and drying their habitat.

Middle Rio Grande System - Water Operations

Temporary Waivers

Reclamation can issue temporary waivers to contractors to modify the date of their water deliveries into the following calendar year. Reclamation requests extensions or a waiver of the delivery date only for reasons beneficial to United States interests, specifically for enhanced

winter flows and fisheries management on the Rio Chama above Abiquiu Reservoir, to take advantage of opportunities for supplemental water storage and management, and to provide improved overall management of upstream supplies. The direct effects of Reclamation's waiver actions are limited to the Rio Chama; however, this action can also be used to optimize Middle Rio Grande Valley flow to benefit listed species by supplying additional water to sustain the silvery minnow in the river by minimizing drying events during low flow periods.

Timing of Releases from Heron Reservoir to Offset Depletions (Pojoaque Tributary Unit)

Reclamation has discretion over timing of releases from Heron Reservoir to offset storage effects (depletions) at Nambé Falls Reservoir. This timing will have no net effect on native flows in the mainstem of the Rio Grande; however, the water can be released during periods when supplemental water would otherwise be released, thus saving a small amount of supplemental water for future use. Any water that is passed through the Middle Rio Grande creates more available habitat for the silvery minnow.

Supplemental Water Program

Reclamation proposes to seek approximately 20-30,000 af of supplemental water per year for the duration of this consultation. Reclamation also proposes that when supplies of any supplemental water are nearly exhausted, they will use the remaining supplemental water to manage a gradual river recession to baseline conditions. They also propose to pump water from the LFCC to the Rio Grande, and examine the feasibility of pumping groundwater to augment Rio Grande flow.

Reclamation's goal of supplemental water management is to maintain a continuous flow of water from Cochiti Dam to the headwaters of Elephant Butte Reservoir.

The availability of supplemental water through a leasing program will always be contingent on the availability of water from willing leasors, and no minimum quantity of supplemental water can be guaranteed. In 2001, Reclamation does not anticipate having any supplemental water available after it repays the MRGCD the 20,900 af of water used in 2000. Benefits to the silvery minnow and its habitat from Reclamation's supplemental water program will only be realized if Reclamation is able to obtain water from willing leasors and it is managed properly. Because supplemental water is not certain, potential benefits to the minnow from this action cannot be assumed and used to offset the adverse affects that are part of the proposed action.

The amount of supplemental water needed in any given year will vary based on hydrologic conditions and annual climatic conditions. Therefore, the hydrological benefits to the silvery minnow will depend on the quantity of water released and the duration of the release.

Below Cochiti Dam

Irrigation Season - Pre-Spring Runoff

The river channel below Isleta and San Acacia Diversion Dams has the potential to dry during the pre-spring runoff irrigation period in both dry and normal hydrologic scenarios. Channel drying before the spawning period has the potential to kill reproductively mature silvery minnows. With the known population at the lowest level ever recorded, failure of a single year class will significantly limit silvery minnow recovery and survivorship (Hoagstrom and Brooks 2000). Repeated drying episodes in the pre-spring runoff season, reducing the number of reproductively mature adults, could conceivably lead to the extirpation of the silvery minnow in the wild in the foreseeable future.

Irrigation Season - Spring Runoff

The spring runoff period is critical for reproductive activities of silvery minnow. Increases in discharge during the May/June time frame are likely the most important environmental cue to the onset of spawning. The potential effects of various flow rates during spring runoff on silvery minnow egg and larval drift is currently unknown. Because silvery minnow have spawned during only modest increases in discharge during the spring runoff period, Reclamation will not use supplemental water to create a manufactured increase in flow downstream of Cochiti Dam. Instead, Reclamation will use available supplemental water to maintain continuous flow in the river. Maintaining continuous flow, especially through the spawning season, is necessary to prevent extinction of the silvery minnow and to maintain its habitat.

Irrigation Season - Post Runoff

Reclamation proposes to release available supplemental water and pump from groundwater or the LFCC to increase discharge below Isleta and San Acacia Diversion Dams in the post-runoff period. Releasing available supplemental water during the tail-out of spring runoff should reduce the rate of decreasing discharge. This will reduce the formation of lateral, isolated pools, thereby reducing the numbers of silvery minnows killed. It is understood that there is a 50 percent carriage loss rate between the Isleta Diversion Dam and the San Acacia Diversion Dam. Therefore, if for example, 100 cfs is released from Cochiti Dam, 100 cfs would reach the Isleta Diversion Dam, but only 50 cfs would reach the San Acacia Diversion Dam. It should be noted that river drying may also occur in the Albuquerque Reach after 2001, if the City of Albuquerque and the MRGCD do not renegotiate their minimum flow agreement. River drying in this reach will degrade silvery minnow habitat and kill any silvery minnows in the reach. Loss of silvery minnows and river drying in this reach will further limit the ability of this species to recover and survive.

Cochiti and Albuquerque Division

Supplemental flows released through Cochiti Dam will augment perennial flows through these reaches under normal irrigation. Supplemental discharge may increase the normal range of flows (250-1000 cfs) within these reaches by over 400 cfs. This change is within the normal variability of the river in this reach and effects are expected to be minimal in terms of increase in habitat availability. These moderate increases will increase the depth of some mesohabitats and will slightly increase habitat diversity by wetting additional habitat on islands and bars and increasing the availability of shallow, lower velocity habitat which silvery minnow prefer.

Belen and Socorro Division

Aquatic habitat conditions within the Belen and Socorro Divisions under the baseline scenario can vary from a dry river with isolated pools to baseflows ranging from 50 to 100 cfs, to extremely high peak flows (over 8,000 cfs) from local rain events. The maintenance of continuous flowing conditions throughout the entire Belen Division is an objective of Reclamation's post runoff water operations.

The post-runoff irrigation season is when drying of the river channel is most likely to occur, resulting in significant decreases in the likelihood of the survival of larval and juvenile fish into winter. Channel drying in the Belen and Socorro Divisions during the post runoff period may severely impact young-of-year silvery minnow by trapping them in isolated pools. Using available supplemental water and pumping from the LFCC and groundwater wells to maintain adequate continuous flow will benefit the silvery minnow by preventing stranding in isolated pools, resulting in death, and by maintaining silvery minnow habitat.

Low flow or dry conditions could occur if an unforseen event occurs that exceeds Reclamation's ability to compensate for low flow conditions through pumping from the LFCC or from groundwater pumping. For example, if evapotranspiration demand in the Socorro Division is substantially higher than predicted for an extended period, the resulting low flow conditions may be too extensive for the pumping to fully compensate for the lack of water in the river. If this occurs, mortality of silvery minnows is likely, with accompanying degradation of silvery minnow habitat.

Natural conditions beyond Reclamation's control can also result in the formation of isolated pools, mortality of silvery minnows, and degradation of silvery minnow habitat. For example, flow increases from events such as thunderstorm runoff can re-wet portions of the river channel and form lateral isolated pools when the channel narrows as discharge returns to baseflow conditions. This occurrence is a function of baseline river conditions and is not the result of actions considered in this consultation. However, increases in flow from upstream water management or LFCC or groundwater pumping can have similar effects on the river channel and the silvery minnow. In these cases, mortality of silvery minnows will occur, with accompanying loss of habitat quality and quantity.

The beneficial effects of LFCC or groundwater pumping on the river and thus on the silvery minnow and its habitat are supplemental flows in the mainstem of the river and filling of depressions in the river that are observed moving downstream. However, unforeseen mechanical or operational problems with the pumps could increase the risk of low flow conditions as discussed above and result in the death of silvery minnows and degradation of its habitat.

During dry periods, some flow may be delivered to San Acacia Diversion Dam through MRGCD's and ISC's drainage facilities to maximize transport efficiency and the amount of water available below San Acacia. This will effectively dry most or all of the Isleta Reach. Silvery minnow in upstream reaches are the source of the future population when downstream reaches are dewatered (Platania and Dudley 2000). The drying of the Isleta Reach will cause the mortality of silvery minnow in that reach and will reduce the amount of available minnow habitat. Drying of the upper reaches causes the mortality of the individual silvery minnows that will repopulate downstream reaches, reducing the likelihood of survival and recovery of the species.

Middle Rio Grande System - Diversion Dams

Operations

The Cochiti heading and the Angostura, Isleta, and San Acacia Diversion Dams are operated conjunctively to supply the irrigation needs of the four MRGCD divisions. The maximum diversion is a function of the capacity of the dam and associated main canals. The effects of diversion are the same under most operational scenarios. Entrainment of fish, barriers to

upstream movement of silvery minnow, and reduction of flow (resulting in a decrease in habitat quality and quantity) occur during any diversion operation.

The most significant impact of operations at the Cochiti heading and Angostura, Isleta, and San Acacia Diversion Dams on the silvery minnow is the reduction of downstream river flows. Other significant impacts include the potential for entrainment of silvery minnow into the associated main canals and the physical barriers the diversion dams present to upstream movement of silvery minnow. As a result of these barriers and limited upstream recolonization, more eggs will be released in the lower reaches, and fish hatching from these eggs will be unavailable to recolonize the upper reaches. The Angostura, Isleta, and San Acacia Diversion Dams fragment aquatic habitat, reducing the quality and extent of habitat. The continuity of silvery minnow habitat is also lost in the vicinity of diversion dams.

Operation of the remainder of the MRGCD's irrigation system is part of the proposed action. Entrainment of silvery minnows into the MRGCD's irrigation system was documented by collection of 114 silvery minnows in July and August 1993 (Lang and Altenbach 1994). A survey of 74 sites documented that the highest number of silvery minnows (106 minnows) entrained in the Belen Division canals and only seven collected at the irrigation system return drains to the river. The implication of this research is that very few silvery minnows that enter the irrigation system return to the river, and they presumably perish in canals due to unsuitable habitat, dewatering, or predation. Annual dewatering throughout the MRGCD's irrigation system commonly results in mortality of fish in the canals (Lang and Altenbach 1994).

Because the vast majority of the silvery minnow population resided in the San Acacia reach in 1999 and 2000, completely dewatering this reach in 2001, 2002, or 2003 would have dire consequences for the species.

Maintenance of Diversion Dams

Maintenance of the diversion dams usually occurs in dry conditions with flow being directed elsewhere in the river. This will result in stranding of minnows in isolated pools. Isolated aquatic habitat in the immediate vicinity of any maintenance activity that is being conducted from the river channel will be sampled for silvery minnow. All silvery minnow collected by Reclamation will be moved to suitable habitat away from the maintenance area. This relocation will minimize the impact of diversion dam maintenance on the silvery minnow.

Formation of isolated pools results in the increased risk of predation of silvery minnows in drying habitats. Predators, primarily fish and birds, have been observed in high numbers, consuming fish in drying, isolated pools, where the fish become concentrated and more vulnerable to predation. Depending on the timing and thoroughness of minnow rescues, this action could reduce the number of silvery minnows killed. However, habitat for and the forage base of the silvery minnow will be degraded.

_Corps' Discretionary Actions

Flood Control Operations

When combined inflows to Cochiti and Jemez Canyon Dams exceed 7,000 cfs, the Corps will only release up to 6,000 cfs from Cochiti Dam (or a combined release from Cochiti and Jemez Canyon Dams), even though the current safe channel capacity at Albuquerque is 7,000 cfs. It is the channel constriction (5,000 cfs capacity) at the San Marcial Railroad Bridge downstream that will cause the Corps to limit the release to 6,000 cfs. During peak runoff, the river channel is flowing bank to bank and thus, a small decrease in the magnitude of discharge will mainly affect the depth of predominantly high velocity aquatic habitat, which the silvery minnow do not prefer. It may, to a small degree, affect the amount of overbanking that may occur during this time.

Flows from local thunderstorms naturally produce short term fluctuations in flow. The regulation of flood water resulting from summer thunderstorms would not significantly affect silvery minnow habitat availability. However, this regulation may have the potential to alter the natural pattern of flow in the Isleta and San Acacia reaches to a limited extent. While small thunderstorms can be passed through the dams to match inflow, flows from larger thunderstorms may require storage in a Corps reservoir. The release of the flood waters would occur over a period of time at a lesser rate than stored. The magnitude of this adjustment falls within the natural variability of summer thunderstorm events. The release of the waters between thunderstorms events may improve river conditions unless those waters are subsequently diverted out of the river.

Cochiti Fish Screen Placement

The Corps has previously consulted with the Service to minimize impacts to listed species during fish screen placement at Cochiti. The short-term reductions in flow resulting from Cochiti fish screen placement in November and February would not appreciably affect habitat conditions under any of the proposed hydrologic scenarios due to the short duration of the flow reduction. Continued coordination with the Service prior to placement is necessary to minimize impacts.

Carry-over Water

The Corps proposes to deliver future carry-over water at a constant low-flow rate over the entire winter period from November 1 to March 31. This action will effectively mimic the shape and duration of the natural winter hydrograph, but will be at a higher flow rate than historically found. A decrease in low-velocity and side channel habitats that are preferred by silvery minnows may occur as a result of this action, depending on the amount of water to be released. It is also possible that the State or the Rio Grande Compact Commission may request that the Corps evacuate carry-over storage other than at a constant low-flow rate or at a different time period. If carry-over water is released during the irrigation season, the State would have to coordinate with the MRGCD to ensure flows reached the downstream delivery point.

Consultation tiered to this programmatic biological opinion will be necessary to determine specific impacts to the silvery minnow from the magnitude, duration, and timing of the release of carry-over water each year that such an action will take place.

Abiquiu Tunnel Inspection

The inspection of the Abiquiu outlet tunnel as described in the proposed action section will not affect the silvery minnow because releases would only be stopped for approximately one hour.

Delivery of Cochiti Recreation Pool Replacement Water

The delivery of Cochiti Recreation Pool replacement water will not affect the silvery minnow because the delivery of this SJC water is made in the winter.

Summary of Effects

The proposed action, as described, will have significant adverse affects on the silvery minnow. The species now occupies less than five percent of its historic range and the entire extant population now occurs within the action area. Entrainment at the diversion dams strands eggs, larvae, and adult fish on irrigated agricultural fields, resulting in death. The diversion dams block upstream passage by silvery minnows, preventing repopulation of areas upstream of the dams. Dam operations result in reduced sediments and water temperatures that cause habitat loss. Dewatering reaches of the river traps silvery minnows in isolated pools resulting in death. Dewatering also reduces or eliminate the habitat and forage base of the silvery minnow for up to several months. In a worst case scenario (severe drought), the majority of the Angostura, Isleta, and San Acacia Reaches could be dewatered partially or totally. Under all hydrological scenarios described in the proposed action, river drying could result in the loss of 90 to 100 percent of all silvery minnows in a given year.

Southwestern Willow Flycatcher

Reclamations's Discretionary Actions

Water Operations

The significant effects of operating MRGCD facilities on flycatchers in the Rio Grande are the effects on native flows from potential storage of native water in El Vado Reservoir and the diversion of native flows at the downstream diversion dams. Both of these actions will reduce the amount of water that would otherwise flow in the river and may therefore adversely affect the flycatcher. The reduction in native flow will be partially compensated for by pumping of water from the LFCC and from groundwater.

El Vado Reservoir Storage

Storage of native water in El Vado Reservoir typically occurs during spring runoff and summer rain events. This storage results in a proportional decrease in the amount of water that is passed through Abiquiu and Cochiti Reservoirs and is thus available in the Middle Rio Grande below Cochiti Dam. Depending on the amount of already stored water, El Vado Reservoir can capture part or all of the flow associated with spring runoff and rain events. For example, the volume of spring runoff on the Rio Chama in 2000 was very low due to drought conditions. The available storage space in El Vado Reservoir was sufficient to capture all of these flows.

Spring runoff on the Rio Chama is one component of the overall runoff on the Middle Rio Grande below Cochiti Dam. Runoff from the mainstem of the Rio Grande is the other significant source of water during this time period. The relative volume of spring runoff contributed by the Rio Chama and the mainstem of the Rio Grande is largely dependent on local snowpack conditions. Thus, the relative significance of runoff flows from the Rio Chama on the Rio Grande is also dependent on the volume of runoff from mainstem flows. In the last 20 years, the Rio Chama contributed about 30-45 percent each year. In years with high mainstem runoff, an increased volume of Rio Chama runoff flow could be stored without adversely impacting the flycatcher downstream. However, in years with little to no peak flow input from the mainstem Rio Grande, the impacts of storing Rio Chama runoff flows at El Vado Reservoir may be more severe.

Effects of reducing peak flows in the Rio Grande by storing native flows in El Vado Reservoir during spring runoff include: (1) reduction in overbank flooding and associated loss of low velocity habitat used by flycatchers, and (2) continued narrowing of the Rio Grande channel downstream due to the long-term reduction in channel-forming discharge. Channel narrowing reduces the availability of shallow, low velocity habitat that is needed to create/maintain suitable flycatcher habitat.

Reduction in overbank flooding downstream due to the storage of peak native flows in El Vado Reservoir will adversely affect flycatcher nest establishment and the rearing and fledging of juveniles at sites throughout the action area. Overbank flooding associated with spring runoff and summer rain events is an important component of flycatcher nesting success. The presence of overbank flooding to provide low-velocity flows in flooded vegetation is a key component in the physical structure selected as nest locations by flycatchers.

Reduction in overbank flooding adversely affects the maintenance and establishment of riparian vegetation downstream. High discharges are important for the creation and maintenance of the riparian ecosystem, and specifically, migratory and nesting habitat for flycatchers. Also, the rate and timing of the recession of spring runoff is important to recruitment of native cottonwood and willow vegetation that is utilized by flycatchers for migrating, nesting, and foraging.

Flycatcher territories upstream of the confluence of the Rio Chama with the Rio Grande would be unaffected by operations at El Vado Dam and Reservoir.

Diversion Dams

The Cochiti heading and the three downstream diversion dams are operated conjunctively to supply the irrigation needs of the four MRGCD divisions. The maximum diversion is a function of the capacity of the dam and associated main canals. The most significant impact of operations at the Cochiti heading and Angostura, Isleta, and San Acacia Diversion Dams on the flycatcher is the reduction of downstream river flows. The effects of diversion at the dams are the same under most operational scenarios, with reduction of flow occurring during any diversion operation.

Flows in the Rio Grande above the confluence of the Rio Chama are unregulated and are not significantly influenced by any Reclamation water operation. Thus, future baseline conditions and the potential effects of Reclamation's actions on flycatchers in the Velarde Reach will be addressed only in the context of river maintenance activities.

The main effect of the various hydrologic scenarios on future baseline conditions on the flycatcher is associated with spring runoff and overbank flooding. All dry, normal, wet, and prolonged runoff analyses in the assessment included a discussion of the number of days with a discharge over 5,000 cfs below Cochiti Dam. This discharge was used to represent the flow above which significant overbank flooding could be expected in the lower reaches of the Middle Rio Grande (e.g., Belen, Rio Puerco, Socorro, San Marcial). Localized overbank flooding may occur at lower discharges depending on site-specific river conditions.

Dry, Normal, Wet Year Scenarios

Spring runoff in dry scenarios normally has a low peak discharge, <4,000 cfs Cochiti release, that often occurs early in the season (April to early May). Both of these situations provide little opportunity for overbank flooding during the peak flycatcher breeding season (June-July) and therefore provide marginal breeding conditions. Nesting success during dry years on the Middle Rio Grande will be low. The timing and magnitude of spring runoff during normal and wet years should be more conducive to flycatcher breeding. Overbank flooding should occur in both scenarios, albeit to a lesser extent under normal conditions. All scenarios yielded periods of dry channel conditions immediately post-runoff.

Prolonged Drought Conditions

As with the dry conditions above, in no case did spring runoff during the three consecutive years of drought (model years 1999-2001) provide for substantial overbank flooding during the early breeding season. No flycatcher surveys were conducted in the Middle Rio Grande during the last extended drought, 1988-1990. While flycatchers on the Rio Grande likely did not increase

during this period, they did persist. It is anticipated that the species would be impacted to a greater extent by a prolonged drought in the future.

River flows. Maximum diversions at Cochiti, Angostura, Isleta, and San Acacia Diversion Dams, could reduce peak runoff flows to the extent that overbank flooding does not occur in the lower reaches. Also, the increased frequency and magnitude of low river flows and dewatering during the flycatcher breeding season may decrease nesting success and habitat suitability. Depending on summer precipitation, occupied flycatcher breeding habitat could become dewatered for an extended period of time during the breeding season, causing reduced food sources resulting in reduced nesting success. The area that would likely become dewatered earliest and to the greatest extent would be the lower reach of the Middle Rio Grande between San Marcial and Elephant Butte Reservoir. This area contains occupied flycatcher habitat, partly because overbank flooding and sediment deposition have occurred more frequently here compared to adjacent reaches of the river in recent history. In recent years, there have been records of 8 to 16 flycatcher territories between San Marcial and Elephant Butte Reservoir. In 1999, there were an estimated 28 territories in this reach, and in 2000, there were 31 territories, by far the largest known population on the Rio Grande and the second largest in New Mexico. Therefore, dewatering this reach will impact the highest number of breeding pairs of flycatchers in the Middle Rio Grande, potentially impacting 43 percent of known breeding pairs. Table 5 depicts the river drying that can be predicted to occur without supplemental water.

Other than the river channel, sources of water adjacent to currently occupied flycatcher habitat in the lower reaches of the Socorro Division include overbank flooding, LFCC outflow, and wetlands supported in part by the high level of Elephant Butte Reservoir. Of these, irrigation diversions at San Acacia Diversion Dam have the potential to impact overbank flooding and the river channel. All potential runoff scenarios can yield periods of dry channel conditions immediately post-runoff. The proposed water operations will adversely affect flycatchers. For example, in a dry or even normal precipitation year, water operations may dewater the river channel where flycatchers occur, either prior to their arrival in late April (with continued dry conditions through much of the breeding season) or during the breeding season. These actions limit the insect diversity and abundance that provide forage for flycatchers. The presence of water below flycatcher nests also likely deters certain nest predators. A pronounced dewatered situation occurred in 1996, when the San Marcial area was dry in April and remained dry until late June. Based on surveys, only one early nesting attempt was located and it failed (Johnson *et al.*, 1999). In addition, water operations may result in flooding during the nesting period, directly inundating nests, resulting in loss or reproductive output for that year.

Other effects of the proposed water operations include their influence on native and non-native vegetation trends and the lateral extent from the river channel of suitable riparian habitat for flycatchers. Lack of overbank flooding in spring, lack of sediment for seed germination, and water management between Cochiti Reservoir and the headwaters of Elephant Butte Reservoir have resulted in a monotypic age-class structure of native vegetation, particularly older cottonwood trees, and increased encroachment of exotic plant species, such as saltcedar and

Russian olive (Howe and Knopf 1991; Crawford *et al.* 1993). Furthermore, the lateral extent of suitable habitat for the flycatcher is constrained by water operations that limit overbank flooding to sites located close to the river's edge, resulting in a relatively narrow strip of suitable nesting habitat for flycatchers. The narrowness of suitable riparian vegetation increases risks to flycatchers of adverse effects from flooding, predation, parasitism, and other disturbances. Stromberg (1993) found that the width of riparian vegetation communities and their biomass increases with mean and median annual flow volume and drainage size in alluvial river channels. The flycatcher depends on large patch sizes of riparian vegetation with adequate insect food supply to raise young into July, August, and September. These attributes can be adversely affected by drying the river after spring run-off, preventing expansion of riparian vegetation and production of insects for flycatchers during the breeding season.

LFCC and Groundwater Pumping

Because no specific proposal was included in the assessment for groundwater pumping and only a partial proposal was included for pumping from the LFCC in the proposed action, only a very general analysis of these actions can be performed. The proposed use of nine pumps to pump water from the LFCC to the Rio Grande at Brown Arroyo, Neil Cup, the north and south boundaries of BDANWR, and Ft. Craig may provide beneficial water adjacent to some of the known flycatcher territories in the San Acacia Reach. However, without additional information, it is difficult to predict how far the river flow will extend in a drought year.

It is possible that pumping may reduce the amount of flow in the LFCC by an undeterminable amount. Groundwater pumping could also lower the groundwater table by an undeterminable amount. In addition, the construction needed to implement these actions could fragment riparian habitat used by the flycatcher.

Transects through, or openings in, flycatcher habitat can fragment the habitat, reducing its suitability to flycatchers. It can also increase the risks of predation and parasitism of nesting flycatchers by increasing access to the nest site. Depending on the location of pumps or wells, pumping from the LFCC or from groundwater wells could potentially reduce the suitability of flycatcher habitat or could prevent potential habitat from developing into suitable habitat. Similarly, suitable habitat, in certain situations, could be destroyed or reduced in suitability by groundwater pumping through reduction in extent or health of riparian vegetation or by reducing production of insects needed by flycatchers for food.

Non-Federal Activities

Withdrawals and depletions and related infrastructure used for agricultural irrigation in the Middle Rio Grande basin adversely affect flycatchers by changing the magnitude, timing, duration, and quality of flows available in the river. A more detailed analysis of effects of diversion dams in the Middle Rio Grande (Cochiti, Angostura, Isleta, and San Acacia Diversion Dams) is included under Federal actions.

If use of the recently created conservation pool is implemented, it will benefit the flycatcher in the Middle Rio Grande. Approximately 30,000 af of water from the conservation pool (maximum of 100,000 af), will be released each year, unless it is not needed. Any additional water added to the Middle Rio Grande will provide or enhance habitat that may become dewatered without it.

Corps Discretionary Actions

Flood Control Operations

When combined inflows to Cochiti and Jemez Canyon dams exceed 7,000 cfs, the Corps will only release up to 6,000 cfs from Cochiti Dam (or a combined release from Cochiti and Jemez Canyon Dams), even though the current safe channel capacity at Albuquerque is 7,000 cfs. It is the channel constriction (5,000 cfs capacity) at the San Marcial Railroad Bridge downstream that will limit the release to 6,000 cfs. This will likely reduce the amount of overbank flooding that will occur during this time, and thus may reduce formation of flycatcher habitat.

Summary

In 2000, approximately 55 flycatcher territories were documented in the Middle Rio Grande, from Isleta Pueblo to Elephant Butte Reservoir. In a worst case scenario of severe drought, the majority of the Angostura, Isleta, and San Acacia Reaches could be dewatered, except for the effect of proposed pumping from the LFCC to the river. Although it is not feasible to use the information contained in the assessment to precisely predict how much of the river would remain wet with the use of 9 pumps during a drought, it appears likely that the proximal riverine habitat of at least 22 of the 55 territories, or 40 percent, could become dewatered. These would include flycatcher territories on the Isleta Pueblo downstream to the Sevilleta National Wildlife Refuge. Downstream of the San Acacia Diversion Dam, the minimal quantity of pumping proposed in the assessment may maintain river flow in proximity to an undetermined number of territories.

In 1996, when the river became dewatered in the vicinity of the San Marcial Railroad Bridge beginning in April, none of the known flycatchers bred successfully. Flycatchers may not nest in otherwise suitable habitat when the habitat is dewatered. When dewatering occurs, the forage base for flycatchers declines and the vegetative component of the habitat may be damaged depending on the amount and extent of dewatering. When this occurs, the flycatchers may go elsewhere to nest or may not breed that year. While we do not know the impact of such temporary habitat loss on subsequent breeding seasons, if the river remains dry during consecutive years of this proposed action, the quality of the nesting habitat could decline and flycatchers may permanently abandon this breeding area. Loss of this area means that approximately 40 percent of flycatcher territories within the Middle Rio Grande drainage could be lost.

An additional effect of the proposed water operations is that the river channel may continue to

incise or stay at the same level of channelization. A channel forming discharge is not part of the proposed action. The incised channel will continue to limit the formation and maintenance of flycatcher habitat in the action area.

River Maintenance

Rio Grande silvery minnow and southwestern willow flycatcher

All proposed river maintenance activities occur within the historic range of the silvery minnow and flycatcher. However, due to the recent extirpation of the silvery minnow upstream of Cochiti Reservoir and downstream of Elephant Butte Reservoir, river maintenance projects upstream of Cochiti Reservoir and below Elephant Butte Reservoir may not directly affect the silvery minnow. River maintenance projects that promote channelization in these reaches could adversely affect the flycatcher and its potential habitat.

The assessment is not specific in reference to the timing, duration, and severity of the proposed action. Many river maintenance projects are developed on an as-needed basis, meaning that unforseen conditions may facilitate the project, therefore it does not allow for a complete analysis of the potential effects. River maintenance projects vary in duration, depending on the scope, immediate need, time of year, river flow conditions, and project location. In some cases, such as the Santa Ana Project referenced in the assessment, river maintenance projects may be completed in phases over several years. Some river maintenance projects may last only a few days. These two types of projects may affect many miles of river or only a few hundred feet.

The assessment does mention, in a broad sense, the number and location of potential river maintenance projects; however, it does not provide exact locations. The assessments indicates that a total of 57 projects could occur in approximately 226 river miles. The effects of each project are likely to vary. Each reach defined in the assessment is geomorphically and hydrologically different. Each maintenance/restoration project should be consulted on prior to construction, and should tier to this programmatic biological opinion.

As documented in the assessment, channel narrowing has occurred at an alarming rate in all reaches. There has been at least a 40 percent reduction in the active channel over the last 80 years, with the channel shrinking from 1400 feet to 600 feet in width in many reaches of the Rio Grande. It has been hypothesized that this channel narrowing has accelerated the decline of silvery minnow populations (Service 2000). Channel narrowing or channelization was a goal of many early river engineering projects. These projects were initiated in the 1930s and 1950s for flood control and improved water deliveries. Early river maintenance projects included levees, jetty jacks, rip rap, and other non-permeable engineering techniques. These and other river engineering methods are proposed in the assessment and will adversely affect the silvery minnow and its habitat and the flycatcher by reducing overbank flooding and facilitating channel narrowing.

Although channel narrowing may not be the only factor contributing to the decline of the silvery minnow in these reaches, it may be one of the most noticeable factors and can be repaired. Any river maintenance project that facilitates channel narrowing, such as those outlined in the assessment as river engineering projects, will adversely effect both the silvery minnow and flycatcher. The adverse impacts to both listed species include, but are not limited to, controlling and limiting overbank flooding and reducing channel width and reducing the amount of peak discharge needed to produce overbank flooding and channel widening.

Habitat restoration and bioengineering projects would have positive effects on both the silvery minnow and flycatcher. Although unequivocal analysis cannot be made on the effects of each proposed action, the general conceptual methods proposed will have beneficial effects for listed species. General improvements to the river and riparian areas by habitat restoration and bioengineering projects, planned in consultation with the Service, include the following:

- re-connectivity of floodplain to the river with overbank flows;
- improved riparian habitat with removal of invasive non-native vegetation that has been demonstrated to be unsuitable for, or unoccupied by flycatchers, in conjunction with reintroduction of native vegetation and periodic inundation of riparian areas; and
- widening of the river channel to allow active geomorphological river conditions which produce natural aquatic habitats conducive to native fish and riparian habitats.

Adverse effects of river maintenance include, but are not limited to, the following:

- localized dewatering of the river by redirecting water flows to perform necessary work may adversely affect the silvery minnow and its habitat and may adversely affect the flycatcher;
- introduction of non-native types of substrate, *i.e.*, large boulders, rip rap, non-erodible materials, which will modify the channel making it unsuitable for silvery minnows and making the floodplain unsuitable for flycatchers;
- removal of native and some non-native species of vegetation from the action area could adversely affect the flycatcher by destroying potentially suitable habitat; and
- increased human activities in the project area during construction may adversely affect the flycatcher if construction occurs during the breeding or nesting season.

Increased human access to areas once relatively remote may adversely affect flycatchers, depending on proximity of activities and the potential for human-caused fires and wood cutting. Vandalism and human-caused fires can also increase negative impacts to native riparian vegetation. Heavy equipment use in the action area for an undetermined amount of time may impact the flycatcher if used during the breeding or nesting season. The potential exists for fuel or oil spills causing contamination in the river, adversely affecting the silvery minnow and its habitat. The construction of borrow pits and spoils will adversely affect the flycatcher if placed near potentially suitable habitat by limiting potential occupation of breeding territories.

IV. Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Cumulative effects include:

- Increases in development and urbanization in the historic floodplain that result in reduced peak flows because of the flooding threat. Development in the floodplain makes it more difficult, if not impossible, to transport large quantities of water that would overbank and create low velocity habitats that the silvery minnow prefers. Development also reduces overbank flooding favorable for both the silvery minnow and the flycatcher.

- Increased urban use of water, including municipal and private uses (e.g., Intel at Rio Rancho). Further use of surface water from the Rio Grande will reduce river flow and decrease available habitat for the silvery minnow and flycatcher.

- Contamination of the water (*i.e.*, sewage treatment plants, runoff from feed lots, dairies, and residential development). Potential decrease in surface water (by municipal use) will lower the dilution factor for contaminants, and will result in a decrease in water quality, which will adversely affect the silvery minnow and its habitat.

- Gradual change in floodplain vegetation from native riparian species to non-native species (*i.e.*, saltcedar) that result in narrow, deep aquatic habitat. The silvery minnow prefers shallow, low velocity habitats. Therefore, there will be less habitat available for the silvery minnow. The flycatcher will be adversely affected by the increased risk of wildfire.

- Intentional and unintentional destruction and fragmentation of flycatcher habitat, such as by human-caused wildfires, trash dumping, and cutting and removal of native riparian vegetation.

- Private, local, and State grazing actions that create abundant brown-headed cowbird foraging opportunities, thereby increasing the likelihood of brood parasitism on local flycatcher populations.

- Future local actions include farming and grazing in the Middle Rio Grande floodplain and terraces, and water removal from the river. Livestock grazing may adversely impact flycatchers by destroying habitat, negatively impacting native vegetation, and by attracting brown-headed cowbirds. Other human activities that will adversely impact the silvery minnow and flycatcher by decreasing the amount and suitability of habitat include dewatering the river for irrigation; increased water pollution from non-point sources; adverse

effects from increased recreational use, suburban development, and removal of large woody debris; and logging.

- Increases in private development and urbanization in the historic floodplain that reduce and fragment riparian habitat for the flycatcher on the landward side of the levee, while increasing pressure on riparian habitat and wildlife within the bosque.

The Service anticipates that these types of activities will continue to threaten the survival and recovery of the silvery minnow and flycatcher by reducing the quantity and quality of habitat through continuation and expansion of habitat degrading and destroying actions.

V. Conclusion

After reviewing the current status of the silvery minnow and the flycatcher, the environmental baseline for the action area, the effects of the proposed water operations and river maintenance activities, and the cumulative effects, it is the Service's biological opinion that water operations and river maintenance of the Middle Rio Grande, as proposed, are likely to jeopardize the continued existence of the silvery minnow and the flycatcher. Critical habitat for these species is not currently designated in the action area, so none will be affected.

The silvery minnow now occupies less than five percent of its historic range and the entire extant population now exists within the action area. Entrainment at the diversion dams results in death of silvery minnows by stranding eggs, larvae, and adult fish on irrigated agricultural fields. The diversion dams block upstream passage by silvery minnows and therefore prevent repopulation of areas upstream of the dams. Dam operations result in reduced sediments and water temperatures that cause habitat degradation and loss. Dewatering of river reaches traps and subsequently kills silvery minnows in isolated pools. Dewatering decreases water quality and quantity and availability of forage items, and removes shelter. In a worst case scenario (severe drought), the majority of the Angostura, Isleta, and San Acacia Reaches could be dewatered, killing a significant number of silvery minnows. Under all hydrological scenarios described in the proposed action, river drying could occur to an extent that would result in the loss of 90 to 100 percent of all silvery minnows in any given year.

In 2000, approximately 55 flycatcher territories were documented in the Middle Rio Grande, from Isleta Pueblo to Elephant Butte Reservoir. In a worst case scenario of severe drought, the majority of the Angostura, Isleta, and San Acacia Reaches could be dewatered, except for the effect of proposed pumping from the LFCC to the river. Although it is infeasible to use the information contained in the assessment to precisely predict how much of the river would remain wet with the use of 9 pumps during a drought, it appears likely that the proximal riverine habitat of at least 22 of the 55 territories, or 40 percent, could become dewatered. These would include flycatcher territories on the Isleta Pueblo downstream to the Sevilleta National Wildlife Refuge. Downstream of San Acacia Diversion Dam, the minimal quantity of pumping proposed in the assessment may maintain river flow in proximity to an indeterminable number of territories.

In 1996, when the river became dewatered in the vicinity of the San Marcial Railroad Bridge beginning in April, none of the flycatchers known at that time bred successfully. Flycatchers may not nest in otherwise suitable habitat when the habitat is dewatered. When dewatering occurs, the forage base for flycatchers declines and the habitat may be damaged depending on the amount and extent of dewatering. When this occurs, the flycatchers may go elsewhere to nest or may not breed that year. While we do not know the impact of such temporary habitat loss on subsequent breeding seasons, if the river remains dry during consecutive years of this proposed action, the quality of the nesting habitat could decline and flycatchers may permanently abandon this breeding area. Loss of this area means that approximately 40 percent of flycatcher territories within the Middle Rio Grande drainage could be vacated, jeopardizing the continued functioning of the Rio Grande flycatcher metapopulation, and thus the persistence of the subspecies.

An additional effect of the proposed water operations and river maintenance is that the river channel may not significantly recover from its currently incised status. A channel forming discharge is not part of the proposed action. The incised channel will continue to limit the formation and maintenance of flycatcher habitat in the action area, thereby jeopardizing the recovery of the Rio Grande metapopulation.

VI. Reasonable and Prudent Alternative

Regulations (50 CFR §402.02) implementing section 7 of the ESA define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

The Service has developed the following reasonable and prudent alternative to the June 30, 2001, through December 31, 2003, water operations and river maintenance proposal that we believe will avoid jeopardy to the silvery minnow and flycatcher. Implementation of elements of the reasonable and prudent alternative that involves access to Indian Pueblo or Tribal lands requires the consent of the affected Indian Pueblo or Tribe. If the Federal agencies implement elements of the reasonable and prudent alternative that may affect Indian Pueblo or Tribal trust resources, then government-to-government consultation is required.

The following items are elements of the single reasonable and prudent alternative:

A) Provide river flow from Cochiti Dam to Elephant Butte Reservoir from October 31 to April 30 of each year, with a target flow of 50 cfs at the San Marcial Floodway gage. Flows will not drop below 40 cfs. From May 1 to June 15 of each year, provide a minimum flow of 50 cfs at the San Marcial Floodway gage. From June 16 to July 1 of each year, ramp down the flow to achieve 50 cfs over San Acacia Diversion Dam, as described in element D.

Because of gage error and the fluctuations in river flow, the Service recognizes the difficulties in maintaining a specific minimum flow. Because of these difficulties, the Service understands that flows might drop below the minimum required flows for very short durations. These minor fluctuations may not necessarily trigger the need for reinitiation of consultation. Therefore, Reclamation and the Corps, in coordination with the Service, will develop protocols and procedures for monitoring deviations from the minimum flow requirements for reinitiation purposes. These protocols and procedures shall be developed within 30 days of the date of this biological opinion and shall address the minimum flow requirements in elements A, C, and D.

B) Between April 15 and June 15 of each year, provide a one-time increase in flows (spawning spike) to cue spawning, if necessary.

C) Provide year-round river flow from Cochiti Dam to below Isleta Diversion Dam. Flows will not drop below 100 cfs. When reductions in upstream reservoir releases are necessary, ramp down releases to the extent possible. (This edited paragraph includes an **APPROVED CORRECTION**: The word ***"below"*** was added relative to Isleta Diversion Dam.)

D) From July 1 to October 31 of each year, provide a minimum flow of 50 cfs over San Acacia Diversion Dam.

E) In coordination with the Service, release any supplemental water (from conservation water pool, leases of water from Indian Pueblos and Tribes or other willing parties, etc.) in a manner that will most benefit listed species.

F) Provide $150,000 ($75,000 from Reclamation and $75,000 from the Corps) to the New Mexico Ecological Services Field Office for captive propagation activities (including egg collection, transportation, relocation, rearing, breeding, etc.) to be used by facilities propagating silvery minnows (Dexter and Mora National Fish Hatcheries and Technology Centers, New Mexico Fishery Resources Office, New Mexico State University, Albuquerque Bio Park, and Rock Lake State Fish Hatchery). These activities will augment captive populations and facilitate repopulating the upper reaches of the river.

G) Within one year of the date of this opinion, set up an account ($175,000 total for three years) for the establishment of one or more viable populations of silvery minnows within the historic range of the species, not including off-channel refugial sites. The agencies must make the following contributions to the account: At least $50,000 by the end of Year 1, $50,000 by the end of Year 2, and $75,000 by the end of Year 3. These contributions will be shared equally by the agencies.

H) Reclamation shall pump water from the Low Flow Conveyance Channel to the river when intermittency is likely. The entire capacity of pumps to be utilized must meet or exceed the total capacity of pumps used in the 2000 irrigation season (100 cfs). Pumping shall be initiated at least 24 hours prior to a recession in flows. Pumping shall continue even if river

flow has receded upstream of any particular pump to continue to benefit the flycatcher and its habitats until at least October 1 of each year. Pumps may be placed at Brown Arroyo, Neil Cup, the north and south boundaries of the Bosque del Apache National Wildlife Refuge, and Fort Craig. Dewatered areas upstream, downstream, and between pumps shall be informally surveyed for the presence of breeding flycatchers and pumping implemented, if feasible, where breeding flycatchers are found.

I) Initiate the procedure to provide for fish passage at the San Acacia Diversion Dam in coordination with the Service and the MRGCD to allow upstream movement of silvery minnows. Reclamation will produce a plan for evaluating a full suite of fish passage alternatives at the San Acacia Diversion Dam within 90 days of the date of this opinion. Reclamation will require time to complete the evaluations. Reclamation will make every reasonable effort to begin the environmental evaluation process within 120 days of the date of this opinion and begin implementation as soon as possible. Reclamation will provide the Service with written reports providing the status of this element on a quarterly basis for the duration of this opinion. Reclamation and the Service will annually review the progress made and adjust the time line if needed. Consultation with the Service for the provision of fish passage will tier to this programmatic biological opinion. In the interim, implement all feasible short-term fish passage/river reconnectivity actions.

J) In consultation with the Service, conduct habitat/ecosystem restoration projects in the Middle Rio Grande to increase backwaters and oxbows, widen the river channel, and lower river banks to produce shallow water habitats, overbank flooding and regenerating stands of willows and cottonwoods to benefit the silvery minnow and flycatcher and their habitats. Restoration will take place on at least one site per reach on the Rio Grande from the area of Velarde to the headwaters of Elephant Butte Reservoir. The reaches include the following, as described on page 13 of the assessment: Velarde, Española, Cochiti, Middle, Belen, Rio Puerco, Socorro, San Marcial. Based on the size of a successful breeding area used by a group of flycatchers on the Middle Rio Grande, each restoration site will encompass approximately 60 acres (approximately 100 meters wide by 2.5 kilometers long) along the river's edge, incorporating modifications of these dimensions based on site-specificity, as needed. Monitoring for effectiveness of each restoration project to benefit the silvery minnow and flycatcher will be conducted at each site annually for a period of at least fifteen years post-project completion in order to assess whether native riparian habitats are self-sustaining and successfully regenerating, and whether the habitats are maintaining suitability for recovery of listed species. Monitoring reports will be provided to the Service by January 31 of each year. Adaptive management principles will be used, if necessary, to obtain successful restoration of silvery minnow and flycatcher habitats. The environmental evaluation process for each project should begin when this opinion is issued and construction at the first restoration site should begin no later than six months from the date of this opinion. At least four reaches must be completed by the end of this consultation period. Consultation with the Service on each site will tier to this programmatic biological opinion.

K) When bioengineering cannot be used in Reclamation river maintenance projects, habitat restoration will be implemented to offset adverse environmental impacts resulting from river alteration. Restoration will occur at a ratio of 5:1 in terms of area of riverine habitat restored to area of habitat adversely impacted, respectively. Habitat restoration will occur within the same or adjoining reach as the river maintenance project, or in tributaries of those reaches, in consultation with the Service.

L) The Corps will begin the procedures to implement the proposed relocation of the San Marcial Railroad Bridge to increase the channel capacity in the lower reach of the Middle Rio Grande.

M) Each year that annual snowpack runoff is at or above average on the mainstem Rio Grande, and is legally and physically available, and is in excess of the water needed for the proposed conservation water pool, the Corps will ensure seasonal overbank flooding over baseline levels and increase sites of overbank flooding to create backwater habitats for the silvery minnow. The timing, amount and locations of overbank flooding will be planned each year in conjunction with the Service, and may be conducted in coordination with compact deliveries. Duration and extent of overbank flooding will be monitored annually, and the results will be reported to the Service by October 15 of each year.

N) Each year that annual snowpack runoff is at or above average on the mainstem Rio Grande, and is legally and physically available, and is in excess of the water needed for the proposed conservation water pool, the Corps will ensure that suitable and potential flycatcher breeding habitats experience natural seasonal overbank flooding and pooling of, or slow velocity, water in backwater habitats throughout the breeding season. The timing, amount and locations of overbank flooding will be planned each year in conjunction with the Service, and may be conducted in coordination with compact deliveries. Duration and extent of overbank flooding will be monitored annually, and the results will be reported to the Service by October 15 of each year.

Incidental Take Statement

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA

provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary and must be undertaken by the Federal agencies so that they become binding conditions of any Federal grant or permit issued to any non-Federal water users, as appropriate, for the exemption in section 7(o)(2) to apply. The Federal agencies have a continuing duty to regulate the activity covered by this incidental take statement. If the Federal agencies (1) fail to assume and implement the terms and conditions or (2) fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Federal agencies must report the progress of the action and its impact on the species to the service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Amount or Extent of Take Anticipated

The Service has developed the following incidental take statement based on the premise that the reasonable and prudent alternative will be implemented.

Implementation of the reasonable and prudent alternative should result in river flow between Cochiti Dam and Elephant Butte from October 31 to July 1.

The Service anticipates that up to 25,000 adult silvery minnows and 75,000 silvery minnows under 30 millimeters in total length may be taken in any year due to the Federal and non-Federal actions described and analyzed in this biological opinion. It is the Service's opinion that approximately one of every hundred silvery minnows that are injured or killed will be found because of predation, the cryptic nature of the silvery minnow, and its small size. This approximation was determined by reports in 1999 during intermittency when hundreds of silvery minnows were found in isolated pools. The total number of pools during the onset of intermittency is unknown, and it is likely that several other pools were present but not sampled. Smith (1999) determined that typical isolated pools only persisted for a few days before drying; however, larger more infrequent pools may last for several days (Smith and Hoagstrom 1997).

In 1999, Smith (pers. comm.) sampled isolated pools in relation to another study and determined that silvery minnows were present in both large and small pools. During this sampling foray a large isolated pool under the San Marcial Railroad Bridge was sampled for silvery minnows and only a few were collected. However, sampling two days later by University of New Mexico personnel determined that several hundred silvery minnows were in the pool and documented 144 dead silvery minnows (Platania and Dudley 1999). It was also noted by Platania and Dudley (1999) that many predator tracks, most likely great blue herons, were found adjacent to these pools. Therefore, it can be inferred that many dead silvery minnows were consumed by predators before this sample was collected. Predatory birds have been seen consuming fish from isolated pools as well as hunting in isolated pools during river intermittency (pers. comm., Jude Smith).

Though the number of fish present in any pool is unknown, it must be assumed that many of the fish preyed upon in these pools are silvery minnows.

Therefore, using the best scientific information and methodology available, if more than 250 adult silvery minnows or 750 silvery minnows under 30 millimeters in total length are found dead in any year, the level of anticipated take will have been exceeded. Live silvery minnows rescued from isolated pools will not be counted toward incidental take for this consultation. Silvery minnows found dead in lateral isolated pools created by increased flows from storm events will not count toward incidental take for this consultation. Silvery minnows found dead in lateral isolated pools caused by water management, which results in fluctuations in flows or intermittency will count toward incidental take. This take will be in the form of harm and harassment.

The Service also anticipates that no more than 100,000 silvery minnow eggs each year will be taken through entrainment at the diversion facilities on the river. Take of eggs will occur in the form of harm, wound, and kill.

This is the total level of take anticipated for the proposed actions of all Federal agencies and non-Federal water users as described in the Description of Proposed Action section of this opinion.

With implementation of the reasonable and prudent alternative, no flycatchers are expected to be incidentally taken as a result of the proposed water operations, because all of their known occupied habitats in the action area are expected to have water flowing in the adjacent river channel throughout the flycatcher breeding season. There are currently no known occupied flycatcher territories in areas adjacent to the river channel that may become dewatered from this water operations proposal with implementation of the reasonable and prudent alternative.

Because the river maintenance portion of the proposed action will require project-specific consultations, including those activities proposed on pages 34-36 and 38-42, any incidental take resulting from those activities will be analyzed and covered, as appropriate, in future biological opinions.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species when the reasonable and prudent alternative is implemented.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the silvery minnow.

1. Salvage silvery minnow from isolated pools and a receding river in coordination with the Service's silvery minnow rescue coordinator. This will minimize take by rescuing silvery minnows to the maximum extent practicable.

2. Salvage silvery minnow eggs daily from May 1 through May 31 at all diversion dams. This will minimize take by rescuing silvery minnow eggs to the maximum extent practicable.

3. Continue to seek and release supplemental water from all available sources. This will minimize take by ensuring that as much habitat as possible is available for the silvery minnow.

4. Encourage water users to willingly provide supplemental water for the benefit of the species. This will minimize take by ensuring that as much habitat as possible is available for the silvery minnow.

5. Work with the State to continue gaging diversions and returns to the Rio Grande, Rio Chama and tributaries from the Colorado/New Mexico State line to Elephant Butte Reservoir. This will minimize take and benefit the species by providing the Service with information on river conditions on a daily basis and facilitating rescue/salvage actions.

Terms and Conditions

Compliance with the following terms and conditions must be achieved in order to be exempt from the prohibitions of section 9 of the ESA. These terms and conditions implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. The salvage of silvery minnows (eggs, larvae, and adults) requires an ESA section 10(a)(1)(A) permit from the Service and such take is not covered by this incidental take statement.

1.1 Reclamation, in coordination with the Service and the Corps, shall survey the river for isolated pools in the San Acacia and Isleta Reaches in areas likely to become intermittent at least four times each week from July 1 through October 1 of each year and count and salvage any silvery minnows present. Reclamation, in coordination with the Service and the Corps, shall also survey the river daily (once every 24 hours) as flows recede and count and salvage any silvery minnows present. For silvery minnows salvaged, a monthly report shall be prepared and provided to the Service containing the date, number of fish salvaged, the location in which salvage occurred in latitude and longitude, and the deposition of salvaged fish. In addition to conducting all normal silvery minnow monitoring, expand these efforts to any new populations established within this consultation period.

2.1 At all diversion dams, each main canal in the action area will be monitored for eggs entrained into the system and any eggs found will be salvaged with a Moor Egg Catcher

for at least two hours each day per each main canal, between May 1 and May 31 (the peak spawning period), in coordination with the Service. A report will be provided to the Service by June 15 of each year providing, at a minimum, the following information on salvage of silvery minnow eggs: location of each canal where eggs were collected, date of collection, number of eggs collected, and where eggs were deposited.

3.1 Any supplemental water obtained shall be used in a manner that will most benefit the silvery minnow. Coordination of this release will occur during water operations conference calls.

4.1 Reclamation will notify SJC Project water contractors and other water rights holders that leasing water to Reclamation for use to benefit the silvery minnow will not affect their State water rights.

5.1 Work with the State to continue gaging diversions and returns in the Middle Rio Grande at the signing of this consultation.

5.2 The State shall provide a report to the Service by April 30 of each year, documenting annual depletions and withdrawals.

The nearest Service Law Enforcement Office must be notified within 24 hours in writing should any listed species be found dead, injured, or sick. Notification must include the date, time, and location of the carcass, cause of injury or death (if known), and any pertinent information. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. If necessary, the Service will provide a protocol for the handling of dead or injured listed animals. In the event any party to this consultation suspects that a species has been taken in violation of Federal, State, or local law, all relevant information should be reported in writing within 24 hours to the Services New Mexico Law Enforcement Office (505/883-7814) or the New Mexico Ecological Services Field Office (505/346-2525).

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the action. If, during the course of the action, the anticipated level of take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agencies must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Monitor/study silvery minnow spawning throughout the irrigation season in the Angostura, Isleta, and San Acacia reaches.

2. Continue to work collaboratively with the Middle Rio Grande ESA Workgroup and others to develop implement a long-term plan to benefit the recovery of the silvery minnow and flycatcher.

3. Survey and monitor all suitable flycatcher habitats throughout the action area annually. Using habitat characteristics agreed to in coordination with the Service, map and monitor all suitable and potential flycatcher habitats within the action area and report findings to the Service annually.

4. Provide funding ($125,000) for research to better understand micro- and macro-habitat characteristics of occupied flycatcher habitat and methods to most successfully restore it in the action area. Plan this research in coordination with the Service. Begin to implement the findings as soon as available in the restoration and adaptive management projects for the flycatcher described in the Reasonable and Prudent Alternative.

5. In consultation with the Service, develop a strategy for the action area to minimize the risk of wildfire.

6. Develop a contingency plan in the event of wildfire in flycatcher habitat that would reduce impacts to endangered species.

1. Develop a network to monitor fluctuations of groundwater in the shallow aquifer and the deep aquifer to better understand the groundwater - surface water relationship.

2. Study alternatives for providing storage space in Corps reservoirs for a permanent conservation pool.

3. If a long-term solution has not been successfully implemented (habitat restoration in the upper reaches, successful captive propagation program, river re-connectivity, successful repopulation efforts, etc.), the Corps should work with the State to make more water available proportionate to credit status, if the State remains in a credit status.

4. In coordination with the Service, perform environmental contaminants/water quality studies in the Middle Rio Grande and implement water quality protection or remediation measures based on the results of these studies.

5. Continue to pursue the execution of an agreement for actions to be taken by MRGCD to benefit the listed species.

6. Implement a strategy to improve water management/efficiency related to the irrigation system (e.g., lining ditches, changing irrigation practices, etc.) by 30 percent prior to December 31, 2003, in coordination with an interagency advisory group. Begin implementation within two months of the date of this opinion. Any water savings gained from these actions should be made available for use as supplemental water for the benefit of listed species.

7. Encourage adaptive management of flows and conservation of water to benefit listed species.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Reinitiation Notice

This concludes formal consultation on the action(s) outlined in the June 8, 2001, request. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. This consultation is valid until December 31, 2003, and consultation must be reinitiated prior to the expiration of this opinion to ensure continued compliance with sections 7 and 9 of the ESA. Updates of any environmental commitments may require reinitiation of consultation. If territorial flycatchers are documented in habitat that may be affected by dewatering caused by the proposed action, or if occupied flycatcher nests may be inundated by flood water caused by the proposed action, the Service must be contacted for further consultation. An increase in net depletions within the action area may also result in the need to reinitiate consultation. In instances where the amount or extent of incidental take is exceeded, any Federal operations causing such take must cease pending reinitiation, except during flood control operations.

In future correspondence on this project, please refer to consultation number 2-22-01-F-431. Please contact Dr. Joy Nicholopoulos of our New Mexico Ecological Services Field Office at 505-346-2525, if you have any questions or would like to discuss any part of this biological opinion.

Sincerely,

/s/ Nancy M. Kaufman

Regional Director

cc: Supervisor, Ecological Service Field Office, Albuquerque, NM
Assistant Regional Director, Region 2 (ES)
Regional Section 7 Coordinator, Region 2 (ES)

LITERATURE CITED

Ahlers, D. and L. White. 1995. 1995 southwestern willow flycatcher survey results: Selected sites along the Rio Grande from Velarde, New Mexico, to the headwaters of Elephant Butte Reservoir. U.S. Bureau of Reclamation, Albuquerque, New Mexico. 143 pp.

Ahlers, D. and L. White. 1996. 1996 southwestern willow flycatcher study results: Selected sites along the Rio Grande from Velarde, New Mexico, to the headwaters of Elephant Butte Reservoir and along the Pecos River from the headwaters of Lake McMillan to Avalon Dam. U.S. Bureau of Reclamation, Denver, CO. 92 pp.

Ahlers, D. and L. White. 1997. 1997 southwestern willow flycatcher study results: Selected sites along the Rio Grande from Velarde, New Mexico, to the headwaters of Elephant Butte Reservoir. U.S. Bureau of Reclamation, Denver, CO. 38 pp.

Ahlers, D. and L. White. 1999. 1998 southwestern willow flycatcher study results: Selected sites along the Rio Grande from Velarde, New Mexico, to the headwaters of Elephant Butte Reservoir. U.S. Bureau of Reclamation, Denver, CO. 72 pp.

Ahlers, D. and L. White. 2000. 1999 southwestern willow flycatcher study results: Selected sites along the Rio Grande from Velarde, New Mexico to the headwaters of Elephant Butte Reservoir. U.S. Bureau of Reclamation, Denver, CO. 111 pp.

Arizona Game and Fish Department. 1996. Wildlife of special concern in Arizona (Draft). Nongame and Endangered Wildlife Program. Arizona Game and Fish Department, Phoenix, Arizona. 23 pp.

Bent, A.C. 1960. Life histories of North American willow flycatchers, larks, swallows and their allies. Dover Press, New York, New York. 555 pp.

Bestgen, K. and S. Platania. 1989. Inventory and microhabitat associations of fish of the middle Rio Grande, New Mexico: Year I Progress Report. New Mexico Department of Game and Fish and U.S. Bureau of Reclamation.

Bestgen, K. and S. Platania. 1991. Status and conservation of the Rio Grande silvery minnow, *Hybognathus amarus*. Southwestern Naturalist 26(2):225-232.

Bestgen, K. and D.R. Propst. 1994. Redescription, geographic variation, and taxonomic status of the Rio Grande silvery minnow, *Hybognathus amarus* (Girard, 1856). Contribution 69. Larval Fish Laboratory, Colorado State University.

Biella, J. and R. Chapman (eds.). 1977. Archeological investigations in Cochiti Reservoir, New Mexico. Vol. 1: A survey of regional variability. Report submitted to the National Park Service, Santa Fe, for the U.S. Army Corps of Engineers, Albuquerque, New Mexico.

Brittingham, M. and S. Temple. 1983. Have cowbirds caused forest songbirds to decline? BioScience 33:31-35.

Brown, B. 1988a. Breeding ecology of a willow flycatcher population in Grand Canyon, Arizona. Western Birds 19:25-33.

Brown, B. 1988b. Monitoring bird population densities along the Colorado River in Grand Canyon: 1987 breeding season. Final Report to the Glen Canyon Environmental Studies. Bureau of Reclamation, Salt Lake City, Utah. 26 pp.

Browning, M. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241-257.

Bullard, T.F., and S. G. Wells .1992. Hydrology of the middle Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico. U.S. Department of the Interior, Fish and Wildlife Service Research Publication 179.

California Department of Fish and Game. 1992. State and Federal endangered and threatened animals of California (Revised July 1992). California Department of Fish and Game, Natural Heritage Division, Sacramento, California. 13 pp.

Camp Pendleton Marine Corps Base. 1994. Biological Assessment: Riparian and Estuarine Habitat.

Cook, J.A., K.R. Bestgen, D.L. Propst, and T.L. Yates. 1992. Allozymic divergence and systematics of the Rio Grande silvery minnow, *Hybognathus amarus* (Teleostei: Cyprinidae). Copeia 1992(1): 36-44.

Corman, T.E., C.E. Paradzick, J.W. Rourke, J.A. Spencer, and M.W. Sumner. 1997. Arizona Partners In Flight southwestern willow flycatcher survey: 1993-1996 summary report. Arizona Game and Fish Department Technical Report 113. 104 pp.

Crawford, C., A. Cully, R. Leutheuser, M. Sifuentes, L. White, and J. Wilber. 1993. Middle Rio Grande Ecosystem; Bosque Biological Management Plan. Middle Rio Grande Biological Interagency Team. U.S. Fish and Wildlife Service. Albuquerque, New Mexico. 291 pp.

DeLoach, C.J. 1991. Saltcedar, an exotic weed of western North American riparian areas: a review of its taxonomy, biology, harmful and beneficial values, and its potential for biological control. Report to the Bureau of Reclamation, Boulder City, NV, Contract No. 7-AG-30-04930.

Drost, C.A., M.K. Sogge, and E. Paxton. 1998. Preliminary diet study of the endangered southwestern willow flycatcher. Report to U.S. Bureau of Reclamation. U.S.G.S. Biological Resources Division/Colorado Plateau Research Station, Northern Arizona University. 26 pp.

Dudley, R.K. and S.P. Platania. 1996. Rio Grande silvery minnow winter population habitat use monitoring project, April 1996. Report to the U.S. Army Corps of Engineers, Albuquerque MRGCD. 12 pp.

Dudley, R.K. and S.P. Platania. 1997. Habitat use of the Rio Grande silvery minnow. Report to U.S. Bureau of Reclamation, Albuquerque, New Mexico. 88 pp.

Dudley, Robert K. and Steven P. Platania. 1999a. *Summary of Population Monitoring of Rio Grande Silvery Minnow*. Report to U.S. Bureau of Reclamation, Albuquerque, New Mexico. 15 November 1999. 13 pp.

Dudley, Robert K. and Steven P. Platania. 1999b. Draft summary of aquatic conditions in the middle Rio Grande between San Acacia Diversion Dam and San Marcial Railroad Bridge Crossing for the period 14 through 26 April 1999. Report to U.S. Bureau of Reclamation, Albuquerque, New Mexico. 15 pp.

Eagle Ecological Services. 1994. Southwestern willow flycatcher surveys, Rio Chama between Abiquiu Dam and the Rio Grande. Report to the U.S. Army Corps Of Engineers, Albuquerque District. 26 pp.

Finch, D.M., and W. Yong. 1997. Use of willow habitat along the Low Flow Channel by willow flycatchers and other migratory birds. 1996 progress report to the Bureau of Reclamation.

Griffith, J. and J. Griffith. 1994. 1994 brown-headed cowbird removal program on Marine Corps Base Camp Pendleton, California. Final Report, October 18, 1994, P.O. No. M00-681-M4840. Griffith Wildlife Biology, Calumet, Michigan.

Griffith, J. and J. Griffith. 1995. The status of the southwestern willow flycatcher at the upper San Luis Rey River, San Diego County, California, in 1994. Final Report to the U.S. Forest Service, Palomar Ranger MRGCD, No.43-91U4-4-0271.

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna, Number 27. Cooper Ornithological Club. Berkeley, Calif. 608 pp.

Hanna, W.C. 1928. Notes on the dwarf cowbird in southern California. *Condor* 30:161-162.

Hansen, S. and C. Gorbach. 1996. *Middle Rio Grande Water Assessment.* U.S. Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico. 13 pp.

Hoagstrom, C. and Brooks, J. 2000. Memorandum to Joy Nicholopoulos, Supervisor, New Mexico Ecological Services Field Office from New Mexico Fishery Resources Office, entitled *Rio Grande silvery minnow recovery priorities*. August 14, 2000. 10 pp.

Holmgren, M. and P. Collins. 1995. Interim report on the distribution, breeding status, and habitat associations of seven Federal special-status bird species and brown-headed cowbirds at Vandenberg AFB, Santa Barbara County, California. Museum of Systematics and Ecology, Department of Ecology, Evolution, and Marine Biology, University of California: Santa Barbara, California. Environmental Report No. 3.

Howe, W. and F. Knopf. 1991. On the imminent decline of Rio Grande cottonwoods in central New Mexico. Southwestern Naturalist 36:218-224.

Howell, S. and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York, New York. 851 pp.

Hubbard, J. 1987. The Status of the Willow Flycatcher in New Mexico. Endangered Species Program, New Mexico Department of Game and Fish, Santa Fe, New Mexico. 29 pp.

Huels, T. 1993. Unpublished data, Vertebrate Museum, University of Arizona, Tucson, Arizona.

Hull, T. and D. Parker. 1995. The Gila Valley revisited: 1995 survey results of willow flycatchers found along the Gila River near Gila and Cliff, Grant County, New Mexico. Prepared by Applied Ecosystem Management, Inc. for the Phelps Dodge Corporation. 25 pp.

Hundertmark, C. 1978. Breeding Birds of Elephant Butte Marsh. New Mexico Ornithological Society Publication No.5:1-17.

Johnson, K., P. Mehlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered southwestern willow flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44(2):226-231.

Kus, B. 1995. The status of the least Bell's vireo and southwestern willow flycatcher at Camp Pendleton, California, in 1995. Department of Biology, San Diego State University, San Diego, California.

Lang, B.K. and C.S. Altenbach. 1994. *Ichthyofauna of the Middle Rio Grande Conservancy MRGCD irrigation system: Cochiti Dam to Elephant Butte State Park, July-August 1993*. Report to Bureau of Reclamation. 83 pp.

Ligon, J. 1961. New Mexico Birds and where to find them. The University of New Mexico Press, Albuquerque, New Mexico.

Mayfield, H.F. 1977a. Brown-headed cowbird: agent of extermination? *American Birds* 31:107-113.

Mayfield, H.F. 1977b. Brood parasitism: reducing interactions between Kirtland's warblers and brown-headed cowbirds. Chapter 11 *in* Endangered birds: management techniques for preserving threatened species (S.A. Temple, ed.). University of Wisconsin Press, Madison Wisconsin.

Maynard, W. 1995. Summary of 1994 survey efforts in New Mexico for southwestern willow flycatcher (*Empidonax traillii extimus*). Contract # 94-516-69. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 48 pp.

McCarthey, T.D., C.E. Paradzick, J.W. Rourke, M.W. Sumner, and R.F. Davidson. 1998. Arizona Partners In Flight southwestern willow flycatcher survey: 1997 Survey and Nest Monitoring Report. Arizona Game and Fish Department Technical Report XX.

McDonald, K., J. Snider, L. Peterson, M. Germain, and S. Staats. 1995. Results of 1995 southwestern willow flycatcher surveys in the Virgin River drainage and southern Utah. Utah Division of Wildlife Resources: Cedar City, Utah. Publication No.95-17.

McGeen, D. 1972. Cowbird-host relationships. Auk 89:360-380.

McKernan, R. and G. Braden. 1997. Status of the southwestern willow flycatcher along the lower Colorado River: Year 1, 1996. Report to the Bureau of Reclamation, Boulder City, N.V. and the U.S. Fish and Wildlife Service, Carlsbad, CA. 55 pp.

McKernan, R. and G. Braden. 1998. Status of the southwestern willow flycatcher along the lower Colorado River: Year 2, 1997. Report to the Bureau of Reclamation, Boulder City, N.V. and the U.S. Fish and Wildlife Service, Carlsbad, CA. 64 pp.

Mehlhop, P., and P. Tonne. 1994. Results of Surveys for the Southwestern Willow Flycatcher, Rio Grande Floodway, San Acacia to Bosque Del Apache Unit, Socorro County, New Mexico. New Mexico Natural Heritage Program. University of New Mexico, New Mexico. 127 pp.

Muiznieks, B., T. Corman, S. Sferra, M. Sogge, and T. Tibbitts. 1994. Arizona Partners In Flight 1993 southwestern willow flycatcher survey. Technical Report 52. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Phoenix, Arizona. 25 pp.

Muldavin, E., E. Milford, and Y. Chauvin. 1997. River bar vegetation monitoring in the middle Rio Grande. Final Report submitted the Bureau of Reclamation. 26pp.

New Mexico Department of Game and Fish. 1995.

New Mexico Department of Game and Fish. 1996. Rio Grande silvery minnow monitoring in 1994 and 1995. Sante Fe, New Mexico.

New Mexico Department of Game and Fish. 1998a. New Mexican Wildlife of Concern. Santa Fe, New Mexico.

New Mexico Department of Game and Fish. 1998b. Rio Grande silvery minnow monitoring in 1997. Sante Fe, New Mexico.

Paradzick, E., R.F. Davidson, J.W. Rourke, M.W. Sumner, A.M. Wartell, T.D. McCarthey. 2000. Southwestern willow flycatcher 1999 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report #151. Arizona Game and Fish Department, Phoenix, Arizona.

Parker, D. 1997. The Gila Valley Revisited: 1997 Survey Results of Willow flycatchers Found Along the Gila River Near Gila and Cliff, Grant County, New Mexico. Unpublished report to Phelps Dodge Corporation. 11 pp.

Peterson, R.T. 1990. A field guide to western birds. 3rd ed. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.

Pflieger, W. 1980. *Hybognathus nuchalis* Agassiz, pp.177. *In* D. lee, C. Gilbert, C. Hucutt, R. Jenkins, McCallister, and J. Stauffer, eds., Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History, Raleigh, North Carolina

Phillips, A. 1948. Geographic variation in *Empidonax traillii*. Auk 65:507-514.

J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson, Arizona. 212 pp.

Paxton, E., J, S.M. Langridge, and M.K. Sogge. 1997. Banding and Population Genetics of Willow flycatchers in Arizona-1997 Summary Report. Colorado Plateau Research Station. U.S. Geological Survey Biological Resources Division. Northern Arizona University, Flagstaff, AZ. 63 pp.

Platania, S . 1991. Fishes of the Rio Chama and the upper Rio Grande, New Mexico with preliminary comments on their longitudinal distribution. Southwestern Naturalist 36(2): 186-193.

Platania, S . 1993. The fishes of the Rio Grande between Velarde and Elephant Butte Reservoir and their habitat associations. U.S. Bureau of Reclamation, Albuquerque, New Mexico. 188 pp.

Platania, S . 1995. Reproductive biology and early life-history of Rio Grande silvery minnow, *Hybognathus amarus*. U.S. Army Corps of Engineers, Albuquerque, New Mexico. 23 pp.

Platania, S. and C. Altenbach. 1998. Reproductive strategies and egg types of seven Rio Grande basin cyprinids. Copeia 1998(3): 559-569.

Platania, S. and R. Dudley. 1997. Monitoring the status, habitat association, and seasonal occurrence of Rio Grande silvery minnow in the vicinity of the Montaño Bridge. American Southwest Ichthyological Consulting, Albuquerque, New Mexico.

Platania, S. and R. Dudley. 1999. Draft summary of aquatic conditions in the Middle Rio Grande between San Acacia Diversion Dam and San Marcial Railroad bridge crossing for the period 14 through 26 April 1999. Prepared for the Bureau of Reclamation and New Mexico Ecological Services Field Office.

Platania, S. and R. Dudley. 2001. Summary of population monitoring of Rio Grande silvery minnow (21-27 February 2001). Report to the Bureau of Reclamation and Corps of Engineers. Albuquerque. 7pp.

Platania, S.P., and C.W. Hoagstrom. 1996. Response of Rio Grande fish community to an artificial flow spike: Monitoring Report Rio Grande Silvery Minnow Spawning Peak Flow. New Mexico Ecological Services State Office, Albuquerque, New Mexico.

Ridgely, R., and G. Tudor. 1994. The Birds of South America: Suboscine Passerines. University of Texas Press. Austin, Texas.

San Diego Natural History Museum. 1995. *Empidonax traillii extimus* in California. The willow flycatcher workshop. 17 November 1995. San Diego, California. 66pp.

Sferra, S., R. Meyer, and T. Corman. 1995. Arizona Partners In Flight 1994 southwestern willow flycatcher survey. Final Technical Report 69. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Phoenix, Arizona. 46 pp.

Skaggs, R. 1996. Population size, breeding biology, and habitat of willow flycatcher in the Cliff-Gila valley, New Mexico. Final Report. Contract #95-516-91. New Mexico Department of Game and Fish. 38 pp.

Smith, J.R., and C.W. Hoagstrom. 1997. Fishery investigations on the low flow conveyance channel temporary outfall project and on intermittency in the Rio Grande. Progress Report, 1996 to Bureau of Reclamation, Albuquerque, New Mexico.

Smith, J.R. 1998. Summary of Low Flow Conveyance Channel Fish Investigations for Fiscal Year 1997. Draft. U.S. Fish and Wildlife Service Report Submitted to the U.S. Bureau of Reclamation, Albuquerque, New Mexico.

Smith, J.R. 1999. Summary of Rio Grande investigations for FY1997. Draft. U.S. Fish and Wildlife Service Report Submitted to the U.S. Bureau of Reclamation, Albuquerque, New Mexico.

Smith, J.R. and J.A. Jackson. 2000. Draft memorandum from the New Mexico Fishery Resources Office to the New Mexico Ecological Services Field Office, U.S. Bureau of Reclamation and U.S. Army Corps of Engineers. Preliminary 1999 Rio Grande collections of Rio Grande silvery minnow only. January 5, 2000.

Sogge, M. and T. Tibbitts. 1992. Southwestern willow flycatcher (*Empidonax traillii extimus*) surveys along the Colorado River in Grand Canyon National Park and Glen Canyon National Recreation Area. National Park Service Cooperative Park Studies Unit/Northern Arizona University, Flagstaff, Arizona. 43 pp.

Sogge, M., T. Tibbitts, and S. Sferra. 1993. Status of the southwestern willow flycatcher along the Colorado River between Glen Canyon Dam and Lake Mead - 1993. Summary Report. National Park Service Cooperative Park Studies Unit/Northern Arizona University, U.S. Fish and Wildlife Service, and Arizona Game and Fish Department., Flagstaff, Arizona. 69 pp.

Sogge, M., T. Tibbitts, and S. Sferra. 1995a. Southwestern willow flycatcher (*Empidonax traillii extimus*) monitoring at Tuzigoot National Monument. 1995 progress report to the National Park Service. National Biological Service Colorado Plateau Research Station/Northern Arizona University, Flagstaff, Arizona. 20 pp.

Sogge, M., T. Tibbitts, and S. Sferra. 1995b. Southwestern willow flycatcher surveys along the San Juan River, 1994 - 1995. Final report to the Bureau of Land Management, San Juan Resource Area. National Biological Service Colorado Plateau Research Station/Northern Arizona University, Flagstaff, Arizona. 27 pp.

Sogge, M., T. Tibbitts, and S. Sferra. 1995c. Southwestern willow flycatchers in the Grand Canyon. Pages 89-91, *In* E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac eds. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Department of the Interior, National Biological Service, Washington, DC.

Sogge, M., T. Tibbitts, and S. Sferra. 1994. Distribution and status of the southwestern willow flycatcher along the Colorado river in the Grand Canyon - 1994. Summary Report. National Biological Survey Colorado Plateau Research Station/Northern Arizona University, Flagstaff, Arizona. 37 pp.

Sogge, M, M. R. Marshall, S. Sferra and T. Tibbitts. 1997. A southwestern willow flycatcher natural history summary and survey protocol. National Park Service Technical Report NPS/NAUCPRS/NRTR-97/12. 39pp

Spencer, J., S. Sferra, T. Corman, J. Rourke, and M. Sumner. 1996. Arizona Partners In Flight 1995 southwestern willow flycatcher survey. Draft Technical Report January 1996. Arizona Game and Fish Department, Phoenix, Arizona. 69 pp.

Stiles, F. and A. Skutch. 1989. A guide to the birds of Costa Rica. Comstock, Ithaca, New York. 364 pp.

Stransky, K. 1995. 1995 field survey by the Colorado Division of Wildlife: southwestern willow flycatcher (*Empidonax traillii extimus*), Denver, Colorado.

Sublette, J., M. Hatch, and M. Sublette. 1990. The Fishes of New Mexico. Univ. New Mexico Press, Albuquerque, New Mexico. 393 pp.

Tibbitts, T., M. Sogge, and S. Sferra. 1994. A survey protocol for the southwestern willow flycatcher (*Empidonax traillii extimus*). Technical Report NPS/NAUCPRS/NRTR-94/04. National Park Service Colorado Plateau Research Station, Flagstaff, Arizona. 24 pp.

U.S. Army Corps of Engineers. 1979. Interim Feasibility Main Report and Environmental Impact Statement, Middle Rio Grande Flood Protection: Bernalillo to Belen, New Mexico. Albuquerque, New Mexico.

U.S. Army Corps of Engineers. 1986. General Design Memorandum Main Report, Middle Rio Grande Flood Protection: Bernalillo to Belen, New Mexico. Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 1989. Notice of review: animal candidate review for listing as endangered or threatened species. Federal Register 54:554.

U.S. Fish and Wildlife Service. 1993a. Proposal Rule to List the Rio Grande Silvery Minnow as Endangered, with critical habitat. 58 Federal Register 11821-11828.

U.S. Fish and Wildlife Service. 1993b. Notice of 12-month petition finding/proposal to list *Empidonax traillii extimus* as an endangered species, and to designate critical habitat. Federal Register 58:39495-39522..

U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; final rule to list the Rio Grande silvery minnow as an endangered species. Federal Register 59:36988-37001.

U.S. Fish and Wildlife Service. 1995. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694-10715.

U.S. Fish and Wildlife Service. 1996. Emergency Consultation on Rescue of Rio Grande Silvery Minnow. Biological Opinion #2-22-96-E-305, dated May 17, 1996. Albuquerque, New Mexico

U.S. Fish and Wildlife Service. 1998. Emergency consultation on rescue of Rio Grande silvery minnow, September 9, 1998. Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 1999c. *Rio Grande Silvery Minnow (Hybognathus amarus) Recovery Plan*. Region 2, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 138 pp.

U.S. Bureau of Reclamation. 1993. Final Supplement to the Final Environmental Impact Statement-River Maintenance program for the Rio Grande-Velarde to Caballo Dam-Rio Grande and Middle Rio Grande projects, New Mexico. 140 pp.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137-162.

Wheelock, I. 1912. Birds of California: an introduction to more than three hundred common birds of the state and adjacent islands. A.C. McClurg and Company, Chicago, Illinois.

Whitfield, M. 1990. Willow flycatcher reproductive response to brown-headed cowbird parasitism. Masters Thesis, California State University, Chico, California State University, Chico, California.

Whitfield, M. 1994. A brown-headed cowbird control program and monitoring for the southwestern willow flycatcher, South Fork Kern River, California, 1994. Prepared for the California Department of Fish and Game. Kern River Research Center, Weldon, California. 12 pp.

Whitfield, M. and C. Strong. 1995. A brown-headed cowbird control program and monitoring for the southwestern willow flycatcher, South Fork Kern River, California. California Department of Fish and Game, Bird and Mammal Conservation Program Report 95-4, Sacramento, California. 17 pp.

Whitfield, M.. and K.M. Enos, 1996. A Brown-headed Cowbird control program and monitoring for the Southwestern willow flycatcher, South Fork Kern River, California, 1996. Final report to the U.S. Army Corps of Engineers, Contract DACW05-96-P-0900. Weldon, California: Kern River Research Center; 1996. 16 pp.

Willard, F. 1912. A week afield in southern Arizona. Condor 14:53-63.

Wilson, B.C. and A.A. Lucero. 1997. Water use by categories in New Mexico counties and riverbasins, and irrigated acreage in 1995. New Mexico State Engineer Office, Technical Report 49. 149 pp.

APPENDICES

Table 1: Range-wide population status for the southwestern willow flycatcher based on 1996 survey data for New Mexico and California, 1997 survey data for Colorado and Utah, 1998 survey data from Nevada, 1999 survey data for Arizona, and personal communication of 1999 and 2000 survey data.[1]

State	Number of sites with resident WIFLs	Number of drainages with resident WIFLs	Number of territories within site			
			≤5	6-20	>20	Total number of territories
Arizona	47	12	33	11	3	289
California	11	8	7	2	2	91
Colorado	7	6	2	4	1	69
New Mexico	19	6	16	2	1	209
Nevada	10	4	8	2	-	46
Utah	5	4	5	0	0	8
Texas	?	?	?	?	?	?
Total	99	40	69	21	7	712 [2]

[1]Based on surveys conducted at >800 historic and new sites in AZ (Sogge and Tibbitts 1992, Sogge *et al.* 1993, Muiznieks *et al.* 1994, Sogge and Tibbitts 1994, Sferra *et al.* 1995, 1997, Sogge 1995a, Sogge *et al.* 1995, Spencer *et al.* 1996, McKernan 1997, McKernan and Braden 1998, Paradzick *et al.* 2000); CA (Camp Pendleton 1994, Whitfield 1994, Griffith and Griffith 1995, Holmgren and Collins 1995, Kus 1995, San Diego Natural History Museum 1995, Whitfield and Strong 1995, Griffith and Griffith 1996, M.Sogge pers. com.); CO (T. Ireland 1994 *in litt.*, Stransky 1995); NM (Maynard 1995, Cooper 1996, 1997, Parker 1997, Skaggs 1996, Williams 1997); NV (C. Tomlinson 1995 *in litt.*, 1997, M.Sogge pers. com, B.McKernan pers. com., McKernan and Braden 1999); UT (McDonald *et al.* 1995, 1997, Sogge 1995b). Systematic surveys have not been conducted in Texas.

[2] Personal communication from Mark Sogge (USES, unpubl. data) indicates that as of the end of the 1999 breeding season just over 900 willow flycatcher territories are found at 143 sites throughout it's range.

Table 2: Agency actions that have undergone formal section 7 consultation and levels of incidental take permitted for the southwestern willow flycatcher range-wide.

Action (County)	Year	Federal Agency[1]	Incidental Take Anticipated
Arizona			
Cedar Bench Allotment (Yavapai)	1995	Tonto NF	Indeterminable
Tuzigoot Bridge (Yavapai)	1995*	NPS	None
Windmill Allotment (Yavapai)	1995	Coconino NF	Loss of 1 nest annually/for 2 years
Solomon Bridge (Graham)	1995	FHWA	Loss of 2 territories
Tonto Creek Riparian Unit (Maricopa)	1995	Tonto NF	Indeterminable
Eastern Roosevelt Lake Watershed Allotment (Maricopa)	1995	Tonto NF	Indeterminable
Cienega Creek (Pima)	1996	BLM	1 nest annually by cowbird parasitism
Glen Canyon Spike Flow (Coconino)	1996	USBR	Indeterminable
Verde Valley Ranch (Yavapai)	1996*	Corps	Loss of 2 willow flycatcher territories
Modified Roosevelt Dam (Gila/Maricopa)	1996*	USBR	Loss of 45 territories; reduced productivity/ survivorship 90 birds
Lower Colorado River Operations (Mohave/Yuma)	1997*	USBR	Indeterminable
Blue River Road (Greenlee)	1997	A/S NF	Indeterminable
Skeleton Ridge (Yavapai)	1997	Tonto NF	Indeterminable
White Canyon Fire – Emergency Consultation (Final)	1997	BLM	Harassment of 4 pairs
U.S. Hwy 93 Wickenburg (Mohave/Yavapai)	1997	FHWA	Harassment of 6 birds in 3 territories and 1 bird killed/decade
Safford MRGCD Grazing Allotments (Greenlee, Graham, Final, Cochise & Pima)	1997	BLM	Indeterminable
Lower Gila Resource Plan Amend. (Maricopa, Yavapai, Pima, Final, La Paz & Yuma)	1997	BLM	Indeterminable
Storm Water Permit for Verde Valley Ranch (Yavapai)	1997	EPA	Indeterminable
Gila River Transmission Structures (Graham)	1997	AZ Electric Power Coop. Inc.	Indeterminable
Arizona Strip Resource Mgmt Plan Amendment (Mohave)	1998	BLM	Harm of 1 nest every 3 years

Table 2: Agency actions that have undergone formal section 7 consultation and levels of incidental take permitted for the southwestern willow flycatcher range-wide.

Action (County)	Year	Federal Agency[1]	Incidental Take Anticipated
CAP Water Transfer Cottonwood/Camp Verde (Yavapai/Maricopa)	1998	USBR	Indeterminable
Cienega Creek Stream Restoration Project (Pima)	1998	BLM	Harassment of 1 bird
Kearny Wastewater Treatment (Final)	1998	FEMA	Indeterminable
Fort Huachuca Programmatic (Cochise)	1998	US Army	None
SR 260 Cottonwood to Camp Verde (Yavapai)	1998	FHWA	Indeterminable
Wildlife Services (ADC) Nationwide consultation	1998	Wildlife Services	in consultation
Alamo Lake Reoperation (LaPaz, Mohave)	1998	ACOE	Loss of 1 nest w/ 2 eggs in 20 years due to projected inundation
Grazing on 25 allotments on the Tonto NF (Various)	1999	USFS	in consultation
Mingus Avenue Extension (Yavapai)	1999	ACOE	Indeterminable
The Homestead at Camp Verde Development	2000	Prescott NF/EPA	in informal consultation
Wikieup/Big Sandy Caithness power plant	2000	WAPA/BLM	in informal consultation
Interim Surplus Criteria, CA Water- lower Colorado River	2000	USBR	in consultation
Tonto Creek Crossing - Tonto NF (Gila County)	2000	USFS	in consultation
Big Sandy/Santa Maria Grazing Allotments (La Paz)	2000	BLM	in consultation
California			
Prado Basin (Riverside/San Bernardino)	1994	Corps	None
Orange County Water MRGCD (Orange)	1995	Corps	None
Temescal Wash Bridge (Riverside)	1995	Corps	Harm to 2 willow flycatchers
Camp Pendleton (San Diego)	1995	DOD	Loss of 4 willow flycatcher territories
Lake Isabella Operations 1996 (Kern)	1996	Corps	Inundation 700 ac critical habitat; reduced productivity 14 pairs
Lake Isabella Long-Term Operations (Kern)	1997	Corps	Indeterminable
H.G. Fenton Sand Mine and Levee near Pala on the San Luis Rey River (San Diego)	1997	Corps	None

Table 2: Agency actions that have undergone formal section 7 consultation and levels of incidental take permitted for the southwestern willow flycatcher range-wide.

Action (County)	Year	Federal Agency[1]	Incidental Take Anticipated
Colorado			
AB Lateral - Hydroelectric/Hydropower Facility, Gunnison River to Uncompahgre River (Montrose)	1996	USBR	None
TransColorado Gas Transmission Line Project, Meeker, Colorado to Bloomfield, New Mexico	1998	BLM	None
Nevada			
Gold Properties Resort (Clark)	1995	BIA	Harm to 1 willow flycatcher from habitat loss
Las Vegas Wash, Pabco Road Erosion Control Structure	1998	Corps	Harm to 2-3 pairs of willow flycatchers
New Mexico			
Corrales Unit, Rio Grande (Bernalillo)	1995	Corps	None
Rio Puerco Resource Area	1997	BLM	None
Farmington MRGCD Resource Management Plan	1997*	BLM	None
Mimbres Resource Area Management Plan	1997*	BLM	1 pair of willow flycatchers

BIA = Bureau of Indian Affairs; BLM = Bureau of Land Management; Corps = Army Corps of Engineers; DOD = Dept. of Defense; EPA = Environmental Protection Agency; FEMA = Federal Emergency Management Agency; FHWA = Federal Highway Administration; NF = National Forest; NPS = National Park Service; USBR = U.S. Bureau of Reclamation; USFS = U.S. Forest Service.

* Jeopardy opinions.

Table 3. Estimated minimum population, in territories, of southwestern willow flycatcher along the Middle Rio Grande during the 2000 breeding season, as reported by Reclamation in 2001 biological assessment.

River Reach	Number of Territories	Percent of Known Population of Middle Rio Grande
Velarde	2	3 percent
San Juan Pueblo	15	21 percent
Isleta Pueblo	14	19 percent
Sevilleta NWR	8	11 percent
Bosque del Apache NWR	2*	3 percent
San Marcial (N of RR Bridge)	8	11 percent
Fort Craig (S of RR Bridge)	23	32 percent
Total	**72**	

*The Service has information on only one territory within the BDANWR in 2000.

Table 4. Hectares of flycatcher habitat categories on the Rio Grande between San Acacia Diversion Dam and the Delta of Elephant Butte Reservoir, as defined by Reclamation.

Flycatcher Habitat Category	San Acacia Diversion Dam to North Bosque del Apache Refuge	North Bosque del Apache Refuge to San Marcial Railroad Bridge	San Marcial Railroad Bridge to Elephant Butte Delta, along river channel (LFCC east)	San Marcial Railroad Bridge to Elephant Butte Delta, west of river channel (LFCC west)	Delta of Elephant Butte Reservoir	Total
Highly suitable	24	340	241	46	66	717
Suitable	414	368	128	72	48	1,030
Marginally suitable	230	533	53	134	6	956
Potential	167	151	50	35	35	438
Low suitability	2,131	2,184	127	953	172	5,567
Total	2,966	3,576	599	1,240	327	8,708

Table 5. Stream-reach conditions expected without supplemental water.

Flow conditions within the Middle Rio Grande for 2001 and beyond without supplemental water are expected to include continuous and intermittent flow. The Middle Rio Grande includes the headwaters of the Rio Chama watershed and the mainstem of the Rio Grande from Velarde, New Mexico, downstream to the headwaters of Elephant Butte Reservoir. Expected flow conditions for wet, normal, and dry years (using a spring runoff index of less than 80 percent, 80-120 percent, and greater than 80 percent of average flow at Otowi Bridge), without supplemental, by reach, are identified as follows:

Reach name	Description	Flow condition		
		Wet	Normal	Dry
Velarde/Cochiti	Velarde to Cochiti Dam	Continuous	Continuous	Continuous to possible intermittent
Cochiti/Angostura	Below Cochiti Dam to Angostura Diversion Dam	Continuous	Continuous	Continuous to possible intermittent
Angostura/Albuquerque	Below Angostura Diversion Dam to Isleta Diversion Dam	Continuous to possible intermittent	Possible intermittent to intermittent	Intermittent
Isleta/Belen	Below Isleta Diversion Dam to town of Belen	Continuous to possible intermittent	Intermittent	Intermittent
Belen/San Acacia	Town of Belen to San Acacia Diversion Dam	Continuous	Continuous to possible intermittent	Possible intermittent
San Acacia/Lemitar intake	Below San Acacia Dam to Lemitar intake	Continuous	Continuous to possible intermittent	Possible intermittent to intermittent
Lemitar intake/Brown Arroyo return	Lemitar intake to downstream of Brown Arroyo return	Continuous to possible intermittent	Intermittent	Intermittent
Brown Arroyo/Neil Cup	Downstream of Brown Arroyo return to Neil Cup	Continuous	Possible intermittent	Intermittent
Neil Cup/ Elephant Butte	Neil Cup to headwaters of Elephant Butte	Continuous	Possible intermittent	Intermittent

Note that condition designations do not include summer (August through October) monsoon conditions. In a heavy monsoon season, conditions may possibly improve. A light monsoon season would result in more intermittency.